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German Nutrition Society

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Summary

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Introduction

This booklet called "The 13th Nutrition Report – Summary" is a very short version of the 13th Nutrition Report published by the German Nutrition Society. The 13th Nutrition Report is an important instrument for those responsible in nutrition and health policy, as well as for food manufacturers, for the public, nutritionists, dieticians and the media. The 6 chapters are providing substantial information about various aspects in the field of nutrition: The nutritional situation in Germany including among others reviews of the supply of selected nutrients among the German population (DEGS Study) and of the prevalence of pre-obesity and obesity in Germany. Furthermore, descriptions about the catering situations in nurseries and in institutions for older people are given. An evaluation of the influence of food processing and meal preparation on factors like food choice, nutrient intake, intake of food additives and body weight in different age groups is provided as well as an evidence-based analysis on the influence of nutrition in the prevention of different nutrition-related diseases. For this purpose, regarding cancer, those types of cancer already considered as part of the Nutrition Report 2012 were selected. Finally, an umbrella review of the evidence of the impact of measures for behavioral and conditional prevention of obesity was conducted.

Regrettably, the long version of this Nutrition Report (approximately 400 pages) is only available in German. For further information, please contact:

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Please enjoy reading this booklet.

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1.1 Trend analysis of food consumption on the basis of agricultural statistics

1.1.1 Methods

The data for calculating the long-term trend analysis are provided by the agricultural statistics compiled by the Federal Statistical Office, each federal ministry responsible for agriculture, as well as the Federal Office for Agriculture and Food (BLE). The data published here originate from official company statistics and relate to the production or wholesale level. In part, they are also based on information provided by food industry associations or on estimates calculated using tax revenue data (e.g. tax on sparkling wines). Since the agricultural statistics are based on foodstuff production levels, the data, in addition to the quantities intended for human consumption, may also in many cases encompass elements (e.g. bones, shells, skins or peelings) that are not intended for human consumption (i.e. used for animal feed). In any case, human consumption represents by far the most important component. The data include the difference between foodstuff exports and imports. Because of the common European market, these amounts are often difficult to calculate precisely and in some cases may only be estimated. Because of these limitations, the data from agricultural statistics are only of limited value for the assessment of the nutritional situation with regard to absolute amounts. However, since these limitations change very little over time, the agricultural statistics do indeed offer a valuable basis for trend analyses in overall food consumption.

Finally, a nutritional evaluation is carried out taking into account food ingredients and their relationship to potential health risks.

1.1.2 Results

Germans' per capita consumption of vegetables, glucose, cheese and poultry meat has continued to increase from the 1950s to 2014/2015; this confirms the trend already identified in the Nutrition Report 2012. In contrast, the consumption of rye, potatoes, fresh fruit, alcohol (calculated as aqueous ethyl alcohol) and vegetable fats (including margarine) continue to decline. The consumption of fresh dairy products, meat and butter has proved relatively stable recently. However, a trend reversal has been observed in recent years with regard to the consumption of some other foodstuffs: The consumption of cereal products has recovered and has recently increased again, and the consumption of eggs appears to be experiencing a renaissance after many years of decline. In contrast to this, there has been a real slump in recent years in the consumption of citrus fruits and fish.

For the period 2004 to 2014/2015, a more detailed breakdown was undertaken to allow evaluation within food groups (e.g. according to type of cereal or fruit). In addition, these data were examined statistically for possible trends using linear-regression analyses. A significant trend is deemed to exist if the resultant regression coefficients β are greater than zero, given only a very slight error probability ($p < 0.05$).

Cereals: The consumption of *common wheat* in the period observed was quite stable at about 60 kg per capita per year; the intake of *oats* (approx. 2.5 kg per capita per year) has also shown little change since 2005. In contrast to this, the intake of *durum wheat* has increased significantly (approx. an additional 250 g per capita per year), while the intake of *rye* continues to decline substantially (approx. 100 g less per capita per year).

Processed foodstuffs: An extensive, continuous and statistically significant increase in the consumption of *pasta* and *rice* can be seen (on average approx. an additional 150 g or 190 g per capita per year). The consumption of *legumes* (approx. 600 g per capita per year) and *bread* and *bread rolls* are both unchanged compared with data from the Nutrition Report 2012. The consumption of *potatoes* continues to be subject to significant fluctuations, but is trending downward overall.

Vegetables: Apart from *cabbage*, all other trends are positive. Furthermore, statistically significant increases can be seen in the consumption of *tomatoes* (approx. an additional 400 g per capita per year), of *carrots* and *beetroot* (approx. an additional 180 g per capita per year) as well as of *bulb vegetables* (approx. an additional 160 g per capita per year) (Figure 1).

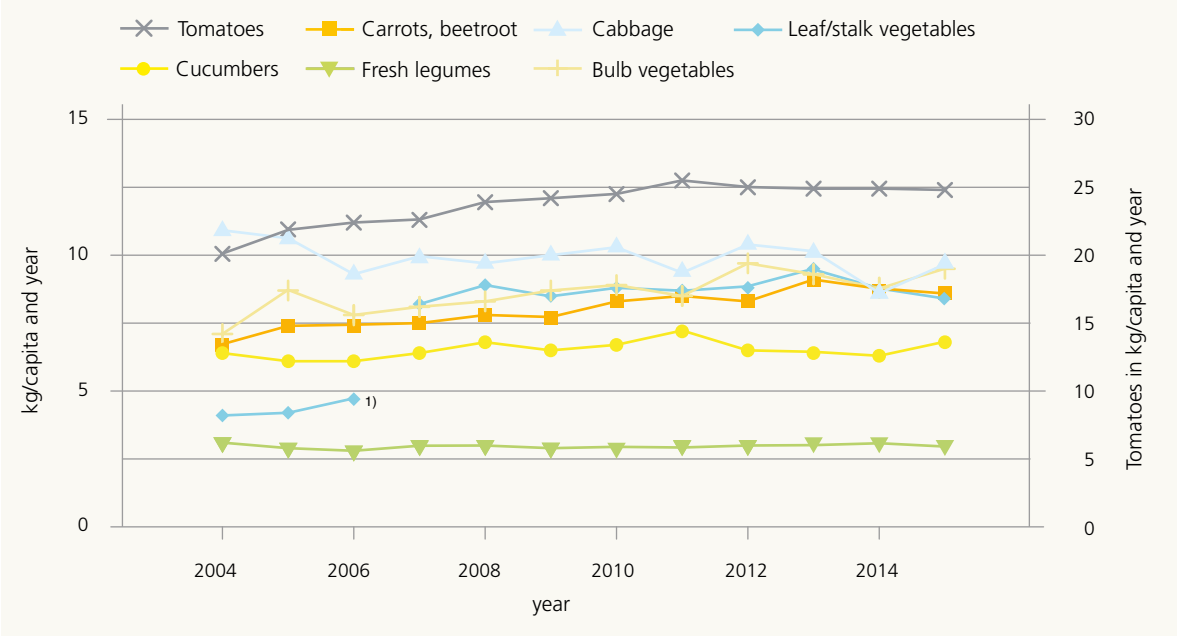


Figure 1: Consumption of selected vegetables (2004 to 2015)

1) As of marketing year 2006/2007 inclusive curled lettuce, endives, lamb's lettuce as well as radiccio, rocket and other lettuces

Fruit: During the reporting period, there was a significant decline that averaged 1.2 kg per capita per year; *apples*, *pears* and *peaches* were most significantly affected. The consumption of *plums*, *cherries* and *apricots* was relatively stable. On the other hand, significant increases were observed in the consumption of *nuts* as well as *berry fruits* such as *blueberries*, *blackberries*, *raspberries* or *redcurrants* (an approx. additional 120 g and 100 g per capita per year respectively); the consumption of *strawberries* remained stable.

Tropical fruits: Consumption of *clementines*, *lemons* and *grapefruit* along with other *citrus fruits* is stable: the only significant decrease in consumption is seen with regard to *oranges* (approx. 180 g less per capita per year).

Confectionery: While the Nutrition Report 2008 indicated a sharp increase in the consumption of this food group, this has turned into a significant decline (*confectionery sugar* around 50 g less per capita per year; *hard* and *soft caramels/candies* approx. 25 g less per capita per year). In contrast, the consumption of *chocolate products* experienced a significant increase averaging approximately 135 g per capita per year (an increase of around 25 % since 2000).

Milk and dairy products: Overall, only minor, mostly downward changes in consumption have occurred over time (*yet cream, condensed milk* and *buttermilk products* show significant declines at 50 g, 230 g and 100 g per capita per year respectively).

Cheese: A significant increase in consumption continues the trend already seen in the last two Nutrition Reports due to an increase in the areas of *hard, semi-hard* and *soft cheese* (approx. additional 220 g per capita per year). The statistically significant reductions observed in the consumption of *processed cheese*, as well as *curd, cooked (processed) cheese* and *whey cheese* were marginal. Only in the case of *cream cheese* the decline was significant (approx. 130 g less per capita per year).

Meat: The consumption of this food group as a whole has been stable at about 60 kg per capita per year for some time. There were significant increases in the consumption of *beef, veal* and *poultry meat* by approx. 50 g and 120 g per capita per year, while the consumption of *pork, mutton* and *goat meat* as well as *offal* decreased.

Soft drinks: Significant increases in *mineral water* and *refreshing drink* consumption (each averaging approx. an additional 1.1 l per capita per year) are obvious. The consumption of *fruit juices* continues to decline significantly. With regard to the consumption of *coffee* and *tea*, recent years have seen a trend reversal: for the last few years, significant increases have been observed (approx. an additional 1.9 l for *coffee* and around 0.3 l for *tea*, per capita per year) (Figure 2).

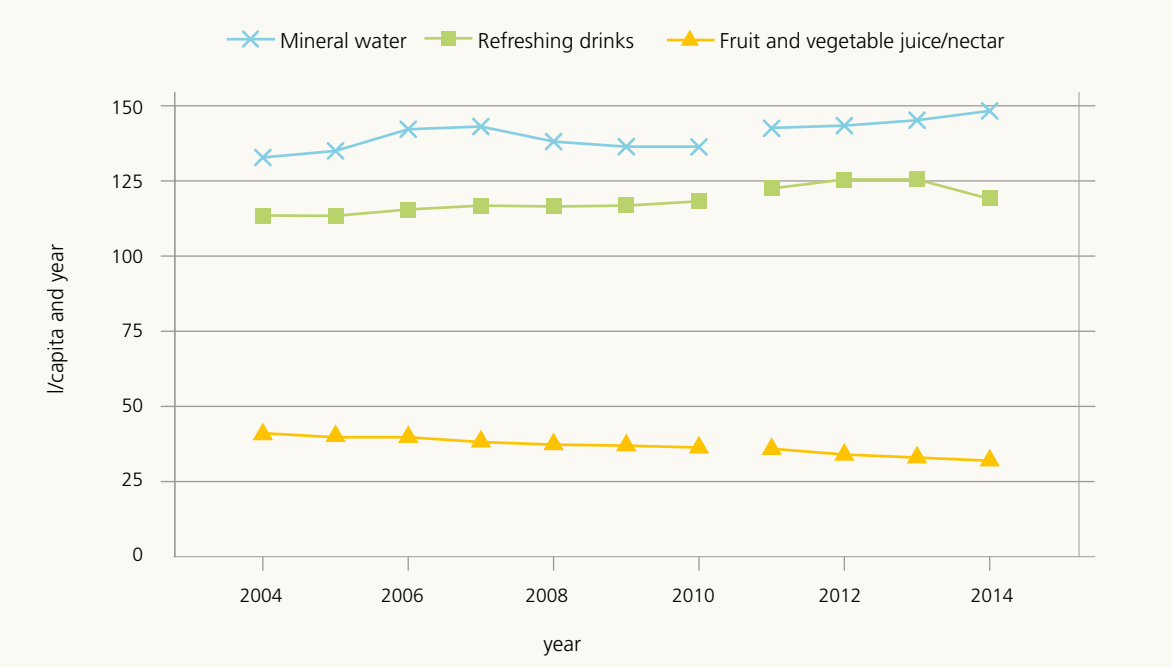


Figure 2: Consumption of soft drinks (as of 2011 calculation is based on census 2011; 2004 to 2014)

Alcoholic beverages: As already has been the case in previous Nutrition Reports since the turn of the Millennium, the consumption of *alcohol* in general continues to decline significantly. This development is mainly due to the decline in the consumption of *beer* (approx. 1.0 l less per capita per year) and *spirits* (around 35 ml less per capita per year).

1.1.3 Evaluation

From a nutritional point of view, the continuing high consumption of meat has both advantages and disadvantages. On the one hand, it contributes to the population receiving a good supply of protein of high biological value, vitamins A, B_{12} and thiamine (vitamin B_1), as well as highly bioavailable trace elements from meat such as iron, zinc and selenium. On the other hand, the intake of undesired food ingredients, such as saturated fatty acids, cholesterol, purines and salt (in processed meat and sausage) is increasing. High meat consumption is often associated with significantly higher fat intake due to various methods of food preparation (breadcrumb coating, fatty gravies and sauces) and thus associated with higher overall energy intake. (Sea) Fish consumption is seen as favourable from a nutritional perspective due to its content of long-chain, highly unsaturated n-3 fatty acids and iodine. Meanwhile, sea fish has been superseded as the main source of iodine by milk and dairy products but continues to be highly relevant from a supply perspective. In addition, (sea) fish still represents an important source of high-quality protein, vitamin A, vitamin D (fatty fish), B vitamins and selenium. Consequently, the decline in fish consumption evident since 2010 – due in part to increased prices, endangered stocks and existing ecological concerns – is to be viewed as negative. On the one hand, continued high consumption of milk, dairy products and cheese should have a positive effect regarding a good supply of protein, calcium, iodine and riboflavin (vitamin B_2). On the other hand, the higher fat varieties of these products contribute toward possible higher energy intake. The decline in the consumption of energy-rich spreadable fat is to be seen as positive. Since the intake of vegetable fats has also declined, overall fat consumption is lower – and this is desirable – but the ratio of (poly) unsaturated to saturated fatty acids may have been adversely influenced as a result. This is considered critical, since probable evidence suggests that the replacement of saturated fatty acids with polyunsaturated fatty acids probably reduces the risk of coronary heart disease. At the same time, vegetable oils are an important source of vitamin E, which means a reduced supply may have had a negative impact on vitamin E intake. Cereal grain consumption has increased further. An increase in the intake of cereal fibre is desirable as this has primary preventive potential in relation to nutrition-related diseases. There is probable evidence suggesting that a high intake of dietary fibre from cereal grains probably reduces the risk of developing type 2 diabetes mellitus and malignant colorectal tumours. Refreshing drinks often have high sugar content levels. There is still a need for action here and greater efforts should be made to significantly reduce the consumption of sugar-sweetened beverages, particularly among children and adolescents. Due to its high sugar and fat content, the rising consumption of chocolate (confectionery chocolate) is viewed with scepticism, while reduced consumption of sweets (confectionery sugar) is to be welcomed both in terms of energy intake and prevention of tooth decay. The increased consumption of various kinds of vegetables and berries over the years is to be viewed positively. This should lead to further improvements in the supply of some vitamins (especially folate and vitamin C) and minerals, phytochemicals and dietary fibre.

1.2 Supply of selected nutrients among the German population based on the results of the German Health Interview and Examination Survey for Adults (DEGS)

1.2.1 Methods

The German Health Interview and Examination Survey for Adults (DEGS) is part of the health monitoring activities of the Robert Koch Institute (RKI). The study aims to provide regularly collected, nationally representative health data for adults aged between 18 and 79 years living in Germany. The first wave of the survey (DEGS1; representative, age-stratified, two-stage, multi-stage cluster sample) was conducted between November 2008 and December 2011. DEGS1 is based on a mixed design that allows both cross-sectional and longitudinal analyses. In total, 7,988 people between 18 and 79 years of age participated in DEGS1. 7,238 people were given a thorough physical examination and asked questions on health-related topics, while

914 were only interviewed. The DEGS data were collected by means of computer-assisted physician interviews (CAPI), physical examinations and participant-completed questionnaires.

To assess the vitamin D supply, the concentration of 25-hydroxyvitamin D (25[OH]D) in blood serum was determined using the chemiluminescent immunoassay. For the evaluation of supply status, the Institute of Medicine's (IOM) system of classification was used: 25(OH)D serum concentration ≥ 50 nmol/l corresponds to an adequate supply; 30 to < 50 nmol/l is classified as sub-optimal supply; at a level of < 30 nmol/l, a vitamin D deficiency is deemed to exist. The measurement of folate was conducted in serum and in whole blood using chemiluminescent micro-particle immunoassay. Taking haematocrit and serum values into account, the folate in red blood cells (erythrocytes) was calculated from folate in whole blood. An adequate supply of folate is assumed given serum folate concentrations of ≥ 4.4 ng/ml (10 nmol/l) or folate concentrations in red blood cells of ≥ 150 ng/ml. The World Health Organization (WHO) recommends a red blood cell folate concentration of 400 ng/ml to maximise risk reduction of neural tube defects for women of reproductive age. Concentrations of sodium, potassium, iodine and creatinine were determined using spot urine samples. The 24-hour nutrient excretion was calculated taking into account creatinine concentrations. The respective daily intake levels were calculated using common procedures on the basis of the measured values. 24-hour iodine excretion as a measure of the supply of iodine was also calculated using the iodine/creatinine concentration ratio measured in spot urine. The WHO classification was used for assessment purposes.

1.2.2 Results

Vitamin D

The mean 25(OH)D serum concentration was found to be 45.9 nmol/l in women and 45.3 nmol/l in men. Overall, 61.6 % of the participants (61.4 % of women; 61.7 % of men) had serum concentrations of < 50 nmol/l. Of these, 29.7 % of the women and 30.8 % of the men had concentrations of < 30 nmol/l. At the same time, 38.6 % of women and 38.3 % of men achieved a 25(OH)D serum concentration of ≥ 50 nmol/l. While the average serum concentrations in men across all ages fluctuated in a range between 43 nmol/l to 48 nmol/l, serum concentrations among women decreased more with age: while participants in the youngest age group had mean values of 52.4 nmol/l, these declined to only 39.8 nmol/l in the highest age group (Table 1).

Table 1: 25(OH)D serum concentrations by sex and age groups

		Cutoffs of 25(OH)D serum concentrations according to IOM 2011 in %		
	Mean 25(OH)D serum concentrations in nmol/l	**< 30 nmol/l**	**30 to < 50 nmol/l**	**≥ 50 nmol/l**
Women (total)	**45.9 (43.8–47.9)**	**29.7**	**31.8**	**38.6**
18–29 years	52.4 (49.2–55.7)	25.1	28.4	46.5
30–39 years	48.2 (43.9–52.4)	32.2	24.4	43.4
40–49 years	46.1 (43.0–49.2)	29.5	30.7	39.8
50–59 years	43.5 (41.2–45.7)	30.3	32.5	37.2
60–69 years	43.9 (41.5–46.4)	27.2	36.9	36.0
70–79 years	39.8 (37.3–42.2)	35.4	39.2	25.5
Men (total)	**45.3 (42.8–47.8)**	**30.8**	**30.9**	**38.3**
18–29 years	46.7 (42.7–50.8)	31.6	29.1	39.3
30–39 years	43.4 (39.3–47.5)	36.4	28.9	34.7
40–49 years	45.2 (41.7–48.8)	33.6	26.6	39.8
50–59 years	44.2 (41.7–46.7)	29.5	34.4	36.1
60–69 years	48.0 (45.0–50.9)	22.1	33.3	44.6
70–79 years	43.9 (40.9–46.9)	29.7	36.3	34.0

Folate

The median serum folate values for men at 7.2 ng/ml and for women at 7.9 ng/ml respectively, were far above the threshold for adequate supply of folate. An increase in the median values was observed in both sexes with increasing age (men: 18 to 29 years 6.3 ng/ml, 70 to 79 years 8.2 ng/ml; women: 18 to 29 years 6.9 ng/ml, 70 to 79 years 8.7 ng/ml). In the case of women of reproductive age (18 to 49 years), the median values for serum folate concentrations were between 6.9 ng/ml and 7.6 ng/ml (Table 2). About 16 % of men and 12 % of women had serum folate concentrations of < 4.4 ng/ml.

Table 2: Serum folate (ng/ml) by sex and age groups

	n	P5	P10	P25	Median	P95
Men (total)	**3,376**	**3.1**	**3.8**	**5.1**	**7.2**	**15.0**
18–29 years	515	2.9	3.5	4.7	6.3	12.9
30–39 years	406	3.1	3.7	4.6	6.7	14.1
40–49 years	597	2.9	3.5	4.9	7.1	14.1
50–59 years	640	3.0	3.9	5.5	7.5	15.3
60–69 years	668	4.0	4.5	5.8	7.9	15.8
70–79 years	550	3.9	4.5	5.9	8.2	17.3
Women (total)	**3,669**	**3.4**	**4.1**	**5.6**	**7.9**	**16.5**
18–29 years	539	3.2	3.7	5.1	6.9	16.3
30–39 years	429	3.2	3.9	5.1	7.4	16.4
40–49 years	691	3.4	4.1	5.6	7.6	15.9
50–59 years	752	3.6	4.4	5.9	8.3	16.2
60–69 years	712	4.2	4.9	6.6	9.0	17.2
70–79 years	546	3.3	4.3	6.0	8.7	17.4

Depending on age, the median folate concentrations in red blood cells were between 191 ng/ml and 243 ng/ml in men and between 175 ng/ml and 231 ng/ml in women and thus above the threshold value for adequate supply. Concentrations below 140 ng/ml were measured in 13 % of men and 16 % of women, suggesting (sub) clinical deficiency. Among women aged between 18 and 49 years, only 3 % (18 to 29-year-olds) to 4 % (30 to 49-year-olds) reached the red blood cell folate concentrations recommended by the WHO for women in reproductive age.

Sodium

The estimated median sodium intake derived from spot urine samples in men was 4.0 g and 3.4 g in women per day corresponding to approximately 10 g and 9 g of salt (NaCl) per day. This means that 50 % of the population consumes more than this amount of salt per day. In 25 % of the men and women, sodium intake amounted to more than 5.7 g and 5.0 g of sodium per day respectively (approx. 15 g or 13 g NaCl/day), and 5 % consumed more than 8.8 g or 8.1 g of sodium per day respectively (22 g/21 g NaCl/day). The mean values for estimated daily sodium intake at 4.5 g for men and 3.8 g for women were above the median values. The assumption that people who more frequently prepare warm meals from fresh food ingredients are adding less sodium cannot be confirmed. For men, cooking their own food did not affect the amount of added sodium. Women who tended to cook more often, sodium intake was even higher than in women who cooked less often.

Potassium

The median, daily potassium excretion derived from spot urine samples for the entire group of 18 to 79-year-olds was 3,326 mg/day for men and 3,017 mg/day for women. The median potassium excretion was highest in the 50-and-older age group (Table 3).

Table 3: Estimated potassium excretion of men and women by age groups

age (years)	n	P5	P10	P25	Median	P75	P90	P95
Men								
19–24	239	1,061	1,241	1,902	2,801	3,850	5,329	5,966
25–34	391	1,468	1,628	2,356	3,410	4,555	6,020	6,551
35–50	875	1,725	1,953	2,486	3,200	4,246	5,392	6,293
51–64	865	1,739	2,067	2,679	3,525	4,471	5,656	6,510
65–79	894	1,619	1,989	2,654	3,528	4,455	5,457	6,151
Total	**3,264**	**1,526**	**1,834**	**2,496**	**3,326**	**4,364**	**5,560**	**6,337**
Women								
19–24	257	1,004	1,255	1,671	2,228	3,067	4,238	4,983
25–34	419	1,309	1,612	2,093	2,730	3,582	4,597	5,699
35–50	993	1,448	1,701	2,282	3,131	4,300	5,620	6,494
51–64	1,008	1,593	1,862	2,468	3,286	4,481	5,703	6,463
65–79	900	1,643	1,933	2,382	3,029	3,968	5,048	6,093
Total	**3,577**	**1,401**	**1,700**	**2,233**	**3,017**	**4,088**	**5,330**	**6,235**

Iodine

Median iodine excretion levels of 69 µg/l and 54 µg/l derived from spot urine samples demonstrated that men and women both clearly fell short of the reference value of > 100 µg/l as recommended by WHO for an adequate supply of iodine. At a value of 113 µg/day, iodine excretion estimated via the iodine/creatinine quotients was found to be in a much less critical area. The estimated median iodine intake derived from this (taking 10 % non-renal iodine losses into account) of 125 µg/day for women and 126 µg/day for men fell below the recommended intake for iodine as specified by both the IOM at 150 µg/day and the German-Austrian-Swiss (D-A-CH) reference values at 200 µg/day. The 95th percentile of estimated iodine intake amounted to 323 µg/day for men and 406 µg/day for women and therefore below the upper intake level of 500 µg/day quoted in the D-A-CH reference values which should not be exceeded under the nutritional conditions of a population not adapted to high iodine intake levels. Comparison of estimated intake of iodine with the IOM Estimated Average Requirement (EAR) of 95 µg/day shows that, on average, > 30 % of DEGS participants are at risk of having insufficient iodine intake (Figure 3). However, this average value of 30 % fails to take into account the fact that in some special situations, such as pregnancy or lactation, a much higher requirement for iodine exists and thus the prevalence of iodine deficiency could be significantly higher.

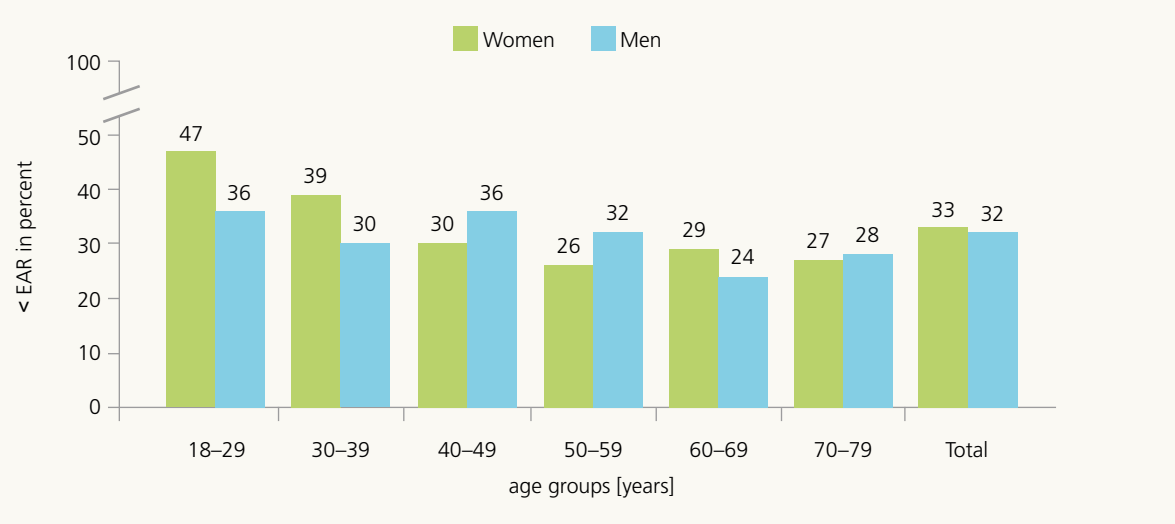


Figure 3: Percentage of DEGS-participants with an estimated iodine intake below the average requirement (EAR of the IOM for adults: 95 µg/day)

1.2.3 Evaluation

Vitamin D

The partly unsatisfactory vitamin D supply is especially due to Germany's geographic location. The body's own dermal formation of vitamin D, requires UVB radiation with a wavelength of 290 nm up to 315 nm. However, these only occur year round in regions below the 35th latitude. In higher latitudes, the intensity and duration of appropriate radiation decreases and the formation of vitamin D becomes dependent on the season. In addition to the seasons, other factors are known to influence the body's production. These include duration of sunshine, time of day and length of time spent outside, use of sunscreen products, wearing clothes that cover the whole body, as well as skin pigmentation and old age. Older people are considered a risk group for vitamin D deficiency because their ability to produce vitamin D diminishes due to decreasing skin thickness and dwindling ability to metabolise vitamin D via the liver and kidneys. However, this is not reflected uniformly in the present data for both men and women: while the concentrations in men only vary slightly across all age groups, these declined almost universally among women as age increased. Gender-specific differences in age distribution cannot be explained conclusively. Increasing immobility and dependency on care are further reasons for lower vitamin D serum concentration in old age because periods spent outside are usually greatly reduced. This especially affects people living in nursing homes.

Folate

On the basis of folate concentration measurements present in serum and in red blood cells, it is obvious that the folate supply within the population is slightly better than has been assumed on the basis of the intake data from the German National Nutrition Survey (NVS II), which compared folate intake with the corresponding D-A-CH reference values. Comparison of the folate concentrations measured in serum and red blood cells with the threshold values for adequate supply showed that approximately 85 % of the adult population in Germany had sufficient supply of this vitamin. If the concentration of folate in red blood cells of 400 ng/ml is taken as the basis (as recommended by the WHO for the prevention of neural tube defects), about 95 % of women of childbearing age had an inadequate supply. The WHO threshold value cannot be regarded as a predictive value for individual risk of neural tube defects but at population level merely serves for estimating folate supply for women of child-bearing age.

Sodium

Estimated sodium intake of the population in Germany derived from spot urine samples was above the D-A-CH reference value of 1.5 g/day for adults in the majority of cases (93 % of males and 90 % of females). It is unclear at which exact level of sodium intake health risks occur.

The WHO recommends not exceeding a sodium intake of 2 g/day; the American Heart Association (AHA) sets the limit at less than 1.5 g of sodium per day. However, the IOM concludes, in contrast, that it remains unclear whether a reduction in sodium intake to less than 2.3 g/day has positive or negative effects on cardiovascular health due to the insufficient and conflicting evidence. Due to the uncertainty of the data, the European Food Safety Authority (EFSA) has so far not declared a tolerable upper intake level for daily sodium intake. In a recent scientific statement, the DGE concluded that there is convincing evidence for an association between salt intake and blood pressure: high salt intake is associated with increased or suboptimal blood pressure and low salt intake with normotensive or optimal blood pressure. Based on WHO recommendation to reduce average salt intake within the population by 30 %, an approximate value of up to 6 g/day is still being quoted for Germany. Other professional scientific bodies endorse a similar approximate value. Based on sodium urinary excretion measurements, 80 % of men and 73 % of women in Germany consume more than 6 g of salt per day.

Potassium

When evaluating potassium excretion through spot urine, the fact that potassium is neither 100 % absorbed nor excreted must be taken into account. In any case, it would appear that, based on the daily potassium intake established here, potassium supply is better than data from NVS II would suggest.

Iodine

The iodine supply within the German population is still not satisfactory. In 30 % of the adults examined in Germany the risk of an inadequate iodine intake was observed (as was previously also the case in children in the German Health Interview and Examination Survey for Children and Adolescents [KiGGS]). A clear need for health-related action is indicated, particularly against the backdrop of desired broad-based measures aimed at reducing high salt intake and that would also have the effect of reducing iodised salt intake. There is no conflict whatsoever between reducing the amount of salt used and ensuring an adequate iodine supply. A sufficient iodine supply can be achieved in a sustainable manner even given reduced salt intake. Prerequisite for this is the increased use of iodised salt in the food industry, as well as in food crafts. It is worth considering an increase of the amount of iodine in salt (as well as in Switzerland since January 2014). Based on current data, an excessive iodine supply within the German population is not to be feared.

1.3 Development and prevalence of overweight (pre-obesity and obesity) in Germany

1.3.1 Methods

The reporting of prevalence and development of overweight in Germany, which was shown in the two previous Nutrition Reports, is being continued across all age ranges. The large-scale national samples taken as part of the 1999, 2003, 2005, 2009 and 2013 microcensuses along with data from several regional cohort studies serve as a data base here. Body mass index (BMI) was used as evaluation criteria: overweight being diagnosed at a value of 25 and above. Further classification follows the international pattern: 25–29.9 = pre-obesity; 30–34.9 = class I obesity; 35–39.9 class II obesity; ≥ 40 class III obesity. In childhood and adolescence, BMI was evaluated on the basis of age and gender-dependent percentiles within a reference population. Children and adolescents are classified as overweight if their BMI value is above the 90th age-and-gender-specific percentile of the reference population. A BMI value above the 97th percentile means extreme overweight and is defined as obesity in this age group. With this definition, obese persons are always included in the group of overweight people.

1.3.2 Results

Pregnancy

In three regional cohort studies with a mean BMI of 22.6 from a total of 6,254 participating women at the beginning of their pregnancy, 13.5 % of the women were pre-obese and 5.0 % obese. Mean weight gain during pregnancy was 14.3 kg. In Bavaria, an increase in average weight gain in women during pregnancy of 0.6 kg was observed between 2000 and 2007.

Infancy

The mean birth weight of new-borns in the regional cohort studies was 3.4 kg. According to calculations by the Federal Statistical Office, 11.6 % of all neonates in the year 2000 had a birth weight of ≥ 4,000 g. Included in this were 1.7 % of new-borns with a birth weight of ≥ 4,500 g. In the course of 10 years, this percentage has decreased slightly: In 2010, 10.1 % of children had a birth weight of ≥ 4,000 g, including

1.2 % of neonates born weighing ≥ 4,500 g. In 2000, 6.1 % of infants were born weighing less than 2,500 g, including 1.1 % under 1,500 g; in 2010 the respective figures were 6.9 % and 1.2 %.

Childhood and adolescence

Within the Federal States, the body weight and height of children and the prevalence of overweight and obesity are systematically recorded and analysed by the responsible state institutions as part of initial physical examinations conducted as they start school. Figures are available for the individual federal states from the years 2008 to 2013. According to these figures, the proportion of children who are overweight when they start school varies depending on the federal state between 8.2 % and 12.0 %; among them between 2.8 % and 5.3 % children were classified as obese. For comparison, the lowest prevalences of obesity and overweight (overall) were found in Baden-Wuerttemberg (2.8 % and 8.2 % respectively) and Bavaria (3.2 % and 8.4 %respectively).

Adults (18 to under 65 years)

According to microcensus data, in the 18 to 65 years age group, 42.4 % of men and 24.8 % of women were pre-obese and 16.1 % of men and 12.3 % of women were obese (Table 4). This results in an overall prevalence of overweight of approximately 59 % in men and 37 % in women. In all age groups, men were more frequently overweight than women (2013: among 20 to 25-year-olds – 31.3 % of men and 18.6 % of women). The proportion of overweight people increased continuously with age and reached its height at the end of working life in the age group 60 to under 65 years, this being 74.2 % of men and 56.3 % of women. Between the ages of 18 and 40, men gained considerably more weight than women – on average 10.7 kg (or approx. 500 g per year of life) compared with 7.2 kg (or approx. 325 g per year of life). In contrast, between the ages of 40 to under 65, women gained more weight on average (+ 3.2 kg) than men (+ 0.2 kg). The increased weight gain occurring in men in younger adulthood means that men of normal-weight already find themselves in the minority from the 30 to 35 years age group onward, while this does not apply to women until beyond the age of 55. The obesity prevalence figures in the represented age groups from 18 to under 65 increase in an almost linear fashion. In the year 2013, about every fourth man (24.7 %) and every fifth woman (20.7 %) was found to be obese by the end of their working life. Underweight (BMI < 18.5) is observed to a significantly lesser extent in Germany than overweight (women: 3.9 %, men: 0.8 %).

Table 4: Body measurements and prevalence of underweight and overweight in adults (18 to < 65 years) on the basis of the microcensus 2013 (average values)

	Women (18 to < 65 years)	**Men** (18 to < 65 years)
Body weight (kg)	67.9	84.8
Body length (cm)	166.0	179.0
BMI	24.6	26.5
Underweight	3.9 %	0.8 %
Normal weight	59.0 %	40.6 %
Pre-obesity	24.8 %	42.4 %
Obesity class I and II	11.2 %	15.3 %
Obesity class III	1.1 %	0.8 %

Senior citizens (65 years and older)

A total of 69.9 % of men and 57.5 % of women were overweight in this age group according to microcensus data – 19.9 % of men and 18.8 % of women were obese. Underweight existed only in very few elderly people (0.5 % male and 2.0 % female). While the overall prevalence of overweight differs significantly between men and women, the gender difference in the prevalence of obesity (class I and II) is considerably lower; class III obesity is even more commonly observed in elderly women than among men in this age group. With increasing age – and here especially in the age group 75 years and above – a reduction in the prevalence of obesity is observed in both sexes.

1.3.3 Evaluation

The prevalence of obesity in Germany remains high and has increased in some age groups. Because of the general social trend of giving birth to children later in life, pregnant women are nowadays more frequently affected by overweight and obesity at the beginning of a pregnancy than was previously the case. Only a minority of adults is able to maintain body weight in the normal range as they grow older and reach old age. The prevalences of obesity in childhood and adolescence are still significantly higher than they were in the 1970s. It continues to be particularly problematic that extremely overweight, obese children and adolescents tend to gain weight further. Despite some analytical weaknesses, this comprehensive analysis shows very clearly, that urgent action is needed to overcome the obesity epidemic.

1.4 Current developments in food intake

1.4.1 Methods

Based on recent publications, an assessment of current developments in food intake was conducted.

1.4.2 Results

"Free-from" food products

In recent years, a growing segment of these "special foods" has been available in the food sector. Many consumers eat such foods occasionally or even regularly, often without any objective medical necessity to do so. The supply of gluten-free foods has increased rapidly in recent years and the introduction of mandatory allergen labelling represents a significant improvement with regard to health protection of affected consumers. Therefore, both developments are welcome. The benefits of a wheat- and gluten-free diet is clearly evidenced and recommended in cases of clinically proven intolerance. Switching to a gluten-free diet is often regarded more as a change of lifestyle, than a diet therapy. Consumers without any clear indication of gluten intolerance link these foods with health benefits (such as weight loss); however, there is no scientific evidence for this assumption. Some gluten-free foods have a comparatively high energy density and a higher fat content, while nutrient density and the fibre content are lower than in comparable products with gluten. By generally abstaining from whole grain products, no benefit can be derived from their preventive effect with regard to development of cardiovascular disease and some cancers. In addition, there is evidence that a gluten-free diet has an adverse effect on intestinal health of individuals without celiac disease and wheat sensitivity.

Sales of so-called "lactose-free" foods are reported at 285 million Euros for the year 2014. To date, however, there has been no statutory regulation regarding the term "lactose-free" so interpretation of a product's allocation to this product group is difficult. In the case of lactose-free milk there is usually a residual content of less than 0.1 g lactose per 100 g. Lactose-free milk and dairy products are good alternatives for consumers with lactose intolerance. Meanwhile, many more food products – such as black bread or toast bread, rusks or boiled ham – which often barely differ from the conventional food, are also being marketed with "lactose-free" labelling. This unsettles consumers and means that people with real or perceived lactose intolerance will turn to these typically more expensive speciality foods even though the conventional food varieties are also lactose-free and would cause no health problems. Milk and dairy products are important nutrient suppliers as part of a varied, wholesome diet and also important for the prevention of nutrient deficiencies, such as calcium, iodine and riboflavin (vitamin B_2). In cases of lactase persistence, it is unnecessary to abstain from these foods and doing so has no health benefits whatsoever.

Vegetarian and flexitarian diets

The reasons for following these current nutritional trends containing less meat and/or to partially or completely give up foodstuffs of animal origin are varied; religious or ethical reasons, ecological viewpoints (including climate protection and animal welfare), and health reasons are all worth mentioning. In the NVS II sample representative of Germany, conducted by the Federal Research Institute of Nutrition and Food for the years 2005 and 2006, it was established that among the total number of around 20,000 men and women aged between 14 and 80 years surveyed, 1.6 % followed a vegetarian diet (2.2 % women and 1.0 % men). The majority of the participants stated that they consumed milk, dairy products, cheese, eggs and sometimes also fish. In contrast, only about 0.1 % of the women and men indicated in the study that they followed a vegan diet. The German Vegetarian Association (VEBU) published estimates in 2015, according to which approximately 10 % of people in Germany followed a vegetarian diet and 1.1 % a vegan diet. The preventive effects of a high proportion of foodstuffs of plant origin in the diet are undisputed and there are many instances of scientific evidence supporting this. Plant-based foodstuffs provide nutritionally valuable substances. The "displacement effect" brought about by the deliberate intake of (more) fruit and vegetable in the context of lower intake of foodstuffs of animal origin and thus lower intake of red meat, saturated fatty acids and a consequently lower energy density, for example, are all associated with lower body weight. The risk of nutrition-related diseases such as type 2 diabetes mellitus, hypertension, ischemic heart disease and cancer is reduced. Therefore, the DGE has for years been recommending a wholesome, balanced diet in form of a varied mixed diet with about 75 % plant-based foods (vegetables, fruit, [wholegrain] cereals, potatoes). A purely vegan diet, however, is associated with potentially critical nutrient supply and risk of nutrient deficiencies which may affect health.

1.4.3 Evaluation

Generally, a voluntary or medical restriction in the choice of foods available leads to an increased risk of nutrient deficiencies and associated health-related consequences. Against this background, the DGE recommends a wholesome diet in form of a varied mixed diet, consisting for the most part of plant-based and the lesser part animal-based foods (milk, meat, fish, eggs and products manufactured from the same). In scientific studies, this diet has been proven to reduce risk of nutrition-related diseases. Scientific evidence that completely abstaining from consuming foods of animal origin leads to additional health benefits does not exist. If food choice is restricted for medical reasons (such as in the presence of allergies), it is necessary to pay attention to the associated reduced nutrient intake.

2 Catering in nurseries (VeKiTa): nutritional situation, awareness and implementation of the specific German Nutrition Society's Quality Standard

2.1 Methods

A survey was conducted in nurseries (Kitas) intending to map the current catering situation, to investigate the awareness and implementation of the German Nutrition Society (DGE) Quality Standard, and to derive recommendations to improve the catering situation and the acceptance of the standard. The study was based on three investigation areas (Figure 4):

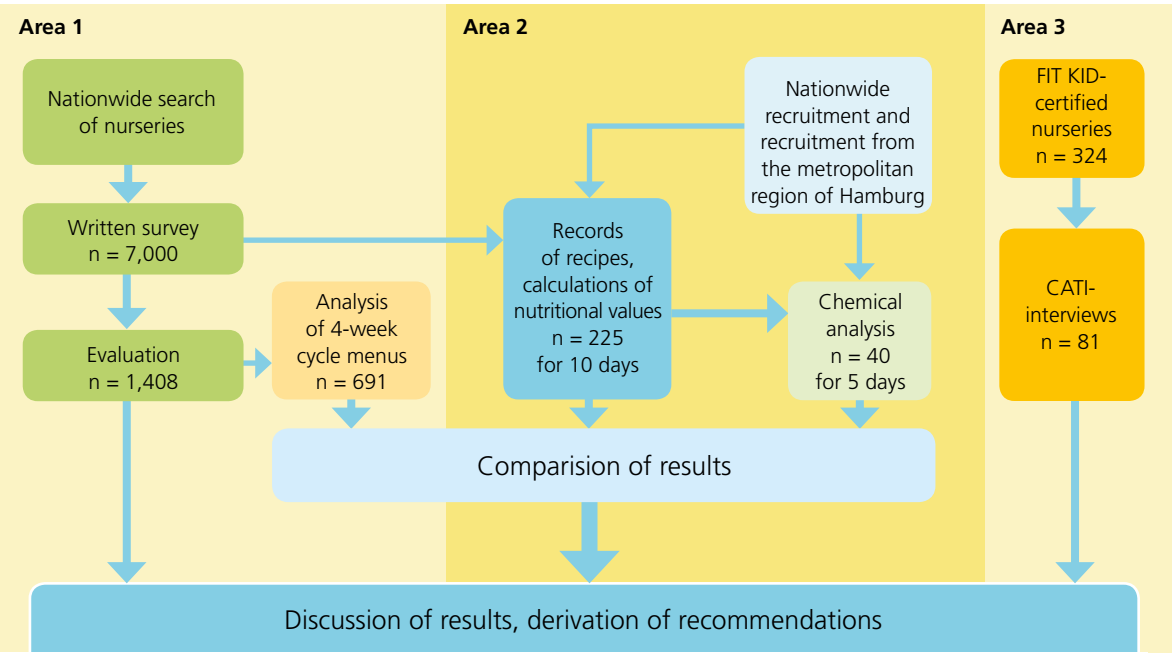


Figure 4: Study design: catering in nurseries (VeKiTa)

(1) Nationwide written survey of the nurseries and evaluation of complete 4-week cycle menus on the basis of the DGE Quality Standard

Based on a self-generated, cross-institutional data file of over 53,000 nurseries in Germany, a random sample of 7,000 addresses stratified by federal state was taken. A machine-readable, tested questionnaire was developed for the survey, which in addition to closed-ended questions, also included open-ended and semi-open-ended questions. As part of the survey, the nurseries were asked to submit menu plans covering a period of at least 4 weeks. The evaluation was based on the "*DGE-Qualitätsstandard für die Verpflegung in Tageseinrichtungen für Kinder*" (DGE Quality Standard for Catering in Nurseries), as published in the fifth edition in 2014.

(2) Calculation of nutritional values for lunch recipes throughout Germany over a period of 10 days; chemical analysis of lunch samples obtained over 5 days exclusively in the metropolitan region of Hamburg (sub-study)

An information letter, recipe data sheets and guidance for specific details regarding foods were sent to the participating nurseries. Facilities, whose meals come from external providers, were asked to forward the documents to their suppliers or caterers.

In the metropolitan region of Hamburg, among those nurseries participating in the chemical analysis, a portion of the lunch for a child aged between 4 and 7 years was collected and frozen once a day for one week. The samples were crushed and the homogenates tested in accordance with the methods for official collection as per § 64 of the German Food and Feed Code *(Lebensmittel- und Futtermittelgesetzbuch*, LFGB) for contents of total fat, crude protein, water and crude ash, as well as for sodium in line with the AOAC method (Association of Official Agricultural Chemists). Carbohydrate and dietary fibre content were determined in accordance with the statement of the "Nutritional Labelling" sub-group of the "Matters of Nutrition" working group of the Food Chemistry Society at the German Chemical Society (GDCh) regarding Directive 90/496/EEC on Nutrition Labelling for Foods. The analysis methods were validated by means of double determination using three commercial ready meals, as well as via external cross-checking by an accredited commercial laboratory. The salt content was calculated based on the measured sodium content.

(3) Survey of "FIT KID" certified facilities using Computer-Assisted-Telephone-Interviews (CATI)

The programming of the guideline for the telephone survey (mainly closed-ended questions; time required 30 mins.) was carried out using in-house software, which was tested for appropriate function in advance.

Evaluation

The input of the data of the written survey was conducted using the survey software EvaSys, which facilitates automated data collection. Further data processing was performed using the statistics programme IBM SPSS statistics, version 22. The submitted recipes were evaluated using the software DGExpert, version 1.6.4.1, on basis of the German Nutrient Data Base (BLS) 3.02. Evaluated nutrients were those, for which appropriate reference values are specified in the DGE Quality Standard. Arithmetic means and standard deviations were determined by chemical analysis. Energy and nutrient contents related to a standard (portion) size of 370 g (food-based approximate amount of the DGE Quality Standard). The Computer-Assisted-Telephone-Interviews were evaluated using MAXQDA and MS Excel 2013 software. The questions covered certification-related experience – in the time prior to certification, during the certification process and after receipt of the final report and certificate. Key points were the certification induced changes and the challenges which had to be overcome by the nurseries due to the implementation of the DGE Quality Standard.

2.2 Results

(1) Written survey and analysis of menu plans

Of the 7,000 nurseries contacted, 1,408 returned a complete written questionnaire (response rate 20.1 %). Referred to all German nurseries, on average 2.6 % were depicted by the records. Of the nurseries surveyed, 30.6 % were funded publicly and 54.8 % were independently run by non-profit organisations such as the *Arbeiterwohlfahrt* (Workers' Welfare Institution [AWO]), the *Paritätischer Wohlfahrtsverband* (Equal Welfare Association), the German Red Cross (DRK), or the Protestant and Catholic churches. Nurseries with private-commercial funding made up 5.6 % of the sample and those supported by parent initiatives 6.6 %. With 82 % and 91.4 %, the nurseries mostly cared for children aged between 1 and below 3 years and between 3 and 6 years, respectively. Very young children under 1 year of age were looked after in 27.8 % of the nurseries and 17.1 % also provided after-school care for children aged between 6 and 12 years. Of the nur-series surveyed, 59.8 % had a domestic kitchen. Furthermore, 20.1 % had a kitchen with a few commercial appliances for heating meals while 16.2 % had a fully equipped kitchen with commercial kitchen appliances. Only 0.4 % of

the nurseries had no kitchen at all and 3.4 % just had a room in which the delivered food was stored until distributed and the dishes washed.

Meal offer and provision: At least one meal was offered in almost all nurseries surveyed. 46 % offered breakfast and 28 % a mid-morning snack. Almost all nurseries (96.1 %) provided lunch. In 56.4 %, an afternoon snack was offered, whereas an evening meal was only available in 1.5 %.

Regarding the *catering system,* 55.4 % of the nurseries received hot hold meals by a caterer. In second place (30.3 %) were catering systems with meals being prepared freshly on site (Cook & Serve). Cook & Serve involves lunches being completely prepared and served within the nursery premises. Other preparation systems (e.g. Cook & Freeze, Cook & Chill) were not very common. Of the surveyed nurseries, 38.4 % employed *professional staff* with several years of vocational education such as home economists, housekeepers, operations managers in home economists, home and nutrition scientists or cooks. In 78.2 % of the surveyed facilities, lunch was consumed in the group room. An additional 29.6 % had a designated dining room and in 6.6 %, the children ate their meals in the foyer or hallway area as well (multiple answers possible).

Regulations on bringing foods to nursery on a daily basis existed in 60.2 % of the surveyed facilities. There were no rules in 11.6 % of nurseries and in 23.8 %, children did not bring any foods to nursery. In 62.7 %, it was permitted *to bring sweets* into nursery only on special occasions. In 17.9 %, children were not generally permitted to bring sweets, whilst in 9.3 % there were no rules regarding the handling of sweets. In addition, 10.1 % did not provide an answer to this question.

Quality and quality management of catering: Of the respondent nurseries, 42.1 % stated that a *hygiene concept* (HACCP) was implemented. Of those who answered the question regarding hygiene control measures (n = 1,368), 90.7 % had a cleaning and hygiene plan, and 89.9 % had established procedures for good hygiene practices, such as hand washing, floor cleaning and the like. Likewise, 88.5 % of the nurseries carried out temperature measurements. However, only 37.8 % took retention samples. Of the nurseries, 36.1 % answered «Yes» to the question as to whether there is an organisational unit (specialist unit/consultant) providing support regarding catering, quality and hygiene, while 57.6 % denied and 6.4 % of the nurseries did not answer. Almost half of the respondents (47.2 %) were aware of *external standards for nursery catering*, while 45.8 % had no knowledge of such standards. *Selection of foods*: 36.5 % of nurseries used fresh vegetables and 29.5 % used predominantly low-fat cuts of meat (more than 80 % of the time). Whole grain pasta and brown rice, as well as low-fat milk and dairy products were rarely used more than 80 % of the time. With regard to whole grain pasta and brown rice this was the case in 10.6 % of nurseries and for low-fat milk and low-fat dairy products in 19.7 %. Similarly, only 14 % of facilities used predominantly rapeseed oil (more than 80 % of the time).

Analysis of menu plans: In total, 837 nurseries participating in the written survey provided menu plans. Of these, 691 fulfilled the requirement to present a 4-week cycle menu (20 days of catering). Therefore, 146 submitted menu plans only covered a period of 1 to 3 weeks. These were not included in the evaluation. Regarding the required *food-frequencies*, not all menu plans fulfilled the requirements of the DGE Quality Standard. Of the menu plans considered (n = 691), 37.8 % completely fulfilled the requirement to provide a daily carbohydrate component and an additional 62.2 % mostly fulfilled this requirement. The requirement to provide vegetables and salad daily was completely fulfilled only by 6.5 % of menu plans submitted and mostly fulfilled by 85.8 %. The requirement to provide salad or raw vegetables at least eight times was completely and mostly fulfilled in 38.9 % and 35.3 % of the menu plans, respectively. As required, in 30.7 % of the menu plans, fish was provided at least four times, while 45.4 % mostly fulfilled this requirement. While there was a tendency to offer fish too rarely, meat or sausage was still offered too often in 44.7 % of the menu plans. However, the requirement to offer meat or sausage on a maximum of eight times over 20 days of catering was completely fulfilled in more than half of the evaluated menu plans (55.3 %). 71.5 % completely fulfilled the requirement to offer lean muscle meat at least four times. More than 90 % of the

menu plans (96.5 %) completely fulfilled the criterion to offer deep-fried and/or breaded products maximally four times.

(2) Calculations of nutritional value and chemical analysis

Calculations of nutritional value: Of the 453 nurseries receiving documents for recording recipes, 225 returned fully completed lunch recipe sheets. In total, recipes of 443 weeks were considered, which corresponds to a total number of 4,567 meals. The evaluation was based on a comparison between the mean nutritional values in the lunches provided during a week (5 days) and the corresponding reference values in the specific DGE Quality Standard (PAL value of 1.6). Lunches should contain 25 % of the daily recommended nutrient levels or respective guiding values averaged over 20 days of catering. In most cases, the reference values for calcium, vitamin E and protein were not reached in the lunches provided over a week. In contrast, the reference values for thiamine (vitamin B_1), vitamin C, magnesium, iron, folate and dietary fibre were reached or exceeded by most lunches provided over a week. Relative to their respective reference values (= 100 %) the median carbohydrate, energy and fat content of the lunches offered were 102 %, 101 % and 100 %, respectively (Figure 5). While 20.9 % of the nurseries exceeded the reference values for energy, protein, carbohydrates and fat in their offered lunch, 29.3 % failed to meet the reference values for energy, protein, carbohydrates and fat averaged over a week.

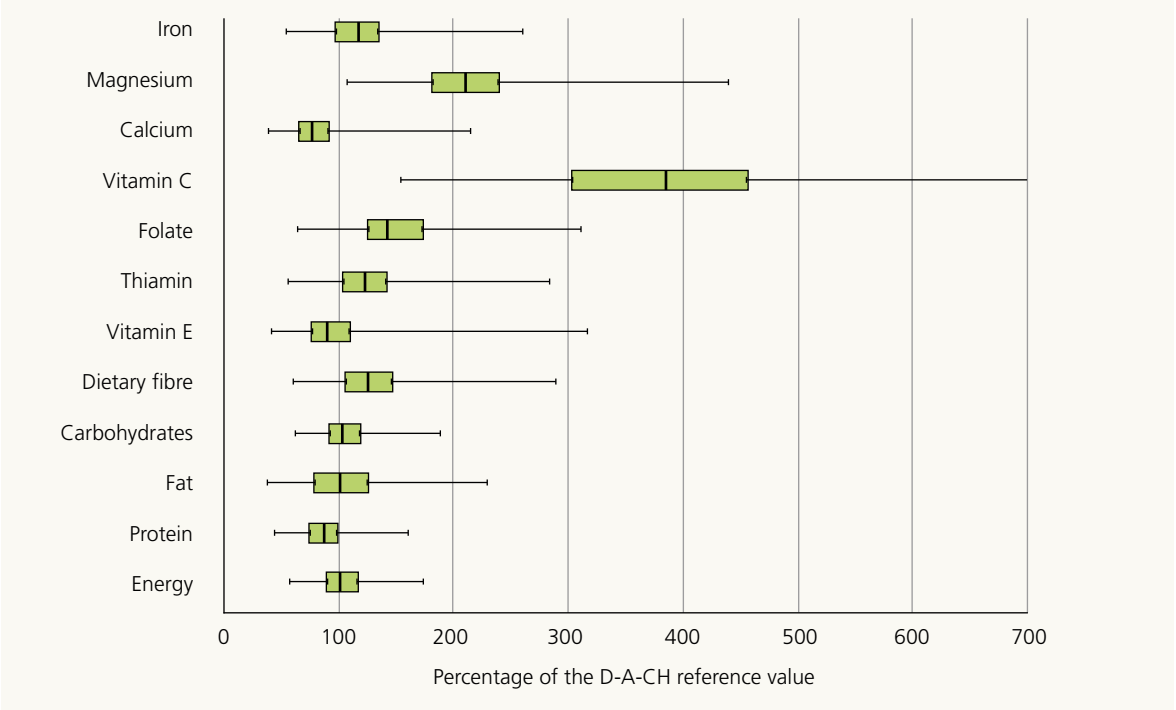


Figure 5: Nutrient supply in comparison to the D-A-CH reference values for nutrient intake (= 100 %) averaged over one week per nursery (n = 225) (median, interquartil range and minimum-maximum-values presented)

Chemical analysis: Of the 40 nurseries that participated in this sub-study, 80 % prepared their food on site (Cook & Serve) and 20 % of the facilities had meals delivered (hot hold meals). Nurseries offering either delivered food cooled via a Cook & Chill service or as deep frozen meals (Cook & Freeze), did not participate in this sub-study. In the 20 % of nurseries receiving hot hold meals, the caterers provided the samples for the analyses. In relation to a standard portion, the mean of the analytically established *energy content* was 98 % of the reference value for lunches. The lowest energy value averaged over a week was 78 % of the guiding value. The standard portions achieved on average 98 % of the reference values for *carbohydrate intake* (range 35–66 g). With an average 13 g per standard portion, *fat content* was identical with the reference values for lunches; they did, however show the highest variation (7–21 g) of all energy-supplying nutrients. The *protein content* of the lunches was on average 84 % of the reference value. Only 4 out of 40 institutions

met or exceeded this value. The recommended *nutrient ratio* was 20 % protein, 30 % fat and 50 % carbohydrates. According to the analysis results, on average 17 % of the nutritional energy was provided by protein, 32 % by fats and 51 % by carbohydrates and dietary fibre. For children, an age-dependent orientation value of 3 g to 6 g *salt* per day is specified. No more than 25 % of the total daily amount of salt should be provided via lunch. Therefore, the 1.8 g average salt content of the meals is to be regarded as high. The *crude ash* is a sum parameter for the content of minerals and trace elements. It is taken into account when calculating carbohydrate content. In the lunches analysed, salt alone made up on average 30 % to 50 % of the crude ash content.

(3) Interviews with FIT KID certified nurseries

Those persons responsible for catering in 81 nurseries were interviewed by telephone about their experiences with the implementation of the DGE Quality Standard and the certification process. In total, 80 of the nurseries were already FIT KID certified and one had largely completed the certification process. Only the final handover of the FIT KID logo was lacking. The majority of interviewees (44.4 %) reported having learned about the possibility of FIT KID certification via the funder. In addition, in 19.8 % of cases, they had become aware of certification through information material from the DGE or by its newsletter. In 14.8 % of the cases, colleagues told them about certification and in 13.6 %, they found information on the Internet. In 9.9 %, the interviewees received the information through the German Consumer Association (*Verbraucherzentrale*) or at an event and in 1.2 % of cases via advertising. The decision to have the facility officially approved and certified was taken in 77.2 % of nurseries by the funding body. In 9.9 % of the nurseries, this decision was made by the nursery management and in 10.1 % by the head of the housekeeping team. Only in 1.3 % of facilities the decision was made by the parents and in 1.3 % by housekeeping staff. In many aspects the food offer changed due to *certification*: the *menu plan* was more varied (73.7 %); of those nurseries stating that they had modified their provision of meat since certification (66.7 % of those interviewed), the *amount of meat in general and meat products* had been reduced in 81.5 % and 83.3 %, respectively; 80.2 % of nurseries had modified their provision of *fish* during the certification process with more than half of these nurseries providing fish more frequently. In addition, the provision of *dairy products* had changed in 70.4 % of nurseries, with 98.2 % of these now using more low-fat dairy products. As regards the provision of vegetables, 48.1 % of the interviewees had made some changes and now more frequently provided *vegetables or salad*; 45.7 % of nurseries made changes regarding the provision of *fruit* (mostly increased provision); 67.9 % of the interviewees had changed their provision of *sweet foods* with 94.5 % now offering only very few sweet desserts. When asked about the impact of the FIT KID certification, 93.8 % agreed that it ensured the provision of wholesome and health-promoting catering, 91.4 % agreed that it increased the value assigned to catering and 92.6 % considered the FIT KID certification as good advertising for their institution. Furthermore, FIT KID certification improved quality in catering operations (85.2 %), created advantages over other nurseries (77.8 %), enhanced the parents' confidence (77.8 %) and improved communication with them (64.2 %). The internal effects were also evaluated: 79 % considered that certification confirmed the work of the staff responsible for the food service and half (50.6 %) stated that it had improved teamwork within the nursery.

2.3 Evaluation

Strengths of catering in nurseries

Clearly favourable is the strong orientation towards the target group: the children's satisfaction with the catering was named on second place regarding the challenges. Their taste preferences and individual and cultural needs are considered in menu planning. Also worth emphasising, is the fact that the children's satisfaction with the catering is regularly checked in most nurseries either by education staff or by other means. Moreover, nutritional socialization and dietary education of the children were part of their focus. In half of the nurseries, it was explained to the children at mealtimes which kind of foods they were eating. The food quality had improved in the past few years but still did not meet the requirements of the DGE Quality Standard. The menu plans still did not meet every aspect of the requirements of the DGE Quality Standard as well. Only in a few nurseries the reference values for dietary fibre, folate, iron and thiamine (vitamin B_1) were not achieved. The averaged reference values for lunch for an average week were exceeded in 75 % of the facilities according to the amounts calculated for vitamin C, thiamine (vitamin B_1), folate, magnesium and dietary fibre. These amounts are considered to be safe. The DGE Quality Standard already formed the basis for catering provision in 29.6 % of the institutions surveyed and 2.5 % of respondents indicated that they had already received FIT KID certification.

The interviews with FIT KID certified nurseries showed that both, the implementation of the DGE Quality Standard and the certification process, is assessed positively, confirmed that a wholesome and health-promoting catering offer is ensured and that parents' trust in catering is increasing.

Weaknesses of catering in nurseries

Offering high-quality, wholesome and health-promoting food sets requirements for premises, equipment and personnel, as well as presupposing an appropriate financial budget. These requirements are not fulfilled across the board. Good flavour, appealing presentation, variety and high nutritional quality, together with impeccable hygiene also demand professionalism. The results of the survey show that further improvements are possible regarding qualified personnel. In this respect, only 38.4 % of the nurseries surveyed employed professional staff with several years of vocational education such as home economists, housekeepers, operations managers in home economists, home and nutrition scientists or cooks. A lack of expertise is also evident in relation to the HACCP-concept: 34.1 % of nurseries stated they were unaware of the concept. In those institutions carrying out training every year in accordance with Regulation (EC) No 852/2004 of the European Parliament and of the Council on the hygiene of foods, the HACCP-concept was significantly more frequent found than in those nurseries not providing training in accordance with the aforementioned directive. Until now, only 35.1 % of nurseries had a documented catering concept. The menu plan analysis showed that the DGE Quality Standards' requirements for the composition of the 4-week cycle menu were fulfilled to different extents by the nurseries. The requirement for the provision of salad and raw vegetables was not and mostly fulfilled in 25.8 % and 35.3 % of the nurseries, respectively. By calculating nutritional values, it became apparent that the reference values for lunch were exceeded for energy in 57.3 %, carbohydrates in 54.2 %, fat in 52.4 %, magnesium in 100 %, thiamine (vitamin B_1) in 78.7 % and vitamin C in 100 % of the nurseries, averaged over one week. Shortfalls were noted with regard to protein in 74.2 %, vitamin E in 60.9 % and calcium in 80.4 % of the nurseries. The low content of calcium in the nurseries' lunches is alarming, because it is of special relevance regarding bone growth.

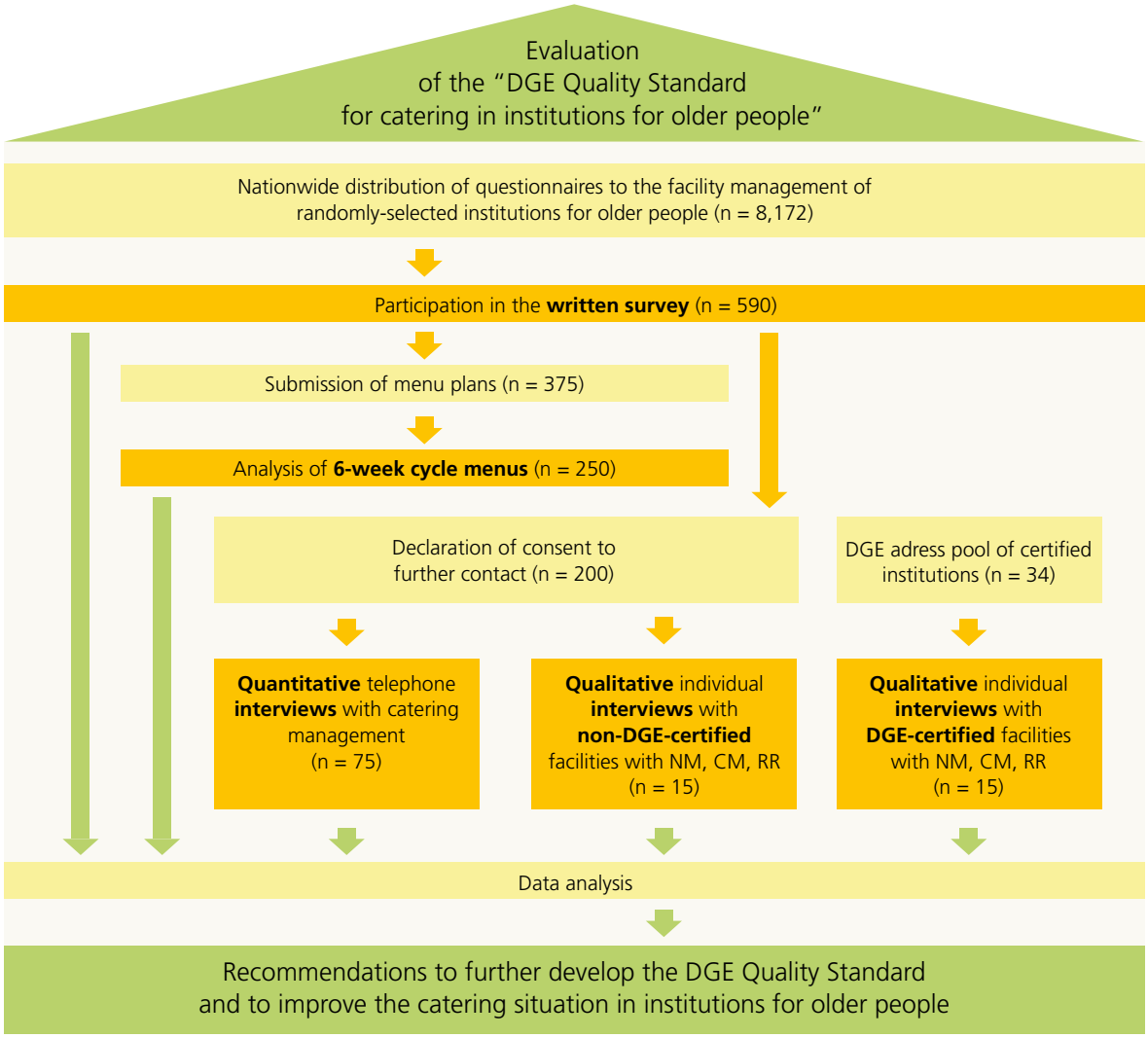
Recommendations for further improvement

Mandatory implementation of the DGE Quality Standard in all nurseries; transparent certification and audit processes; promotion of the importance of wholesome and health-promoting food from the very beginning; support of funders by providing relevant materials as well as training and further education programmes in the field of child nutrition, hygiene and labelling; setting up a central expert body for nutrition and catering within every funding body; training and qualification of educational staff with regard to nutrition and catering; promotion of cooperation between catering and domestic personnel and teachers or educators to encourage a continuous and in-depth education regarding nutrition through an appropriate range of training.

3 Evaluation of the "German Nutrition Society Quality Standard for catering in institutions for older people"

3.1 Methods

The "*DGE-Qualitätsstandard für die Verpflegung in stationären Senioreneinrichtungen*" (DGE Quality Standard for catering in institutions for older people) was evaluated in four sub-projects using the following survey instruments: (1) nationwide written survey, (2) analysis of menu plans, (3) telephone interview of persons responsible for catering, (4) qualitative personal interviews in institutions certified by the DGE as well as in non-certified institutions. The study collectives in sub-projects 2 to 4 were sub-samples of the written survey (sub-project 1), with the exception of certified facilities in the qualitative interviews. In all sub-projects, various characteristics of the institutions (funding body, facility accommodation concept, resident capacity, range of short term and day care offered) and the catering structures (kitchen operator, catering and food delivery system) of the respective study collective were recorded (Figure 6).



NM = nursing management, CM = catering management, RR = resident representation

Figure 6: Flow chart and survey instruments for the evaluation of the "DGE Quality Standard for catering in institutions for older people"

(1) Written survey

The AOK Scientific Institute (*Wissenschaftliches Institut der AOK)* in Berlin provided address data of 10,589 nursing homes, which corresponds to 97 % of all German institutions for older people offering full-time long-term care. The questionnaire (a total of 48 questions) was sent by post to a random sample of 5,000 institutions (1,000 in each of the five regions North, East, Central, and South Germany, and North Rhine-Westphalia); in addition, 3,172 institutions were invited by e-mail. Of the institutions contacted, 590 participated in the survey, corresponding to 7.2 % of the contacted institutions and 5.4 % of all institutions for older people in Germany offering full-time long-term care.

(2) Analysis of the menu plans

As part of the written survey, menu plans covering a period of six weeks were requested. When returning the questionnaire, 375 institutions submitted menu plans, of which 250 randomly selected menu plans were included in the evaluation. All of them covered a six-week period and were available in the form of a menu plan poster. To evaluate the menu plans (lunch only), the first step was to count the frequency of provision of the following food groups: cereal products/potatoes, vegetables, salad/raw vegetables, fruit, fish and meat, as well as breaded/deep fried food components. The next step was to check if the respective weekly frequencies meet the recommendations made in the "*DGE-Qualitätsstandard für Essen auf Rädern*" (DGE Quality Standard for meals on wheels) (since menu plans cover only lunch catering). Based on the criteria mentioned in the chapter "quality assurance in food planning and preparation" of the "DGE Quality Standard for catering in institutions for older people", aspects of food plan design were evaluated.

(3) Telephone survey

Of the 200 institutions, which agreed to further contact by telephone in the written survey, 75 randomly selected institutions (15 per region) were included in the standardized telephone survey. The interviews were conducted with the person responsible for catering in the institution (kitchen or housekeeping management), and lasted for 20 to 30 minutes. The questionnaire consisted of two parts: questions regarding catering structure and interface management as well as questions related to knowledge and possibly implementation of the DGE Quality Standard.

(4) Qualitative personal interviews

Personal interviews were conducted in 15 institutions that had been awarded the DGE-Certificate "Fit in Old Age" and 15 that had not been certified. The non-DGE-certified facilities were randomly chosen out of all institutions that had agreed to further contact in the written survey. The pool of DGE-certified facilities consisted of 34 long-term care institutions for older people, of which 12 were independently run and 22 belonged to four larger funders. In each institution, guided, qualitative interviews (45 minutes each) were separately conducted with nursing management, catering management and a residents' representative. Additionally, a standardised questionnaire about the structure of the institution was completed by each facility manager for the purpose of characterising the institution.

Evaluation

Descriptive statistics: Categorical variables were described as absolute and relative frequency, continuous variables as means (M), standard deviation (SD), median, and 25th (P25) and 75th percentiles (P75).

Inferential statistics: Differences in categorical variables were tested for significance using Pearson's chi-squared test and Fisher's exact test. Not normally distributed continuous variables were analysed using the Mann-Whitney-U-test. Participants with missing data were not taken into account. P values < 0.05 were considered as statistically significant.

Qualitative data analysis: All interviews were transcribed, analysed by the qualitative content analysis according to Mayring and the results were summarised.

3.2 Results

Institutions' characteristics

With the exception of the qualitative survey collective, more than 50 % of the funders of participating institutions were independent non-profit organisations (such as the German Red Cross [DRK], Caritas), approximately 40 % were privately run and only a small proportion publicly run (e.g. municipal). In the qualitative survey both, certified (80 %) and non-certified institutions (73.3 %), had a distinctly higher proportion of independent non-profit funding sources and a lower proportion of private funders (6.7 % and 20 % respectively) than the collectives in other parts of the study. Approximately half of the nursing homes surveyed had 51 to 100 full time long-term care places, about a quarter offered 101 to 200 places and fewer than 5 % of the homes had more than 200 full time long-term care places. Smaller facilities with no more than 50 places represented approximately one-sixth.

Catering structure in institutions for older people

The majority of the institutions ran their kitchen autonomously (53.3 % to 82.7 %). Depending on the study collective, funding body service companies were engaged in 13.3 % to 40 % of the institutions, while external caterers were engaged in less than 13.3 %. In the majority of institutions, warm meals were produced in form of mixed cuisine on site (approx. 80 %). Approximately one in ten homes received hot hold meals delivered. Around 5 % of the homes used chilled or frozen meals that are reheated on-site; among certified homes in the sample of the qualitative interview, this proportion was approximately 27 %. The written survey showed that a median food budget (net) of € 4.50 per day per resident (P25–P75: € 4.06–€ 5.00) was available in the institutions. However, 185 out of 590 institutions (31.4 %) provided no answer to this question.

Level of awareness regarding the DGE Quality Standard

More than two-thirds of participants in the written survey stated that they were aware of the DGE Quality Standard and most had it either fully or partly implemented. In the telephone interview, 60 % of the catering managers stated that they were familiar with the contents of the DGE Quality Standard. The written survey revealed that the DGE Quality Standard was more commonly known among independent non-profit institutions compared with privately run homes; there was no difference in comparison with publicly run institutions (79.8 % vs. 59.2 % vs. 74.1 %, $p < 0.001$). Facilities with more than 50 places were significantly more often aware of the DGE Quality Standard than institutions with no more than 50 places (73.8 % vs. 58.6 %, $p < 0.01$).

Acceptance of the DGE Quality Standard (helpful topics and reasons for non-implementation)

In the written survey, the majority (85.4 %) of institutions which stated that they were aware of the DGE Quality Standard (n = 403) regarded it as helpful, although 8.4 % provided no answer. Of eight predefined subject areas mentioned, the contents of the DGE Quality Standard were felt to be most helpful for menu planning (68.3 %), food choice (57.8 %) and malnutrition (54.9 %). Out of nine suggested reasons, why the DGE Quality Standard had not been implemented or had not completely been implemented, the most frequently selected were the lack of resident acceptance of whole grain products (69.8 %) and meat-free dishes (54.8 %), as well as the lack of suitability for resident needs (39.9 %).

Implementing individual aspects of the DGE Quality Standard

In the written survey, regarding the frequency of provision of certain food groups, almost all facilities – irrespective of their awareness of the DGE Quality Standard – fulfilled the criteria «unlimited supply of table or mineral water» (96.5 % vs. 96.4 %) and «dairy products at least twice a day» (96 % vs. 94 %). The least implemented recommendations were: «meat – a maximum of three times per week» (9.2 % vs. 7.2 %), «use of fish from sustainable fisheries always» (22.3 % vs. 15 %) and «vegetables at least three times a day» (35.2 % vs. 30.5 %). Compared to institutions not aware of the DGE Quality Standard, institutions that were aware of it more frequently fulfilled the recommendations regarding cereal products (80.1 % vs. 71.3 %, $p < 0.05$), whole grain products (82.6 % vs. 73.7 %, $p < 0.01$), fruit (88.8 % vs. 79.6 %, $p < 0.01$) and fish

(77.9 % vs. 65.9 %, $p < 0.01$). In addition, they used rapeseed oil as a standard oil more often (63.3 % vs. 44.9 %, $p < 0.001$). The evaluation of 6-week cycle menus showed no significant differences with regard to the frequency of provided food groups in lunch catering between institutions that were aware of the DGE Quality Standard and those that were not aware of it. Whilst the majority offered cereal products daily (74 %) and fish at least once a week (78.4 %), the recommendations for the daily supply of vegetables (23.6 %), salad or raw vegetables at least twice a week (25.2 %) and fruit three times per week (22.8 %) were rarely met by one out of four institutions. As recommended, meat or sausage for lunch was provided on a maximum of three times a week in 42.4 % of the facilities.

In the written survey more than three quarters of all institutions stated, regardless of their awareness of the DGE Quality Standard, that they have a menu cycle of at least six weeks (76.4 %) and in case of puréed foods, the components were served in an individually recognisable manner (82.7 %). Vegetarian food was available on request in significantly more institutions that were aware of the DGE Quality Standard than in institutions that were not aware of it (80.1 % vs. 64.7 %, $p < 0.001$). More old peoples' homes that were aware of the DGE Quality Standard responded positively to the question on the existence of a hygiene concept (HACCP) in their institution than those, which were unfamiliar with the standard (96 % vs. 86.8 %, $p < 0.001$). Almost all institutions, irrespective of their awareness of the DGE Quality Standard, stated that they implemented individual hygiene control measures. Only the retention of meal samples was implemented significantly more frequently in institutions familiar with the DGE Quality Standard (95 % vs. 88.6 %, $p < 0.05$). According to the written survey, institutions that were aware of the DGE Quality Standard had significantly more often written recipes (61.8 % vs. 47.9 %, $p < 0.01$) and explicit preparation instructions (53.3 % vs. 38.4 %, $p < 0.01$), for at least a majority of their meals, than homes unfamiliar with the standard.

Effects and benefits of implementing the DGE Quality Standard

To assess the effects of implementation, those institutions implementing the DGE Quality Standard were asked via telephone interview for changes in various aspects. For more than half of the respondents (54.8 %, n = 42) there had been changes in the frequency of use of certain food groups in menu planning. Most institutions noted increases in the frequency of provision of vegetables and salads (73.9 %), fruit (52.2 %), fish (47.8 %) and whole grain products (47.8 %), whilst the frequency of provision of meat fell in more than half of the homes (56.5 %). In addition, institutions often mentioned increases in meal options (45.2 %), cost of goods (40.5 %) and residents' satisfaction (31 %).

Dissemination and acceptance of the DGE certification "Fit in Old Age"

In the written survey, 1.9 % of institutions stated they were already certified and 0.5 % that they were in the certification process, while certification was planned in 7.5 % of the homes. Half (50.8 %) stated they were not pursuing certification and 39.3 % gave no answer to this question. In the telephone interview, 7 out of 42 respondents implementing the DGE Quality Standard stated they were pursuing "Fit in Old Age" certification, for which no concrete reasons were stated. Ten interviewees did not know whether their respective institution was pursuing certification.

Effects and benefits of the DGE certification

In the personal qualitative interviews of those responsible for catering, a larger choice of foods, such as more fruit and vegetables, more whole grain products and a greater choice of foods were the most frequently reported effects. In some individual institutions there were also changes regarding the serving system (buffet instead of tray system), changes in food preparation work processes (e.g. low-fat preparation in a combi steamer, homemade desserts). Individual homes registered an increase in residents' satisfaction. It was stated several times that increased food costs and increased time requirements in menu planning and food preparation were the consequences of the certification. Some respondents stated they had not perceived any internal effects because they had already fulfilled most of the requirements prior to certification (n = 4) or they no longer adhered to the requirements after the audit (n = 3).

Challenges in everyday work

In the personal qualitative interview, those responsible for catering referred to several challenges such as inadequate or missing space, insufficient staffing or inadequate staff qualifications (e.g. language barriers among employees, lack of time for higher level activities such as purchase orders or menu planning, failure to take care requirements of residents into account when allocating catering staff numbers), and less-than-ideal interface management (e.g. insufficient implementation of intended food presentation by nursing staff, failure to convey wishes and criticism). Additional challenges are ensuring residents' satisfaction (e.g. special challenges in residents with dementia, "Rest of Life" duration of stay, age differences among residents, unilateral resident wishes, discrepancy between the opinions of relatives and residents), low food budget (e.g. through lack of adjustment given rising food prices), lack of flexibility (e.g. in the case of deliveries from a central kitchen, low budget, lack of staff) and the implementation of legal requirements (e.g. HACCP concept, the new Food Information Regulation). From care managements' point of view, challenges overlapped in some aspects (e.g. staffing, interface management, residents' satisfaction) but did, however, contain additional aspects: Inclusion of residents (e.g. cooking with residents is challenging because of hygiene requirements, lack of equipment to facilitate cooking with the residents), ensuring adequate nutrition in special needs cases (e.g. cases of dementia, chewing or swallowing difficulties, malnutrition, and overweight), resident stays in hospital (residents often return with MRSA-germs, decubitus, exsiccosis or weight loss), negative public image of institutions for older people (e.g. reports exclusively about negative examples) and documentation (e.g. great time exposure for paperwork if residents refuse to eat and drink).

3.3 Evaluation

The DGE Quality Standard was known by a large part of participating institutions and has at least been implemented to some extent. The majority of the institutions assessed the topics of the DGE Quality Standard as relevant with regard to a catering standard. Differences in the implementation of the DGE Quality Standard, when comparing institutions aware of the standard with those not aware, were identified with regard to some specific criteria, although not all of criteria in the DGE Quality Standard were verifiable in the survey. For many facilities, the DGE Quality Standard represents a guideline. The DGE certification "Fit in Old Age" was rarely used at the time of the survey. About half of the respondents responsible for catering saw no benefit in future certification for their catering section. For many people responsible for catering and care services, "nutrition in case of special needs" (e.g. dementia, malnutrition) represents a challenge, which requires special support. In addition, there are great challenges regarding budgeting and staffing, which solution, however, requires changes at political level. Furthermore, it became apparent that potential for improvement exists regarding implementation of interface and hygiene management in the institutions. Recommendations to further develop the "DGE Quality Standard for catering in institutions for older people" can be derived from the survey (selection): The content of the DGE Quality Standard should be adapted to a bigger extent to the specific needs of the residents and the resulting needs of staff. Additionally, catering in case of special needs, which play an important role within the institutions, should be addressed in more detail in the DGE Quality Standard. Information on how to use foods appropriately in order to offer residents, who are diversely health impaired, a selection of varied, tasty and appealing dishes, which meet their special needs and are rich in nutrients, should be provided. To improve the clarity of the menu plans, more concrete recommendations are necessary regarding their layout as well as examples for implementing the criteria of the DGE Quality Standard (e.g. pictograms for the marking of animal species); information about concrete solutions for cross-professional collaborations (catering, housekeeping and care personnel, facility management, and funders) should be included. To increase the awareness of the DGE Quality Standard and the assistance provided by the DGE for the implementation of it as well as the "Fit in Old Age" certificate, it is necessary to step up public relations work and access new communication channels (e.g. online social networks) or co-operation partners (e.g. food wholesalers or the Health Insurance Medical Service [MDK]). In addition, the implementation of the DGE Quality Standard could be supported by the fact that its central contents are taken into account in mandatory MDK quality control checks or that future joint audits for the entire food supply be developed – from food offers through to nursing care.

4 Influence of food processing and meal preparation on food choice, nutrient intake, intake of food additives and body weight of children, adolescents and adults

4.1 Influence of dietary patterns with different percentages of processed foods on food choice, nutrient intake and intake of additives, as well as on body weight of children, adolescents and adults

4.1.1 Methods

The study is based on a secondary data analysis from dietary records from nationwide nutrition surveys that had been carried out earlier:

- Consumption survey of food intake among infants (6 months and older) and young children (VELS): 776 children, 1 to under 5 years old, 2 x 3-day dietary records
- German Health Interview and Examination Survey for Children and Adolescents, KiGGS-module (EsKiMo): 1,234 children 6 to under 12 years old, 3-day dietary records
- National Nutrition Survey II (NVS II): 975 participants, 14 to 80 years old, 2 x 4-day dietary records

A database-supported classification of all individually recorded foods based on the degree of processing was performed using a new developed categorisation system. On the basis of this process participants were assigned to one of five dietary pattern groups (EM1–EM5). These dietary pattern groups were named as: "diet with highest proportion of fresh foods", "diet with mostly fresh foods", "diet with an equal mixture of fresh and processed foods", "diet with mostly highly processed foods", "diet with highest proportion of highly processed foods" (Table 5).

Table 5: Definitions of the dietary patterns

Dietary pattern	Designation
EM1	diet with highest proportion of *fresh* foods
EM2	diet with mostly *fresh* foods
EM3	diet with an equal mixture of *fresh and processed* foods
EM4	diet with mostly *highly processed* foods
EM5	diet with highest proportion of *highly processed* foods

Data analysis

The energy intake and nutrient intake were calculated based on the German Nutrient Database (BLS 3.02). Brand names with exact product descriptions of industrially produced foods (such as infant and toddler food, ready-made meals) were listed in the underlying dietary records, which guaranteed a confident measurement of nutrient intake and intake of food additives. In addition, information was given if meals were self-prepared and if meals were consumed at home or off-side the home. When dishes were prepared based on recipes, the individual ingredients used were recorded.

Normal distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Other statistical procedures and parameters were selected according to frequency distribution. For normally distributed data, single factor analyses of variance were performed. T-test for mean comparisons was performed for two independent random samples. Categorical variables were tested for dependency using the chi-squared test; the Kruskal-Wallis test was performed for non-normally distributed data. Partial correlations were performed according to Spearman and Kendall. A multiple linear regression was performed to test the variable body weight or body mass index (BMI) respectively. The significance level was set at $p \leq 0.05$.

For the classification of foods according to their degree of processing and their intended purpose, a confident categorisation system was designed containing 17 different categories (including sub-categories): 1 to 4 fresh foods, 5 to 7 processed foods and alcoholic beverages, 8 to 17 foods in which the starting products are no longer identifiable after processing and which contain various additives (including added preservatives and vitamins).

4.1.2 Results

Composition of the survey collectives

VELS and EsKiMo: Data were collected from a total of 2,010 infants and young children. The study collective consisted of 1,023 boys and 987 girls with a mean age of 6 years (minimum 1 year old, maximum 11 years old). 75.9 % of the children were of normal weight, 13.2 % were underweight and the remaining children were categorised as overweight or obese (10.9 %).

NVS II: Weighed dietary records were available for data analysis from a total of 975 participants. The survey collective consisted of 412 male and 563 female participants with an average age of 47 (14–80 years). Data on body weight and body height were available for 949 test subjects. 42.6 % of the study participants were of normal weight, 1.7 % were underweight and 55.7 % were overweight or obese.

Determination of dietary patterns

Participants (VELS/EsKiMo and NVS II) were categorized into five equally strong groups (quintiles), each with different dietary patterns according to the degree of processing (EM1–EM5). For NVS II, oldest participants were found in EM1 (diet with highest proportion of fresh foods) on average, whilst youngest participants were found in the group "diet with highest proportion of highly processed foods" (EM5) on average ($p \leq 0.05$). The highest percentage of women and the lowest percentage of men was in EM1. With increasing degree of food processing (EM1 to EM5) the percentage of women dropped whilst that of men increased in each group. The proportions of male and female subjects were roughly equal in the EM4 and EM5.

Food intake

Children and adolescents who consumed large amounts of high processed foods consumed more meat products and sausages than children and adolescents who had a high proportion of fresh foods in their diet (EM1: 32 g vs. EM4: 51 g, $p \leq 0.05$). Likewise, the quantities of confectionery intake increased together with a rising proportion of processed foods (EM1: 31 g vs. EM4: 55 g, $p \leq 0.05$). Children in EM1 in comparison with children from other groups (EM2–EM4) consumed the greatest amounts of vegetables, fruits, milk, fruit

juices and nectar fruit drinks ($p \leq 0.05$). Especially regarding soft drinks, large differences in the intake were identified. Children in EM4 consumed twice the amount of soft drinks (i.e. 154 g/day) compared to children in EM1 (73 g/day, $p \leq 0.05$). Examining the dietary patterns of participants of NVS II, an increase in meat intake and sausage products was noted along with an increase in the degree of food processing ($p \leq 0.05$). On average, men in EM5 consumed 107 g/day of meat and sausage products. The highest intake of confectionery was found among participants in EM5 with significant differences for women but not for men (women 42 g/day, $p \leq 0.05$, men 40 g/day [n.s.]). Regarding high energy drinks, intake of soft drinks dominated in EM5, as well as beer among men ($p \leq 0.05$). Men in EM5 drank 282 g and 341 g of soft drinks and beer per day on average, respectively. Women in EM5 consumed 206 g of soft drinks per day on average.

Energy intake and nutrient intake

There was a statistically significant increase in dietary energy density of 14 % between EM1 and EM4 for children and adolescents (VELS, EsKiMo) (0.85 kcal/g vs. 0.97 kcal/g). Among men in NVS II, energy density increased with an increasing intake of highly processed foods in the overall diet by 8.7 % from 0.69 kcal/g to 0.75 kcal/g, whilst the increase among women was even higher: 16.1 % from 0.56 kcal/g to 0.65 kcal/g ($p \leq 0.05$). In VELS and EsKiMo protein nutrient density declined as the proportion of processed food increased by -8.6 % (EM1: 35 g/1,000 kcal, EM4: 32 g/1,000 kcal, $p \leq 0.05$). For the participants of NVS II, protein nutrient density fell across the groups from EM1 to EM5. The difference in the overall collective was -2.9 % ($p \leq 0.05$). No clear trends could be found with regard to carbohydrate intake and fat intake either among children (VELS, EsKiMo) or among the participants of NVS II. There was a significant increase in median nutrient density for sodium with decreasing proportions of fresh foods or increasing proportions of highly processed foods among children and adolescents between groups EM1 and EM4 by 17.3 % (1,008 mg vs. 1,182 mg/1,000 kcal/day, $p \leq 0.05$). Among the participants of NVS II, sodium nutrient density also rose from EM1 to EM5 (EM1: 1,334 mg/1,000 kcal/day vs. EM4: 1,404 mg/1,000 kcal/day and EM5: 1,402 mg/1,000 kcal/day, $p \leq 0.05$). The significantly highest nutrient density for calcium in children and adolescents in VELS and EsKiMo surveys was found in the dietary pattern with the highest proportion of fresh foods (EM1: 490 mg/1,000 kcal/day). In the overall collective, participants in group EM1 of NVS II also showed the significantly highest calcium nutrient density (433 mg/1,000 kcal/day). The intake levels of thiamine (vitamin B_1), vitamin B_{12} and vitamin C in children and adolescents (VELS, EsKiMo), were above the D-A-CH reference values in almost all groups (EM1–EM4). However, a lower nutrient density was observed for vitamin B_{12} and vitamin C with increasing proportions of highly processed food. For folate, only those test subjects in EM1 and EM2 achieved the D-A-CH reference value on average. The analysis of nutrient density for vitamins in the diet of the participants in NVS II showed significant differences between the different nutrition patterns with regard to folate and vitamin C. Men and women in the dietary pattern with the highest proportions of highly processed food were on average not able to reach the vitamin C reference values. In all dietary pattern groups, the participants in NVS II did not reach the reference values for folate and calcium. The intake of thiamine (vitamin B_1) was above the D-A-CH reference values in all dietary pattern groups.

Intake of food additives (flavour enhancers, preservatives, colourings, and sweeteners)

With increasing proportion of processed or highly processed food (VELS, EsKiMo) the number of food additives consumed per 1,000 kcal of food (= qualitative intake of food additives) increased from 2.7/1,000 kcal in group EM1 to 4.9/1,000 kcal in EM4 ($p \leq 0.05$). EM5 proved to be an exception. This is possibly due to the high proportion of complementary foods and instant formula products. Particularly strict legal regulations regarding to composition and the use of food additives apply to these products.

Body weight

In the VELS and the EsKiMo survey, the prevalence of overweight or obesity in children in the dietary pattern groups with the highest proportions of highly processed foods compared to those with the highest proportion of fresh foods was significantly higher (EM1: 9.2 % vs. EM4: 10.9 % and EM5: 13.4 %, $p \leq 0.05$) (Figure 7). The NVS II showed that BMI increased significantly with age ($p \leq 0.05$); at the same time the proportion of highly processed foods was also seen to have a significant influence ($p \leq 0.05$) on BMI. This was particularly seen in the age group of 65 years and older. A decline in the number of normal weighed persons and an increase in the number of overweighed or obese persons was seen with increasing proportions of highly processed foods.

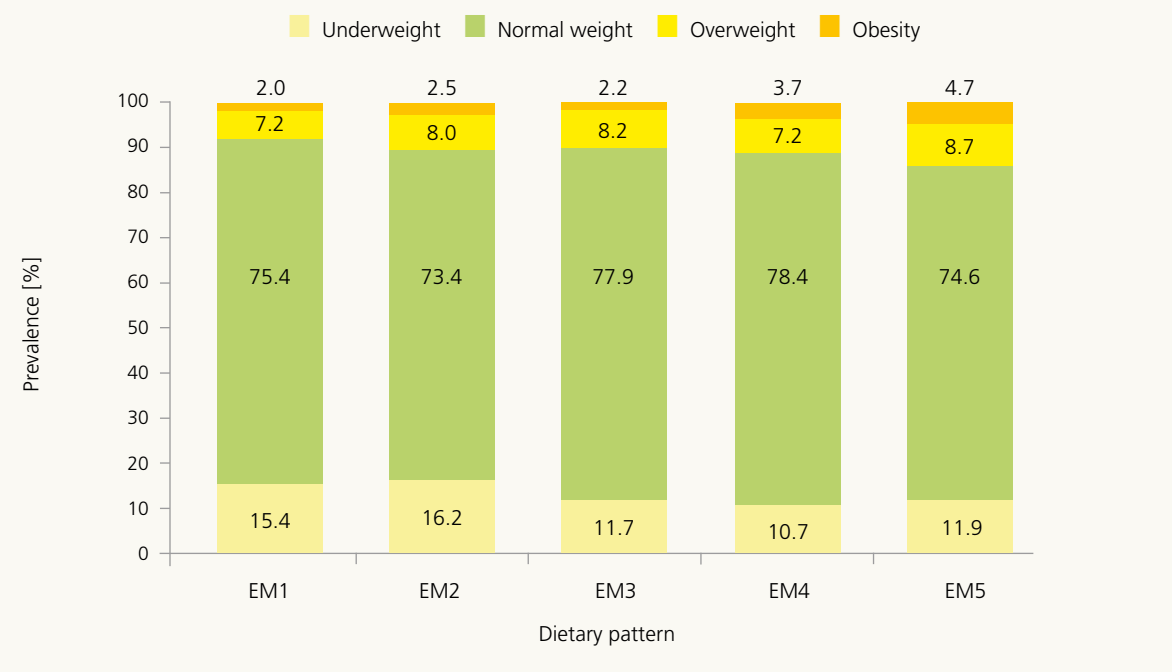


Figure 7: Prevalence of overweight and obesity (VELS, EsKiMo; n = 2,010)

4.1.3 Evaluation

Until now, it was not possible to determine the potential role of the influence factor "degree of processing" in nutrition surveys based on the German Nutrient Database (BLS) and traditional food and nutrition tables because of missing definitions. For the first time, the new developed categorisation system sorts all foods according to the degree to which they have been processed and according to the purpose of processing for the first time. Although there is a large range especially in high processed foods, foods can be classified and used as part of further evaluation for the purpose of defining dietary patterns. With this method it is possible to evaluate intake data available from nutrition surveys to a greater extent and draw conclusions with regard to different target parameters. Influences of the proportions of fresh foods and highly processed foods on energy intake, nutrient intake, body weight, and intake of food additives are apparent in the present evaluation.

4.2 Cooking frequency in relation to food intake by adults in Germany

4.2.1 Methods

Data from the German Health Interview and Examination Survey for Adults (DEGS1; November 2008 to December 2011) were used to evaluate a relation between cooking frequency and gender, age, education, household composition, employment, and food intake. 8,152 people (4,283 women and 3,869 men) aged 18 and older participated in this representative survey. Data collection was performed by computer assisted physician interviews (CAPI), physical examinations and participant-completed questionnaires. One of these questionnaires included questions on food intake, including frequency of preparation of hot meals from basic ingredients/fresh foods. A total of 6,956 data sets from participants with evaluable details regarding cooking frequency were available for statistical analysis. The part of the questionnaire regarding cooking frequency included questions such as: "How often a week do you prepare a hot meal (lunch or dinner) using basic ingredients/fresh foods yourself?" The available answers were: "daily", "5 to 6 times a week", "3 to 4 times a week", "1 to 2 times a week" and "never". The five categories have been combined into three for clearer statistical analysis: "daily" and "5 to 6 times a week" were combined to "almost daily". "3 to 4 times a week" and "1 to 2 times a week" were combined to "1 to 4 times a week" and "never" was kept as an expression. Food intake was measured over a retrospective period of four weeks using a food intake frequency questionnaire covering 53 food groups. Details on food intake frequency were requested via 11 possible responses, ranging from "never" to "3 to 4 times a week" to "more than 5 times a day". The intake levels were calculated using serving sizes ("½ portion", "1 portion", "2 portions","3 portions" and "4 portions [or more]").

Data analysis

Data on the level of education were categorised using the CASMIN index (Comparative Analysis of Social Mobility in Industrial Nations). Employment status at the time of the survey was summarised in four categories "full-time or in education/training", "part time or minor employment", "not working or in marginal employment" and "retired". Regarding to the household composition the different options to answer were single person households, multiple person households and presence of children and adolescents in the household. To identify possible correlations between cooking frequency and sociodemographic factors, percentages and their 95 % confidence intervals of cooking behaviour were calculated according to certain categories. It was assumed that significant differences existed if the 95 % confidence intervals did not overlap. To verify the statistical significance of group differences in cases of slight confidence interval overlap, corrected chi-squared tests for independence were performed according to Rao-Scott. To analyse the relationship between the cooking frequency and food intake, the mean values of quantities consumed and their 95 % confidence intervals were calculated in multiple linear regression models. Analyses were performed separately for men and women and adjusted to age. The participants who never cooked were defined as reference group. The intake details were not normally distributed, therefore the data were transformed by means of logarithmic function. The logarithm values were used to statistically test the significance of the group differences. The statistical significance level was set at $p \leq 0.05$. To optimise the representativeness of the analyses in the sample investigated, all evaluations were weighted. This was intended to correct any deviations of the sample from the population structure (as of 31 December 2010) in terms of gender, age, region, nationality, type of municipality and education.

4.2.2 Results

The gender distribution was balanced (50.6 % women); the group containing 45 to 64 year olds was the largest with 36.7 %. Almost half of the participants (49 %) belonged to the intermediate education group, 36.5 % to the basic education group and 14.6 % to the higher education group. Overall, 61.4 % of women prepared their meals on an almost daily basis, 35.6 % of the participants cooked 1 to 4 times a week and

2.9 % of the participants never cooked. Those in the 65 to 79-year-old age group cooked twice as often on an almost daily basis with 81.9 % than the youngest age group with 39.9 %. The largest group of women, who never cooked (7.1 %) was found in the 18 to 29 year age group. Only 40.2 % of men prepared meals themselves almost daily, 43.7 % cooked 1 to 4 times a week, and 16.1 % never cooked. 65 to 79-year-olds cooked significantly more frequently on an almost daily basis (60.6 %) than younger age groups. However, even 17.1 % of 65 to 79-year-old men never cooked. The lowest percentage of those who cooked on a daily basis were young men aged between 18 and 29 with 31 % (Table 6).

Table 6: Percentage cooking frequency by sex and age groups

	age groups				
	18–29 years % (95 % CI)	**30–44 years % (95 % CI)**	**45–64 years % (95 % CI)**	**65–79 years % (95 % CI)**	**Total % (95 % CI)**
Women	**(n = 535)**	**(n = 743)**	**(n = 1,455)**	**(n = 903)**	**(n = 3,636)**
almost daily	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 to 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)**
almost daily	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 to 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)

n = number (unweighted), CI = confidence interval

Determinants of cooking frequency

Neither level of education nor net household income had a significant influence on cooking frequency. Among women living in single households, 46.6 % cooked almost every day themselves. This means that they cooked significantly less often than women living together with others (63.4 % without children and 67.8 % with children, $p \leq 0.05$). They stated more frequently than women in multi-person households that they prepared their own meals 1 to 4 times a week (48.5 %), or never (4.9 %). Men in single person households prepared meals themselves on an almost daily basis to a significantly lesser extent at 23.5 % than men in multi-person households. Women and men, who were not working or in marginal employment, cooked almost every day more often. Women who were employed full time, reported significantly more often that they never cooked with 4.9 % (CI 3.4–7.0) than female pensioners with 1.2 % (CI 0.5–2.6). Men, who are not working or in marginal employment also cooked significantly more often on an almost daily basis with 44.4 % (CI 39.2–49.8) along with pensioners with 62.3 % (CI 56.5–67.7) than those in full time employment (33.3 %, CI 30.2–36.5).

Impact on food intake

This evaluation showed a significant relationship between cooking frequency and the intake of certain food groups. Women, who cooked almost on a daily basis, had a significantly higher intake of food overall (g/day) as well as of vegetables, fruit, filling side dishes, non-alcoholic and/or non-sweetened beverages than women who never prepared meals themselves. Men who cooked almost every day, had the highest total food intake and ate significantly more vegetables, fruit, meat, dairy products, filling side dishes, non-alcoholic or non-sweetened beverages and fast food than men who never cooked themselves. Conversely, sweets and sweetened beverages were consumed by men who never cooked themselves to a bigger extent than by men who cooked on an almost daily basis (Table 7).

Table 7: Mean food intake by cooking frequency and sex, adjusted for age (minimum – maximum)

Food intake (g/day resp. ml/day)	Women			Men		
	almost daily	1 to 4 times a week	never (ref.)	almost daily	1 to 4 times a week	never (ref.)
Total number[a]	1,100.0* (1,068.5–1,131.5)	952.9 (916.7–989.1)	962.7 (826.3–1,099.1)	1,145.1* (1,103.3–1,186.8)	1,008.7 (977.1–1,040.3)	1,059.5 (1009.9–1109.0)
Fast Food[b]	36.8* (34.3–39.2)	36.7* (33.5–39.8)	51.9 (37.2–66.6)	75.4* (56.5–94.4)	73.4 (63.4–83.5)	71.1 (64.6–77.5)
Vegetables[c]	181.1*** (172.3–189.9)	122.3** (113.6–131.1)	87.4 (64.2–110.7)	136.6*** (129.0–144.2)	95.8 (89.6–102.0)	100.9 (91.1–110.7)
Fruits[d]	276.4*** (256.3–296.6)	245.5** (217.7–273.4)	192.8 (118.4–267.3)	201.5* (186.1–217.0)	170.3 (157.0–183.5)	177.1 (154.5–199.7)
Meat[e]	55.9 (53.4–58.3)	44.0 (40.6–47.4)	58.7 (41.2–76.3)	86.4** (78.9–93.9)	66.3 (62.0–70.7)	69.0 (62.0–76.1)
Sweets[f]	64.9 (60.8–69.1)	65.0 (60.2–69.8)	71.1 (53.3–88.9)	67.3** (62.6–72.0)	73.0* (64.2–81.7)	91.8 (77.6–106.0)
Snacks[g]	3.4 (2.8–3.9)	3.0 (2.4–3.5)	33.3 (-22–88.5)	3.9 (3.2–4.5)	4.1 (3.3–5.0)	6.2 (2.9–9.5)
Bread[h]	136.7 (130.6–142.9)	136.2 (127.4–144.9)	143.4 (114.5–172.4)	179.7 (170.6–188.8)	184.8 (171.2–198.5)	186.6 (169.2–204.1)
Dairy products[i]	378.3 (354.7–402.0)	391.1 (355.8–426.5)	354.0 (260.2–447.8)	411.1*** (369.0–453.1)	379.6** (348.2–411.1)	336.7 (291.9–381.5)
Cereals[j]	2.6 (2.3–2.9)	2.4 (2.0–2.8)	1.8 (0.5–3.1)	3.2 (2.7–3.8)	2.8 (2.3–3.3)	3.6 (1.9–5.3)
Filling side dishes[k]	124.8*** (120.2–129.5)	99.3 (94.5–104.1)	121.8 (84.0–159.5)	154.0*** (144.7–163.4)	121.1 (114.6–127.5)	133.2 (123.2–143.2)
Sweet spreads[l]	10.9 (10.2–11.5)	9.5 (8.7–10.2)	9.6 (7.5–11.8)	12.3 (10.8–13.8)	10.9 (9.0–12.8)	11.5 (10.1–12.8)
Meat products[m]	22.4 (20.2–24.5)	22.5 (20.4–24.6)	37.6 (6.9–68.3)	38.4 (35.8–41.0)	41.2 (38.1–44.2)	43.8 (37.1–50.6)
Fish[n]	18.1 (16.6–19.7)	15.1 (13.7–16.5)	15.2 (8.7–21.7)	20.5 (15.0–25.9)	18.0 (16.3–19.7)	17.7 (15.4–20.0)
Eggs	14.5 (13.5–15.5)	13.7 (12.7–14.7)	14.0 (6.2–21.7)	20.9 (18.6–23.2)	18.9 (17.2–20.7)	18.5 (15.3–21.8)
Fat spreads[o]	8.3* (7.8–8.8)	8.7* (7.9–9.4)	9.9 (7.9–11.8)	10.9 (10.1–11.8)	11.7 (10.7–12.6)	11.1 (9.6–12.5)
Nuts	2.3 (2.0–2.6)	1.8 (1.6–2.0)	1.8 (1.1–2.6)	2.0 (1.6–2.4)	2.1 (1.8–2.4)	2.1 (1.6–2.6)
Sweetened beverages[p]	361.4 (319.1–403.8)	369.7 (298.8–440.6)	624.2 (225.8–1,022.5)	510.7* (443.3–578.1)	574.1 (500.1–648.1)	625.5 (515.3–735.7)
Alcoholic beverages[q]	308.5 (242.3–374.7)	258.0 (229.8–287.5)	236.3 (203.6–269.0)	65.3 (57.7–72.8)	72.3 (60.9–83.7)	88.9 (56.0–121.9)
Non-alcoholic / non-sweetened beverages[r]	2,893.7* (2,784.0–3,003.4)	2,804.4 (2,668.9–2,939.9)	2,494.9 (2,089.3–2,900.5)	2,481.9* (2,350.5–2,613.2)	2,291.6 (2,183.1–2,400.2)	2,138.8 (1,963.9–2,313.7)

Multiple linear regression analysis adjusted for age. T-Test: logarithmized values statistically significant with * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$: significant versus reference group (ref.) = persons who never cook

a Foods without beverages
b Fast Food: bratwurst or currywurst, hamburger or kebab, pizza, French fries
c Vegetables: raw vegetables, cooked vegetables, legumes
d Fruits: fresh fruits, cooked fruits
e Meat: poultry, meat (excluding poultry and sausage)
f Sweets: cake, pie or pastries, cookies, chocolate or chocolate bars, sweets
g Snacks: potato chips, savory snacks, crackers
h Bread: whole grain bread or whole grain buns/rolls, brown bread or mixed-type bread, white bread or wheat buns/rolls
i Dairy products: cheese (soft, semi-hard, hard cheese), cream cheese, curd, yoghurt or soured milk, milk
j Cereals: cornflakes, cereal
k Filling side dishes: rice, pasta, fried potatoes, cooked potatoes
l Sweet spreads: honey or jam, nut nougat spread
m Meat products: ham, sausage, cold cuts
n Fish: cold fish, warm fish
o Fat spreads: butter or margarine
p Sweetened beverages: sugar sweetened beverages, fruit juice
q Alcoholic beverages: beer, cocktails, wine, sparkling wine, cider, liquor
r Non-alcoholic / non-sweetened beverages: calorie-reduced beverages, black or green tea, fruit or herb tea, water, vegetable juice, non-alcoholic beer

4.2.3 Evaluation

The present analysis confirms earlier findings regarding the question whether groups of people still frequently cook for themselves. Generally, women cooked much more frequently on an almost daily basis compared to men of the same age. Older age and low level employment were also associated with an increased cooking frequency. The majority of those in employment have less time to cook during the day and consequently this group is turning more and more to "dining out" solutions. It was also already known that women, who live together with children and/or adolescents in the same household, tend to cook more often on an almost daily basis than women living in multi-person households without children or adolescents. As expected, cooking frequency is associated with the food intake, frequency of particular foods and food groups. Whether this ultimately has medium or long-term effects on health, cannot be answered yet.

5 Evidence-based analysis on the influence of nutrition in the prevention of cancer, type 2 diabetes mellitus and cardiovascular diseases

5.1 Methods

The systematic literature analysis and the subsequent determination of the strength of evidence for a causal relationship between the risk of chronic degenerative diseases and choice of food followed the approach applied in the German Nutrition Society (DGE) guidelines regarding the prevention of nutrition-related diseases. From the DGE Nutrition Circle the following food groups and foods were included in this evaluation: cereals, cereal products, potatoes; vegetables, salad; fruits; milk and dairy products; meat, sausage, fish, and eggs. Legumes, nuts/almonds and (dark) chocolate were also taken into account in the literature analysis as additional independent food groups. Subgroups were defined for each of the food groups to be evaluated, taking into account assumed health aspects. A criterion for this was the occurrence of a characteristic combination of ingredients in food, for which preventive effects are being discussed. The analysis regarded those nutrition-related diseases which are among the most important causes of death from a quantitative point of view in Germany such as cancer, cardiovascular events, and also type 2 diabetes mellitus as most important metabolic disorder. Regarding cancer, those types of cancer already considered as part of the Nutrition Report 2012 were selected. These included carcinomas in the organs/regions of the mouth/throat/larynx, oesophagus, stomach, colon, rectum, lung, breast, ovary, endometrium, cervix, prostate, bladder, kidney, pancreas, liver, gall bladder, and skin.

The systematic literature search was carried out in March 2014 in PubMed; a further search was carried out in September 2015. Initially the terms "dietary intake or food intake", the study design "intervention or cohort study" and the aforementioned diseases were used as search parameters. The search aimed to capture all prospective studies reporting about the association between food intake and food groups and risk of selected diseases. They were then transferred into an own database for further research and analysis. In total over 34,000 citations were captured by the search. This step made it possible to create a well-defined, non-modifiable, permanently available database (for this purpose the freely available database software designed for text analysis "Textpresso" [www.textpresso.org] was chosen). The database also included a specially-designed, hierarchical ontology for terms to be searched in the database. Due to the large number of prospective studies reporting on the association between food intake and risk of the selected diseases the current research project was limited to meta-analyses. The assessment of the strength of evidence (convincing, probable, possible, insufficient), and classification of the relevant literature into levels of evidence was carried out analogous to the procedure described in the DGE guidelines. Intervention studies involving foods represented the minority when compared with intervention studies involving changes in nutrient composition. Therefore, intervention studies were only occasionally included in the assessment of the strength of evidence of food-disease relationships. Most of the results of meta-analyses were thus based on prospective cohort studies.

5.2 Results

Food intake and all-cause mortality

In total, 12 meta-analyses were found that investigated the relation between individual food groups and all-cause mortality. Meta-analyses on the intake of red meat and processed meat showed a positive or no association with all-cause mortality. An increased intake of vegetables and fruits, fish and nuts, however, was inversely associated with all-cause mortality. None of the meta-analyses on the intake of milk and dairy products observed an effect on all-cause mortality.

Food intake and selected nutrition-related diseases

Cereals, cereal products and potatoes form the largest group in terms of volume in the DGE Nutrition Circle. Most meta-analyses with regard to this food group focussed on the intake of cereal products. In the majority of the studies, an increased intake of whole grain products was associated with reduced risk particularly of type 2 diabetes mellitus and cardiovascular diseases. Several times, in the meta-analyses on cereal products there had been reports of increased risk of type 2 diabetes mellitus and lung cancer with an increase in rice intake.

Fruit, vegetables and salad essentially constitute plant-based foods with a comparatively low energy density (< 1–1.5 kcal/g) and a high nutrient density. The meta-analyses on vegetable intake in general, showed significant inverse risk relationships for a number of different types of cancer. Striking, however, is the fact that study results for individual subgroups of vegetables often showed no risk relationships. The exception is stomach cancer, where vegetable intake in general was not inversely associated with disease risk, but only the relationship with vegetables of the genus *Allium* (garlic, onions, leeks, shallots etc.). The results on vegetable intake in relation to risk of type 2 diabetes mellitus is worth highlighting, where until now, eating vegetables had not been associated with disease risk. The meta-analyses revealed that eating cabbages and other cruciferous vegetables in particular, has an inverse relationship with risk of type 2 diabetes mellitus. In total, vegetable intake had been generally inversely associated with risk of cardiovascular diseases. The number of meta-analyses regarding vegetable subgroups was too low, however, to allow any evidence-based statements.

In all meta-analyses concerning fruit intake, there was a significant reduced risk of cardiovascular diseases. This applies to both endpoints – coronary heart disease and stroke. In the case of stroke, it was also shown that the risk associations also apply with regard to the food subgroups of "apples" and "citrus fruits". With regard to cancer, there were no indications that specific fruit subgroups effect disease risk (apart from the lower risk of developing bladder cancer with increased intake of citrus fruit). Only fruit intake in general was inversely associated with risk for various types of cancer. More recent meta-analyses (from 2014) indicated for the first time an inverse relationship between fruit intake and the development of type 2 diabetes mellitus, while previous meta-analyses had failed to observe any association.

The results of meta-analyses regarding the intake of milk and dairy products showed contradictory risk relations with regard to cancer. While inverse associations were observed for the risk of colorectal cancer as well as breast cancer and more recently also stomach cancer, positive associations were observed for prostate cancer risk. The meta-analyses regarding milk (non-fermented, considered individually) showed the same risk relations as those to milk and dairy products (considered as a whole) for both colorectal and prostate cancer. Thus, it can be hypothesized that the mechanism of action is related to the milk itself and does not refer to food technological processes (e.g. fermentation). An inverse relationship with the intake of fermented dairy products was observed in type 2 diabetes mellitus, which agreed with the findings of most meta-analyses regarding the intake of milk and dairy products. For cheese intake there was an inverse association for the risk of stroke and a positive association for prostate cancer risk.

More meta-analyses on the intake of individual meats and meat products were available than for meat intake in general. Red meat (pork, beef, lamb) and processed meat often having the same source of meat were considered as risk-affecting for cancer and as a consequence were evaluated together in several meta-analyses. Also the intake of white meat (poultry) was included in some of the meta-analyses concerning meat. Basically, the intake of red and processed meat was rather positively associated with cancer, especially colon and colorectal cancer. The risk relations regarding the intake of red meat and processed meat and risk of type 2 diabetes mellitus were also positive as well as for stroke. In the case of coronary heart disease the results of the meta-analyses were inconclusive due to the differing results, therefore it is questionable whether risk increases with the intake of red meat. The results of the meta-analyses regarding white meat clearly showed that the intake of this food subgroup is not associated with cancer risk. Liver cancer, which occurs rarely, was even inversely associated with the intake of white meat. There were no meta-analyses available for the assessment of the risk relationship between white meat intake and non-cancer diseases.

The results of the meta-analyses concerning the association between fish intake and risk of coronary heart disease and stroke were consistent: the disease risk decreased with increasing fish intake. There were insufficient indications from meta-analyses as to whether fish should be of the oily or non-oily variety. Fish intake had no effect on the risk of developing type 2 diabetes mellitus. The meta-analyses on cancer were inconsistent. The majority of meta-analyses showed no risk relationships. This also applies with regard to individual cancer sites.

The meta-analyses on egg intake showed no consistently occurring risk relationships except with regard to type 2 diabetes mellitus. Egg intake was associated with increased risk of type 2 diabetes mellitus.

Concerning the association between soy intake and cancer risk, no meta-analyses were available which would allow for a clear assessment. Soy intake was associated with a reduced risk or had no influence on cancer risk.

With regard to legumes in general, there were two meta-analyses on type 2 diabetes mellitus, cardiovascular diseases and stroke. Study results indicated a risk reduction in relation to coronary heart disease via the intake of legumes, but not in relation to type 2 diabetes mellitus or stroke.

The meta-analyses regarding nuts and almonds were primarily directed to metabolic and vascular diseases. The majority of the results of the meta-analyses showed no risk relationships for type 2 diabetes mellitus. In the case of cardiovascular diseases, a significant inverse risk relationship was revealed in relation to the intake of nuts and almonds. The results of meta-analyses for the endpoint stroke showed both, a significant reduction as well as no association at all and therefore allow no definite statement regarding this disease.

Meta-analyses with regard to chocolate intake were limited to the risk of cardiovascular diseases. The vast majority of the meta-analyses showed a risk reduction of coronary heart disease and stroke with increasing chocolate intake. There were no meta-analyses, which focused on the cocoa content of chocolate, therefore only general statements could be made regarding chocolate intake.

Strength of evidence of a causal relationship

The meta-analyses formed the basis for deriving the strength of evidence of a relationship between food intake and chronic disease risk. The respective strength of evidence were derived based on the methodology of the previous DGE guidelines. With regard to whole grain intake, probable evidence of an inverse relationship was established for cancer and cardiovascular diseases along with convincing evidence for type 2 diabetes mellitus. Increased vegetable intake reduces the risk of type 2 diabetes mellitus with probable evidence. This particularly applies to the group of cruciferous vegetables (cabbage etc.). There is probable evidence for an inverse association between vegetable intake and cardiovascular diseases or stroke. With probable evidence fruit intake reduces the risk for almost all chronic diseases and with possible evidence reduces the risk for type 2 diabetes mellitus. The results of the meta-analyses regarding the intake of milk and dairy products showed

for both the group as total and for fermented dairy products, probable evidence of a risk reduction for type 2 diabetes mellitus and possible evidence for a risk reduction in cardiovascular diseases.

The probable evidence for an inverse association for stroke regarding cheese intake is surprising; this was not observed with regard to coronary heart disease. In contrast to the International Agency for Research on Cancer (IARC), in this paper the strength of evidence for a causal association between the intake of meat products and cancer risk has been assessed as probable and not as convincing, due to the mechanisms still being unclear. The intake of white meat was not associated with cancer risk. There is probable evidence that fish intake is associated with reduced risk of cardiovascular diseases. Therefore, recommendations for this food subgroup are sensible, although neither cancer nor type 2 diabetes mellitus appear to be associated with fish intake. With regard to egg intake, the increase in risk of type 2 diabetes mellitus – with strength of evidence evaluated as probable – is striking, particularly since no risk relationships have been observed with regard to other diseases. The results of the meta-analyses for legumes/soy showed only possible evidence of risk reduction for the diseases investigated here (in particular for cancer and cardiovascular diseases) with increased intake of this food group.

There is predominantly possible evidence that the intake of nuts and almonds is negatively associated with chronic diseases risk. With probable evidence, the intake of this food group is associated with reduced risk for coronary heart disease. The assessment showed probable evidence for an inverse association between chocolate intake and risk of cardiovascular disease. To date, no other meta-analyses on chocolate were available with regard to other diseases (Table 8).

A potential disease-preventive effect could be assigned to some of the food groups in the DGE Nutrition Circle (such as vegetables and fruit) or clarified for others. For example, it was possible to establish in the food group "milk and dairy products", that a portion of fermented dairy products (approx. 150 g/day) as part of a daily menu plan can contribute to the prevention of type 2 diabetes mellitus. Furthermore, it would be conducive to include both "nuts and almonds" and "dark chocolate" as independent food groups in food-based dietary recommendations since there are probable preventive effects that help maintain cardiovascular health, which is especially important for the elderly.

Table 8: Strength of evidence for a causal relationship between the intake of different food groups and food subgroups with selected diseases based on meta-analyses

Food groups	Cancer	Type 2 diabetes mellitus	Coronary heart disease	Stroke
Cereals, Cereal products, Potatoes	o	↑	–	–
Bread and buns	o	–	–	–
Whole grain (-products)	↓↓	↓↓↓	↓↓	↓↓
Potatoes without fat	o	–	–	–
Potatoes prepared with fat	–	–	–	–
Vegetables	↓↓	↓	↓↓	↓↓
Cruciferous vegetables	↓	↓↓	–	↓
Tomatoes and tomato products	o	–	–	–
Allium-plants	↓↓	–	–	o
Fruits	↓↓	↓	↓↓	↓↓
Apples	–	–	–	↓
Berries	–	–	–	o
Citrus fruits	o	–	–	↓
Milk and dairy products	↓↑*	↓↓	↓	↓
Milk	↓↑o*	o	o	o
Dairy products	o	o	–	–
Fermented dairy products	o	↓↓	o	↓
Cheese	o	–	–	↓↓
Curdled milk products	–	–	–	–
Meat, Processed meat, Fish, Eggs	o	o	o	↑
Red meat	↑↑	↑	o	↑↑
White meat	o	–	–	–
Processed meat	↑↑	↑↑	↑↑	↑↑
Fish	o	o	↓↓	↓↓
Oily fish	o	o	–	↓
Non-oily fish	–	o	–	o
Eggs	o	↑↑	o	–
Legumes, total	↓	o	↓	o
Soy	↓	–	–	–
Nuts and almonds	↓	↓	↓↓	↓
Chocolate	–	–	↓↓	↓↓
Dark chocolate with at least 50 % cocoa content	–	–	↓↓	↓↓

o no relationship with changing intake; ↓ possible evidence for an inverse relationship; ↓↓ probable evidence for an inverse relationship; ↓↓↓ convincing evidence for an inverse relationship; ↑ possible evidence for a positive relationship; ↑↑ probable evidence for a positive relationship; ↑↑↑ convincing evidence for a positive relationship; – no assessment of the strength of evidence possible/conducted; * mixed relationships regarding particular types of cancer with increased risk for prostate cancer and lower risk regarding the other types of cancer

5.3 Evaluation

Meanwhile there is a good base of prospective studies available that comprehensively report on the relationship between food intake and nutrition-related diseases. Furthermore the number of publications that summarise this knowledge in form of meta-analyses, has greatly increased. Therefore, in the future, evidence judgements on the associations between food intake and risk of the occurrence of nutrition-related diseases will become easier and may, as a result, be used to a greater extent than before for the development and revision of food-based dietary recommendations such as the DGE Nutrition Circle. An evidence judgement regarding food-disease relationships is made under the postulate that consistent findings regarding an association between the intake of a specific food or food group and the risk of chronic diseases can be justified by biological mechanisms. With all probability, these mechanisms are coupled with the ingredients occurring in the food; furthermore, the formation of biologically active substances in the preparation and digestion of this food may provide mechanistic explanations for the associations observed. The analysis showed that the implementation of a food-based dietary recommendation aimed at disease prevention will influence the incidence of various diseases differently. The research approach adopted here regarding the definition of a diet effective as a preventive measure, can only be understood as an initial concept to achieve the derivation of an optimum form of nutrition through a systematic evidence assessment of the relationships between food and disease, in accordance with DGE guidelines. The systematic listing of meta-analyses related to this question and an initial evidence judgement regarding these relationships have, however, clearly demonstrated that disease prevention via a targeted selection of foods can represent a potentially successful public health strategy.

6 Evidence of the impact of measures for behavioural and conditional prevention of obesity – a systematic overview

6.1 Methods

Umbrella Review

The enormous number of results from individual studies in the field of obesity prevention is pooled in systematic reviews (SR). In this umbrella review (UR), the results of the SRs were compared and analysed thus enabling a comprehensive analysis of the available evidence at a high level of abstraction. The literature search for publications was performed in January 2015 in several databases such as The Cochrane Library, MEDLINE/PubMed and PsycINFO using complex, documented search strings. Selection of relevant SRs was carried out by screening titles and abstracts for meeting eight inclusion criteria. In a second step, the respective full-text articles were screened. Eligible SRs were then differentiated according to three settings (school, kindergarten, and workplace). According to the four-eye principle, two reviewers using a specially designed extraction sheet performed data extraction independently. Included publications were evaluated regarding their methodological quality according to the validated checklist for systematic reviews "Assessing the Methodological Quality of Systematic Reviews" (AMSTAR). The assessment of the totality of the evidence was based on the "Evidence Analysis Manual" by the Academy of Nutrition and Dietetics (AND), considering the criteria as follows: quality, consistency of results, quantity, (clinical) impact and generalisability. To improve comparability, the quality of the evidence was categorised as "convincing", "probable", "possible" and "insufficient" in accordance with the nomenclature used by the German Nutrition Society (DGE).

Evaluation and project reports from Germany

To gather universal prevention projects for the settings school, kindergarten and workplace, a comprehensive online search was performed, which was supplemented by a systematic literature search using the databases MEDLINE/PubMed, EMBASE and The Cochrane Library. Since for the majority of projects no publicly available evaluation and/or project report could be found, 155 project managers were contacted by mail, phone and e-mail and asked to send existing evaluation and/or project reports. The response rate was 63 % (n = 97). According to the inclusion criteria, a total of 41 evaluation and/or project reports and three summary reports were included in the analysis. For the final evaluation, a set of criteria was used based on various standards and quality criteria for evaluation research. On this basis, statements about the quality of the evaluation and the effectiveness of interventions were derived.

6.2 Results

Umbrella Review

In total, 1,328 studies were identified in the systematic literature search. Of these, 123 studies were excluded because of duplicate publication and further 1,001 papers were excluded by screening titles and abstracts for inclusion criteria. An additional 166 full-text articles were excluded based on the predefined inclusion criteria. Thus, 38 SRs were included for the final evaluation.

Setting school: Based on the inclusion criteria, 20 SRs were identified for the setting "school". The majority of these studies showed no distinction with regard to age or type of school. In only four of the studies, results for children and adolescents were presented comprehensively and separately for each group. The statistical verification of the comparability of the primary studies in the included meta-analyses showed high heterogeneity among studies. Methodological weaknesses were mainly due to missing *a priori* written study protocols and missing full lists of included and excluded studies. In several SRs, comparative statements regarding behavioural and conditional prevention were missing.

Measures of nutritional education resulted in a significantly positive impact on dietary behaviour (eating habits), but not on anthropometric endpoints. In some studies, the evidence for the effect on dietary behaviour was classified as strong, due to significant increases in fruit and vegetable intake. Only one out of three SRs, exclusively evaluating activity-related interventions, showed mostly significant positive effects on anthropometric endpoints such as skinfold thickness, and on general health condition. The effect on Body Mass Index (BMI) was less significant due to mixed study results. The analysis of combined interventions (nutrition and activity-related) indicated very inconsistent results. Overall, however, the authors of several SRs recommended nutrition and activity-related interventions, or generally a combination of different intervention elements. Parents or family should be included to increase the success rate. Based on the results of the SRs evaluated, the strength of evidence for the setting "school" is to be classified as "probable". This statement does not refer to a single measure, but to all behavioural and conditional prevention measures.

Setting kindergarten: Based on the inclusion criteria, five SRs were included. Methodological weaknesses of included SRs were mainly due to missing *a priori* written study protocols, insufficient consideration of the scientific quality of primary studies in the respective study conclusion, and missing investigations of publication bias.

Except for one intervention, all nutrition education programs showed no effect on anthropometric endpoints, as well as no clearly positive effects on dietary behaviour. Most activity increasing interventions, such as guided sports, showed no significant positive effects on anthropometric endpoints and the level of physical activity. Activity-enhancing environmental changes, such as redesigning playgrounds and purchasing mobile play equipment, resulted predominantly in a significant positive improvement of motor skills. Results of combined nutrition and activity-based interventions showed, shortly after intervention and in one and two-year follow-ups, mixed results on anthropometric indicators. In most SRs, a clear distinction between behavioural and conditional prevention in the presentation of the results was lacking. Based on the results of the SRs evaluated, the strength of evidence for the setting "kindergarten" is to be classified as "insufficient".

Setting workplace: In total, 13 SRs met the inclusion criteria. In the majority of these SRs it remained unclear whether a study design was created *a priori*. Furthermore, most authors did not search for grey literature, did not list all included and excluded literature, did not test for publication bias, and did not provide an adequate statement regarding conflicts of interest.

In one SR, nutrition-oriented prevention measures (modification of the workplace environment, e.g. modification of menu plans and vending machine sales of fruits and vegetables) showed a small, but significant increase in BMI in the intervention group compared with the control group. In contrast, another study concluded that nutrition-oriented interventions could result in a slight weight loss. In one SR, limited evidence was found that nutrition-oriented interventions at work might lead to short-term modification in dietary behaviour by increased fruit and vegetable intake. The use of a pedometer at work showed a significant positive effect on the BMI as study endpoint. Interventions with both, educational and motivational elements, also demonstrated a positive effect on physical exercise, fitness, blood lipid concentrations, workplace attendance, stress at work and the risk of type 2 diabetes mellitus.

Due to the high risk of bias and the low total population, the evidence of activity-enhancing interventions for the BMI as study endpoint is classified as very low. With regard to combined interventions, three meta-analyses showed slight but significant effects on anthropometric endpoints like BMI, body weight, and body fat percentage. However, the authors did not differentiate between behavioural and conditional prevention when evaluating the results. Based on the results of the SRs evaluated, the strength of evidence for the setting "workplace" is to be classified as "possible".

Analysis of the evaluation and project reports from Germany

The analysis of nutrition and activity-based interventions in Germany was based on a total of 41 evaluation and/or project reports, of which 18 projects were conducted at a school setting, 16 at a kindergarten setting, one project was at a workplace setting and 6 projects were conducted at several settings (school/kindergarten/nursery/family). Of the 41 projects, most were model or pilot projects. The total number of participants in the projects varied between 9 and 2,950 although the majority of the projects had less than 500 participants. Half of the projects aimed explicitly at socially disadvantaged groups and thus pursued the goal of health equity. The projects acted on a behavioural prevention level or a combined behavioural and conditional prevention level with the focus on diet/nutrition and exercise. Two-thirds of the projects were intervention studies, which, as part of their behaviour-oriented approach, conveyed contents by using a combination of knowledge- and practical-oriented components, e.g. information supply plus cooking. Information on the duration of the intervention was found in two-thirds of the project reports. Approximately half of the projects had a study duration between 6 and 12 months.

In nearly half of the projects, anthropometric endpoints (e.g. BMI) were used as control of results. In 11 out of 21 studies, positive effects with regard to the anthropometric endpoints were reported. For 90 % of the projects, resource planning was unclear in technical, human and financial terms. Funding was provided mostly by sponsors from the economic sector (n = 15), ministries (n = 10) and local health insurance funds or their associates (n = 3). The records and presentation of the project's cost structure was very heterogeneous. Only one project provided a cost-benefit analysis. Methodological problems revealed from the analysed evaluation and/or project reports can be summarized as follows: several projects with potentially good approaches existed, but there was insufficient evidence that they successfully prevent overweight nor obesity. Due to the small number of projects with long-term follow-up, no conclusion can be drawn as to whether the interventions contribute to the prevention of abnormal body weight in the long run.

6.3 Evaluation

Considering the decades of research for behavioural and conditional prevention of obesity and the resultant enormous number of primary and secondary studies, it is sobering, how few reliable conclusions regarding the effectiveness of different interventions can be drawn. The present analysis shows that many results are flawed with significant uncertainty. Although only investigated in the short-term, a weak positive intervention effect of obesity prevention was shown within the total population for anthropometric endpoints. There are varying degrees of evidence to back the result for the settings of school, kindergarten, and workplace. Whether the effects are linked to a certain type, intensity, or duration of intervention, could not be established in the present analysis. Criteria for success or inhibitory factors cannot be derived universally from these data. In the future, programmes regarding behavioural and conditional prevention of obesity must be accompanied by larger and better quality studies with sufficiently long follow-ups in order to generate valid and reliable results. Economic evaluations of accessibility, sufficiently documented costs, and funding are the prerequisite for describing cost-benefit-relationships. Without this kind of still-to-be-done scientific processing, which has to be sufficiently budgeted for the prevention measures, there will be a lack of reliable evidence of their effectiveness with regard to the programmes on general obesity prevention and most of the measures will remain nothing more than pilot and model projects.

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