THE NUTRITION REPORT

2008
SUMMARY

GERMAN NUTRITION SOCIETY

The Nutrition Report 2008

Summary

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Preface

In 1968 the government of the Federal Republic of Germany commissioned the German Nutrition Society (DGE) to prepare a report concerning the nutritional status of the German population. This Nutrition Report was well received when it was submitted in June 1969 because it was for the first time that an overview of a wide range of nutritional data available in the Federal Republic was presented. As a result government decided to commission the DGE to prepare a comparable report every 4 years.
The following Nutrition Reports provide most recent statistical data of the nutritional situation in Germany which are supplemented by overviews, analyses and reviews of studies on present nutritional problems including evaluations.

The 1969 Nutrition Report dealt with the following subjects on 140 pages:

- Production and consumption in the light of nutritional physiology
- Relation between production and consumption of food produced in Germany
- Population and consumer structure according to economic sectors
- Relation between physiological consumer requirements and food prices
- Food consumption and nutrient intake
- Changes in nutrition in an industrial society
- Evaluation according to nutritional physiology
- Conclusions and future trends

In addition to an analysis of the nutritional situation in the Federal Republic of Germany the Reports of 1972 to 2004 also contain reviews of studies on nutritional problems.

The following subjects were dealt with in 1972:

- Nutritional behaviour in the Federal Republic of Germany
- Nutritional significance of processed food
- Changes in food quality during storage, processing and packaging
- Nutrition education at school
- Nutrition science and nutrition research

In 1976 detailed information was presented in the following fields:

- Food consumption and nutrient supply in the Federal Republic of Germany
- The influence of nutrition on the health situation in the Federal Republic of Germany
- Hygienic-toxicological and microbiological aspects of food
- Communal feeding in the Federal Republic of Germany
- Analysis of some selected samples of the influence of advertising on the nutritional behaviour
- Psychological causes of poor nutritional behaviour

The 1980 Nutrition Report dealt with:

- Development of the nutritional situation in the Federal Republic of Germany
- Nutritional behaviour in the Federal Republic of Germany
- Eating away from home (problem analysis with special regard to the main meal)
- Relationship between nutrition research and health policy

The 1984 Nutrition Report discussed the following topics:

- Development of the nutritional situation in the Federal Republic of Germany
- Chemical-toxicological and hygienic-microbiological aspects of food
- Psychosocial evaluation of nutrition in families with children
- Development of the food demand in the Federal Republic of Germany
- Critical evaluation of alternative diets

The 1988 Nutrition Report dealt with:

- Development of the nutritional situation in the Federal Republic of Germany
- Toxicological and microbiological aspects of nutrition
- Documentation Chernobyl
- Food allergies and food intolerance reactions
- Influence of federal measures on the nutritional behaviour
- Influences on human food intake
- Meals eaten away from home
- Recommendations to meet nutrient and dietary energy requirements
- Nutritional research in the Federal Republic of Germany

The 1992 Report dealt with:

- Development of the nutritional situation in Germany
- Toxicological and microbiological aspects of nutrition
- Selected socio-cultural influences on the nutritional behaviour
- Food allergies and food intolerance reactions
- Tumorigenesis – inhibiting and promoting effects of nutritional factors
- Iodine supply and iodine deficiency prophylaxis in Germany

The Nutrition Report 1996 dealt with:

- The nutritional situation in Germany
- Institutional feeding in the new Federal States (former German Democratic Republic)
- Iodine deficiency prophylaxis in Germany
- Toxicological aspects of nutrition
- Microbiological aspects of nutrition
- Tumorigenesis – inhibiting and promoting effects of nutritional factors
- Significance of phytochemicals for health
- Malnutrition of geriatric patients
- Novel food
- Information provided on food labels as a factor influencing food choice

The Nutrition Report 2000 dealt with:

- The nutritional situation in Germany
- Breastfeeding and infant nutrition in Germany
- Nutritional situation in Day-Care Centres: Study of the Nutritional Situation in Day-Care Centres
- Eating habits and nutritional situation of children and adolescents
- Nutrition of the elderly
- Toxicological aspects of nutrition
- Microbiological aspects of nutrition
- Technological aspects of food processing
- Nutritional influence on the intestinal flora
- Prevention of diseases by wholesome diets

The Nutrition Report 2004 dealt with:

- The nutrional situation in Germany
- Toxicological aspects of nutrition
- Microbiological aspects of nutrition
- Vitamin and mineral content of vegetable food
- Tumorigenesis – inhibiting and promoting nutritional factors
- Nutritional influence on the intestinal flora
- Influence of phytochemicals on health
- Representation and effect of nutritional information on television
- Enrichment of food and new products

The Nutrition Reports provoked considerable interest both within and outside Germany. From 1984 on, summaries of the Nutrition Reports have therefore been translated into English.

Introduction

This booklet called 'The Nutrition Report 2008 – Summary' is a very short version of the 11th Nutrition Report published by the German Nutrition Society. The present Nutrition Report is an important instrument for those responsible in nutrition and health policy, and also for food manufacturers, for the public, nutritionists, dieticians and the media. Within 7 chapters you will find substantial informations about the nutritional situation in Germany, a review of the prevalence of pre-obesity and obesity in Germany, and a description of nutritional problems of the Elderly in German Nursing Homes. Aspects of food safety are always of broad public interest and so we continue to describe toxicological and microbiological aspects. A brand new point of interest is a relatively new area of research that focuses on the early pathogenesis of diseases that occur later in life called 'Perinatal programming'. Following up the Nutrition Report 2004 and the report of the World Cancer Research Fund in 2007, a systematic analysis of the relationship between nutrition and carcinogenesis was pursued. The current evidence was evaluated according to the guidelines of the German Nutrition Society (DGE). The results are pooled in a comprehensive table.

Regrattably the long version of this Nutrition Report (more than 400 pages) is only available in German. For further informations please contact:
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I hope you enjoy reading this booklet.

Prof. Dr. Günther Wolfram
- editor-in-chief -

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1 Nutritional situation in Germany

1.1 Trend Analyses of Food Consumption

As in previous German nutrition reports, the assessment of food consumption over time is based on agricultural statistics. While agricultural statistics provide reliable food consumption data over time, they do not represent the true quantity of food consumed, because they are typically captured at the production and wholesale level. This implies that for many food products, the data provided include non-edible components (e.g. bones, peelings) as well as food not suitable for human consumption (e.g. food used as fodder). In addition, imported and exported goods have to be considered, however the amounts can merely be estimated.

In recent years there has been a considerable increase in grain, poultry and fish consumption. The consumption of vegetables, sugar, as well as cheese and dairy products has shown an upward trend. Moreover, the consumption of rye, potatoes, alcohol, eggs, animal fats and margarine is still declining continuously. There has been a stronger decline in vegetable oil usage than in animal fat consumption. Consequently, total fat consumption has decreased, yet this has resulted in an unfavourable fatty acid composition. The increased mineral water and declined beer consumption can be noted positively. However, there is a simultaneous growth in popularity of energy-dense soft drinks which should be counteracted to prevent overweight.

In the meantime, the rise in fruit and vegetable consumption has slowed down considerably. Therefore, additional prospective efforts will be necessary to attain the goals of the 5-a-day campaign.

1.2 Nutrition behaviour in Germany – data from the Second National Nutrition Survey (NVS II)

The Second National Nutrition Survey (NVS II) assessed food and nutrient intakes. In addition, a comprehensive questionnaire was conducted, regarding eating habits, behavioural patterns and environmental factors (meal-related situations). Measurements of body weight and height, as well as waist and hip circumferences were taken in study centers.
In the main study, a total of 20 000 German-speaking people living in private households and aged 14 to 80 years were selected randomly from 500 communities. They were interviewed from November 2005 to November 2006. Extensive information[1] was collected, from which selected results concerning eating behaviour and nutrition knowledge will be presented herein.

1.2.1 Dissemination of Diets

Overall, 12 % of the 14 to 80-year-olds adhere to a diet, of which 60 % are women. The proportion of men and women reportedly adhering to a diet increases with age. Where only about 10 % of 14 to 18-year-olds are concerned with their diet, over 20 % of the participants aged 65 to 80 years stated this. In all age groups up to the age of 64, more women than men adhere to a diet. In the younger group (14 to 24 years of age) the disparity between men and women was the greatest with approximately twice as many women on a diet.
The main incentive for women (6.3 %) and men (3.4 %) to adhere to a diet is to lose body weight. Young women show the lowest prevalence of overweight and they most frequently report that they comply with a weight-loss diet.
Diabetes mellitus is the second most important reason why people adhere to a diet (3.3 % women, 3.2 % men), followed by lipid metabolism disorders (1.8 % women, 1.4 % men). Such incentives are age dependent: among older people, the reason for engaging in a specific diet is an increased occurrance of metabolic disorders.

[1] Have a look at: www.was-esse-ich.de

1.2.2 Special Diets

4.9 % of women and 2.9 % of men follow specific diets. The largest subgroup is represented by the vegetarian diet. In Germany, 1.6 % are vegetarians (2.2 % women, 1.0 % men), most of which report to consume dairy products; only about 0.1 % are vegan. 0.6 % of the German-speaking participants adhere to Islamic dietary principles.

1.2.3 Communal Catering

A total of 14 % of the population (10 % women, 18 % men) eat in communal cafeterias, including school and university canteens. 15 % of working women and 24 % of working men make use of this offer, whereas 62 % and 50 %, respectively, do not. 23 % of working men and 26 % of working women have no access to a canteen. Most undergraduate and graduate students have access to a cafeteria. 52 % of female students and 68 % of male students make use of their cafeteria. At present, the situation in schools is rather heterogeneous. Many schools are currently being turned into all-day schools without yet having a cafeteria. In the NVS II, only students aged 14 years or older were included in the study, of whom 17 % visit a cafeteria.

1.2.4 Nutrition Knowledge

Knowledge about specific foods, such as probiotic yogurts and ACE drinks is greater in women than men across all age groups.
More than 50 % (51 % women and 54 % men) of the participants aged 19 to 80 years cannot provide details regarding their individual energy requirements. The youngest and eldest participants within this spectrum most frequently lacked such knowledge. There were more women than men among those who were able to estimate their energy requirements (about 47 %). Only 17 % of women and 15 % of men correctly estimated their energy requirements within a tolerance limit.

1.2.5 Cooking Ability

94 % of women rate their cooking abilities as very good, good, or average. 61 % of men believe to have the ability to cook very well to moderately well. Three quarters (74 %) of the women and half of the men (47 %) reported that they learned to cook from their mother.

1.3 Food and Nutrient Intakes of Infants, Children, and Adolescents

The results are based on two nutrition surveys conducted nationwide:
The prospective, multicenter 'Consumption Survey of Food Intake among Infants and Young Children (VELS)' evaluated food consumption and nutrient intakes of 732 infants (6 months and older) and young children (up to 5 years of age). Food intake was assessed using a 3-day weighed dietary record.

The nutrition module EsKiMo of the representative German Health Interview and Examination Survey for Children and Adolescents (Child and Adolescent Survey [KiGGS]) investigated food and nutrient intakes of 2 506 children and adolescents 6 to 18 years of age. The parents and their 3 to 12-year old children completed a 3-day dietary record. Because adolescents often eat out and presumably show little compliance filling out a 3-day dietary record, their diet was assessed using a standardized, structured interview tool (DISHES).

The concept of the optimized mixed diet of the Research Institute of Child Nutrition in Dortmund served as reference for the evaluation of food intake. The D-A-CH reference values were used for the evaluation of the nutrient intakes.

1.3.1 Infants and Young Children

1.3.1.1 Food Intake

With climbing age the intake of almost all food groups increased, merely fruit and vegetable consumption stagnated, however deviations between age groups can be observed. The recommended intake for fruit was only attained by children between 1 and 2 years. Hardly any child older than one year achieved the recommendation for vegetable consumption. On average, the recommendation for the consumption of carbohydrate-rich plant foods was not attained. Especially the consumption of potatoes and grain products (noodles, rice, cereals) differs from recommended amounts. The consumption of bread and pastries was also considerably below the recommendation. Sugar and sweets were already given to infants under the age of one and rose to 40 g/day in the 4- to 5-year olds. The recommended intake of meat, sausages, and eggs was attained by all children from age one, and older children even exceeded the average remarkably. For daily meat consumption a large range was observed.

About 19 % of children received less than half of the recommended amount of meat for their respective age group. In contrast, 19 % of boys and 14 % of girls consumed over twice the recommended amount of meat. The recommended intake of milk and dairy products was not attained by children older than 1 year of age. 22 % of boys and 30 % of girls did not consume even half that amount, however 15 % of boys and 9 % of girls drank 1.5 times the recommended intake of milk. The gender-specific differences in early life were striking: in the first year of life, boys received statistically significantly more meat, meat products and sausages, milk and dairy products, bread and pastries, tropical fruits and beverages than girls of the same age.

1.3.1.2 Nutrient Intake

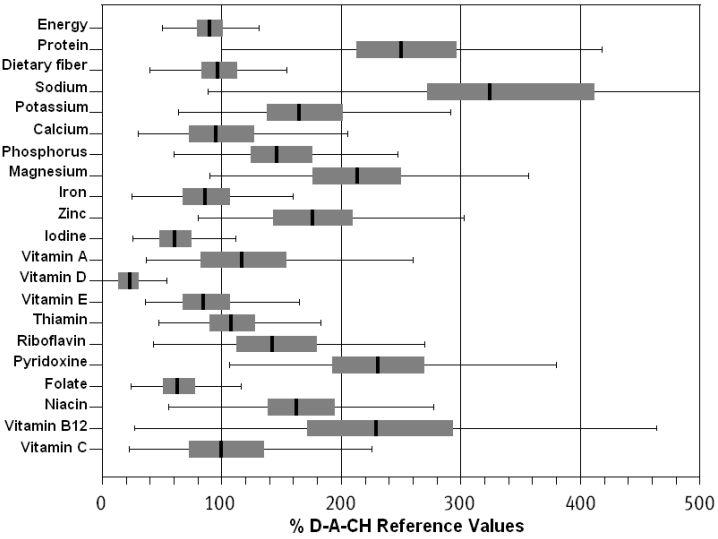
Energy intake was slightly below the recommendations (based on a moderate physical activity level) for all age groups. However, a sufficient energy supply can be assumed because normal body weight development was observed. Fat intake as a proportion of total energy intake corresponded to the recommended values (35 to 45 % or 30 to 40 %). However, the fatty acid composition was unfavourable because young children received too many saturated fatty acids and not enough

polyunsaturated fatty acids. Protein intake was 2 to 3-fold above the recommended values with boys having a statistically significantly greater protein intake than girls. Consistent with the recommended values, median carbohydrate intake was 53 % to 56 % of total energy intake. However, mono- and disaccharides accounted for over 50 % of carbohydrate intake and polysaccharide intake was insufficient. The reference value for dietary fiber intake was not achieved.

Intakes of sodium, potassium, phosphorus, manganese and zinc were above the reference values. Sodium intake was considerably higher than the reference value, which is rated as negative in view of potential adverse effects (early familiarization to a high intake of salt, rise in blood pressure due to an excessive consumption of foods rich in salt). Median intakes of vitamin A, vitamin B_1, vitamin B_6, niacin, and vitamin B_{12} were either within or distinctly above the reference values. Intakes of calcium, vitamin E, and vitamin C were slightly below the reference values. The recommended intake of iron was not attained by half of the participants. Vitamin D intake was also below the reference value. Folate intake was too low, yet this is not specific to children but is observed in all age groups in Germany. Figure 1 shows the energy and nutrient intake in comparison with the reference values of Germany, Austria and Switzerland (D-A-CH-Referenzwerte).

Figure 1: Energy and nutrient intake in comparison with the recommended values of German-speaking countries; boys, 6 months to < 5 years old

(Median, interquartil region and minimum-maximum (without outliers / mavericks and extreme values)
Iodine: iodized salt and foods produced with iodized salt were not included.



1.3.2 Children (6 to <12 years old)

1.3.2.1 Food Intake

Vegetable and vegetable product consumption was far below recommendations. Fruit and fruit product intake was higher than vegetable intake, but again, the recommendations were not attained. Carbohydrate-rich foods such as bread, pastries, grains, and potatoes were consumed in relatively small amounts. Meat, meat products, and sausages were eaten in considerable larger quantities than recommended, although 32 % of children did not achieve the recommendations. This especially applies for the girls where 36 % did not meet the recommendations (boys 28 %). The reference values for fish and fish products were not attained by any group.

Milk and yoghurt intake alone was not sufficient to attain the recommendations for milk and dairy products. However, when considering curd and cheese intake the aspired intake clearly improved. Intake of fats and oils remained overtly below the recommendations in all groups. On average most children achieved a moderate fluid intake in line with the recommendations. However, 48 % of boys and 59 % of girls were under the reference values.

Table 1: Recommendations for the optimized mixed diet of the Research Institute of Child Nutrition, Dortmund, for selected food groups

Recommended foods	Age group		
	4 to <7 years	7 to <10 years	10 to <13 years
Fruit (g/day)	200	220	250
Vegetables (g/day)	200	220	250
Potatoes, Noodles, Rice (g/day)	180	220	270
Bread, Cereal (flakes) (g/day)	170	200	250
Meat, sausages (g/day)	40	50	60
Fish (g/day)	50	75	90
Eggs (pieces/week)	2	2	2-3
Milk, dairy products (g/day)	350	400	420
Vegetable oil, margarine, butter (g/day)	25	30	35
Beverages (ml/day)	800	900	1 000

1.3.2.2 Nutrient Intake

Energy intake among 6 to < 10 year old girls was distinctly lower than among boys of that age. The same holds true for the intakes of fat, protein and carbohydrates. In all age groups, fat intake was within the recommended values of 30 % to 35 % of total energy intake; however, the fatty acid composition was not ideal. Protein intake was clearly above the recommended intake. Although the intake of carbohydrates was sufficient, the proportion of mono- and disaccharides exceeded the proportion of polysaccharides in almost all groups. The intakes of sodium, potassium, magnesium, phosphorus and zinc were relatively high compared to the reference values. The intakes of vitamins B_1, B_2, B_6, B_{12}, C and niacin were within or above the range of the recommendations. Intakes of vitamin A and vitamin E were somewhat below the

reference values, and the recommended intakes of folate and vitamin D were unambiguously too low.

1.3.3 Adolescents (12 to < 18 years)

1.3.3.1 Food Intake

Similar to the previous age group of 6 to < 12-year olds, only a very small proportion of adolescents reached the recommended intake of fruit and vegetables (fruit: 16 % of the boys and 26 % of the girls, vegetables: 19 % of the boys and 30 % of the girls). A great proportion of girls and boys, 89 % and 83 % respectively, did not attain the reference values for carbohydrate-containing foods.

In contrast, the recommendations for the consumption of meat, meat products, and sausages were exceeded more than twice by boys and girls of all age groups. The recommended amount of fish per week was attained only by the 15 to 18 year old male adolescents. Although the recommended intake of milk and dairy products was attained on average in all age groups, about half the adolescents consumed less than the actual recommended amount. The amounts of fat and oils roughly corresponded to the recommended.

1.3.3.2 Nutrient Intake

Median energy intake was slightly higher than the reference values among boys and slightly below the reference values among girls. Fat intake was within the range of the reference value of 30 % to 35 % of total energy intake. Similar to the younger children, the fatty acid composition was not satisfactory. Protein intake was clearly above the reference values. Carbohydrate intake as a proportion of total energy intake was within the range of the reference values. However, intake of mono- and disaccharides was higher than polysaccharide intake in nearly all subgroups.

The reference value for dietary fiber was not attained. The reference values for potassium, calcium, magnesium, phosphorus and zinc were achieved some even exceeded the recommendations considerably. Nevertheless, calcium intake was more than 25 % below the recommended intake for 12 % of the boys and 23 % of the

girls. The calculated median intakes for the vitamins A, B_1, B_2, B_6, B_{12}, C, E and niacin were markedly above the age-specific reference values. As seen in the younger age groups, intakes of vitamin D and folate fell well below the recommended intakes.

To enhance the nutrient supply food-based recommendations should be followed (table 2):

Table 2: Recommendations for improving nutrient supply among children and adolescents

- more foods of plant origin, mainly fruit and vegetables (beginning at an early age) as well as bread and potatoes
- more whole grain products (flour, bread, noodles or rice) instead of highly processed grain products
- replace energy-dense soft drinks with tap or mineral water
- replace full-fat dairy products with low-fat dairy products
- reduce the total amount of sausages and meats high in fat and replace with low-fat products
- increase the use of rapeseed oil as opposed to other oils and fats in households and in the food industry

1.4 Iodine Supply and Iodine Status among Children and Adolescents in Germany

The Child and Adolescent Survey (KiGGS) assessed iodine status in a representative population of minors under the age of 18 years. The WHO criteria for an adequate iodine status, which are based on urinary iodine excretion, are only barely fulfilled. Almost 80 % of children and adolescents range between a mild iodine deficiency and a normal status and 17 % show a moderate to severe iodine deficiency. Iodine deficiency is particularly prevalent in children 0 to 2 years old, followed by children 3 to 6 years of age.

One third of the children and adolescents have a minor enlargement of the thyroid gland. This is one explanation for the fact that between 35 % and 40 % of the children exhibit an iodine excretion of <100 ug/l.

Observed elevations in serum concentrations of thyroid stimulating hormone (TSH) among participants aged 3 years and older correspond to a low urinary iodine excretion.

Despite improvement in the populations iodine status achieved so far, there remains a demand for constant improvement in order to maintain the success achieved.

1.5 Prevalence of Pre-Obesity and Obesity in Germany

In order to conduct a comprehensive evaluation of the prevalence of pre-obesity and obesity in Germany over the life span national data and serial body weight examinations (e.g. school entry examinations) were consulted.

The body mass index (BMI = body weight [kg]/height squared [m^2]) served as a proxy for body size due to its high correlation with total body fat. The following table shows the classification of overweight in adults according to BMI as defined by the WHO.

Table 3: Body weight classification for adults according to the BMI

BMI	category	Risk for diseases
< 18,5	underweight	low (but risk of other clinical problems increased)
18,5–24,9	normal weight	average
≥ 25	overweight	
25–29,9	pre-obesity	increased
30–34,9	obesity class I	moderate
35–39,9	obesity class II	severe
≥ 40	obesity class III	very severe

Among children and adolescents, the BMI is evaluated on the basis of age- and gender-specific percentiles of a reference population. Children and adolescents with a BMI value above the 90th percentile of the reference population are classified as overweight. A BMI value above the 97th percentile is defined as obese.

1.5.1 Children and Adolescents

In the Child and Adolescent Survey (KiGGS)[2] a total of about 15 % of the participants were overweight and about 6 % of those were classified as obese. Gender differences were not apparent. Underweight was a concern for less than 10 % of children and adolescents.

Overweight and respectively obesity occurred more frequently if the mothers were pre-obese or obese. Children from migrant families or those with a low socioeconomic status were also more frequently overweight resp. obese. This is evident from school entry examination data. Overall, school entry examination data from individual federal states show a prevalence of overweight in the range of 9 % to 13.6 % among 6-year-old children. The prevalence of overweight and obesity among first graders has increased considerably over time.

1.5.2 Adults

The representative National Nutrition Survey II (NNS II) yielded data on body weight and height for 13 194 men and women in 2005 and 2006. According to the survey about 68 % of men and 50 % of women are overweight including about 20 % within each gender who are obese. Men are less overweight than women across all age groups. The proportion of overweight individuals increases with age.

The relatively high proportion of overweight among older people in the NNS II can be explained by the fact that individuals over the age of 80, disabled individuals, and people living in nursing homes were not included in the survey. Only very few individuals were underweight (1.9 % women, 0.7 % men).

It is to note that normal weight is only observed in a minority of men above 35 years and women above 55 years.

[2] 2003-2006: 17 641 participants, age: 0 - < 18 years

2 Company canteens – An Assessment of the Current Situation in Germany

A representative telephone survey of 1 095 companies that offer their employees a meal (prepared in the company or by catering) revealed substantial heterogeneity in organizational structures, food offers and processes of providing meals to employees.

The results indicate that type, quality, and amount of food served as well as the implemented quality control procedures in communal dining establishments are independent of the amount of dispensed or prepared meals. High quality meals, well-organized management and quality control can be found in small and large corporations. However, additional efforts are required to further improve personnel skill and increase implementation of quality control measures.

75 % of all establishments prepare meals themselves. Companies that dispense a large amount of meals prefer to prepare at least parts of the meals themselves. The organizational structures and food handling in establishments that offer catered meals are rather distinct from those that prepare meals themselves.

The meals offered differ from facility to facility and the menus display a wide range of choices. In establishments that offer catered meals choices are less extensive.

Facilities that provide catered meals predominantly deliver frozen meals or ready-to-eat meals that are held warm. By comparison, 95 % of companies that prepare meals themselves report immediate serving of meals (‘cook and serve’) often in conjunction with holding meals warm (‘cook and hold’).

47 % of the companies who serve catered meals only hire personnel that lack professional qualification. In comparison 95 % of all companies that prepare meals themselves employ professional staff.

Typically ‘inexpensive’ menus cost between 2.50 Euros and 2.99 Euros and the more expensive meals lie between 3.50 Euros and 3.99 Euros.

Methods regarding quality management and quality control were employed by 89 % of companies that prepare meals themselves, but by only 57 % of establishments that provide catered meals. Consumer satisfaction is assessed regularly by questionnaires in 33 % of companies that provide catered meals and in 58 % of the companies that prepare meals themselves.

3 Nutrition of the Elderly in German Nursing Homes

The prospective survey 'Nutrition of the Elderly in German Nursing Homes' (ErnSTES-Study) provided the first comprehensive assessment of the nutrition and health status of nursing home residents 65 years and older in Germany (773 residents of 10 nursing homes in 7 federal states).

The nutritional status was assessed using the Mini Nutritional Assessment Tool. The results show that nearly two thirds of the participants were potentially malnourished or at risk for malnutrition. A poor nutritional status was recognized in 11 % of male and female residents. Concerning gender specific differences, the study did not display any statistically significant discrepancies.

Based on the WHO BMI classification system (see Table 3, p. 21), 8 % of male and 6 % of female nursing home residents are underweight. 39 % among both genders maintain a BMI within the normal range. 33 % of men and 34 % of women are pre-obese and 20 % of men and women are obese.

Nursing homes attempt to provide an age-appropriate diet that takes taste preferences and chewing problems into account. However, multimorbidity as well as physical and mental impairments can have a profound impact on the appetite, the amount of food ingested and the composition of the diet consumed. The extent of care needed is a much stronger determinant of energy and nutrient supply than is age. The most frequent difficulties were the need for cutting the food (about 50 %), occasional loss of appetite, insufficient food and beverage intake, and the necessity to remind individuals to drink adequate amounts (about 30 % each).

Dairy products show a good suitability and acceptance (e.g. also concerning problems of chewing and swallowing) among the elderly. Therefore, products of this nutrient dense food group are consumed regularly within this cohort. In contrast, fruit, vegetables and whole grain products are consumed in considerably smaller amounts or not at all by many elderly individuals. As a result, the intake of dietary fiber is notably too low. Sweet foods and products rich in fat are both popular. While adding to energy intake, such foods only modestly contribute to the supply of essential

nutrients. Overall, nutrient intakes show a large variation. However, for individual nutrients, the recommended values are nearly attained or even surpassed (e.g. vitamins A, B_1, B_2, B_{12}, niacin, biotin, and zinc).

Despite these comforting results nutrient supply falls short of the recommended values for many elderly individuals. Vitamin D supply is particularly critical. Intakes of vitamin E and C, folate, calcium and magnesium were evidently too low. Since the participation of nursing homes in the study was entirely voluntary, positive selection cannot be excluded. It can be expected that true deficits in food and nutrient supply are even greater in facilities with a less favourable infrastructure. There is still a lot to be done to improve the nutrition situation for nursing home residents. The following table shows a list of recommendations.

Table 4: Recommendations for the Improvement of Nutrition and Health for Nursing Home Residents

Foods should • be of nutritionally high quality and have a high nutrient density, • contain nutrients with a high bioavailability, • be prepared gently and should not be held warm for an extended period of time, • be served in an age-appropriate manner, be easy to chew and swallow and be particularly flavourful (e.g. fresh fruit, sliced vegetables), • be consumed in adequate quantities.
Additional recommended measures are
• to develop a comprehensive concept for the prevention and therapy of malnutrition, • to monitor diets regularly and secure early diagnosis of diet-related health risks and malnutrition, • to assess body weight regularly (e.g. monthly) and keep record of body weight development over time (as a basic measure for monitoring nutritional status) • to continue with mandatory education for nursing home staff, • to put an emphasis on nutrition training for prospective nursing home staff, • to increase employment of dieticians/nutrition experts in nursing homes, • to establish interdisciplinary nutrition teams (consisting of management of nursing service, kitchen management, nutrition expert, physician, therapist depending on the indication, home economics management).

4 Toxicological Aspects of Nutrition

4.1 Foods of Animal and Plant Origin

As will be reported in the following chapter, there is no reason for health concerns to the consumer with respect to residues and contaminants in foods and breast milk.

60-75 % of grain samples contained no quantifiable residues. Maximum levels were exceeded in 1 % to 2 % of the samples. On the one hand, certain fruit and vegetable products showed no or very few exceedances of the maximum levels (e.g. bananas or potatoes). On the other hand, however some foods (e.g. bell peppers, grapes, currents and rucola) showed two-digit percentage exceedances of the maximum levels. These rates of exceedances of the maximum levels (about 7 % to 9 % of the samples) were considerably higher than those for cereals and foods of animal origin. Fortunately, exceedances of the maximum levels were rarely detected in frequently consumed products, such as apples, pears, bananas, carrots, potatoes and tomatoes.

Food for babies and infants is virtually free of residues. Quantifiable but very small residue concentrations were found in 5 % to 18 % of samples in the years 2003 to 2005. The maximum levels were not exceeded in any of the samples.

More than half of the food samples of animal origin contain minor but quantifiable residues. Persistent and ubiquitous organochlorine insecticides such as DDT, hexanchlorinebenzol and lindan were detected. Although these substances have long been prohibited they are still present in the food chain. The maximal level for these persistent substances was very rarely exceeded.

Residues in organic foods were first evaluated in 2005. The residue content of these samples was distinctly lower than that of the total number of samples. Of the samples evaluated, 71.3 % contained no quantifiable residues, 27.2 % contained residues in very small quantities and only 1.5 % contained residues in concentrations above the maximum level. The median amounts of insecticide residues in organic foods were statistically significantly lower (<0.005 mg/kg) than in conventional foods (0.4 mg/kg on average).

The proportion of food samples of organic origin containing multiple residues is also considerably lower than that of conventional foods. None of the tested organic foods (eggs milk, poultry, fish and infant formula) contained veterinary drugs. Residues were detected in 4.5 % of the foods originating from conventional cultivation (predominantly targeted suspected samples); maximum levels were exceeded in 2.5 %. Organic and conventional dairy products, egg pasta products and meat-containing fast foods showed comparable amounts of residues due to organochlorine compounds and dioxine.

4.2 Environmental Contaminants in Breast Milk

Interest among breast-feeding mothers in the investigation of environmental contaminants in their breast milk has been declining sturdily for years. The diminishing number of available samples and the focus on suspect samples has led to uncertainty about the representativeness of the data as well as difficulties in evaluating secular trends of contaminants in breast milk over time. The current levels of persisting organochlorine pesticides, dioxins, PCBs and nitro-musk compounds in breast milk samples in Germany are distinctly below those found in the 1980s and 1990s. According to the National Breastfeeding Commission of the Federal Institute for Risk Management, contaminants detected in breast milk pose no risk to the breast-fed infant. Thus, there is no need to revise the present recommendations for breastfeeding.

The rapid development of analytic techniques has enabled the detection of increasingly smaller amounts of contaminants and the identification of additional, at present unknown, contaminants in breast milk. The most recent example is the detection of polybromated biphenylethers and perfluorinated tensides (PFTs). This highlights the need for continued analysis of breast milk for early detection and prevention, despite the reduction of the burden of contaminants.

PFTs have become ubiquitous in the environment. Worldwide, they are found in water, atmosphere as well as in animal and human materials (breast milk, tissues, organs). Assessments of PFTs in food are sparse. Future programs will contribute to

a considerable gain in the knowledge of the extent and distribution of PFTs. This will have to be accompanied by an evaluation of associated risks.

4.3 REACH – the new European Community Regulation of Chemicals

REACH (registration, evaluation, authorization of chemicals) became effective on June 1, 2007. It stipulates that about 30 000 ‘existing substances’ (EINECS substances) that enter the EU market, at a minimum amount of 1 ton per year per manufacturer or importer, have to be registered within 11 years, beginning on June 1, 2008.

Registration requires each manufacturer (or importer) to report physical-chemical, toxicological and eco-toxicological data as well as data on the intended use, to the European Chemicals Agency (EChA). Depending on the annual amount produced, a risk assessment and an evaluation of the long term effects are mandatory. The toxicological characteristics of new substances are well-known and are therefore classified as ‘REACH-registered’.

There are about 1 000 substances known to be carcinogenic, mutagenic, toxic for reproduction, hormon-like active, environmentally persistent and bio-accumulative. These substances are classified as ‘substances of very high concern’. For these substances, appropriate deadlines will be determined after which they will no longer be allowed to be used.

5 Microbiological Aspects of Nutrition

Diseases caused by food-borne infections and intoxications are subject to registration according to the Infection Protection Act (IfSG). Data regarding the most pertinent food-borne diseases are presented in this chapter.

5.1 Salmonellosis

An overall decline in the prevalence of reported cases has occurred during the last 10 years. The number of salmonella cases was on a downward tendency until 2005, however, in 2006 52 644 new cases were reported and 55 400 in 2007. Nevertheless this decline is the result of numerous programs aimed at reducing salmonella in the livestock, improving hygienic handling of raw materials during processing, employing hygiene and quality management programs and enhancing consumer knowledge through dissemination of information.

As has been the case since the beginning of the 1990s, poultry is by far the leading cause of salmonellosis. The salmonella detection rate in surveillance samples of the national food monitoring for poultry amounts to 16.5 % in 2003, about 9 - 10 % in 2004 and 2005, and to 11.5 % in 2006. This implies that the burden of salmonella in poultry has principally decreased in recent years.

Salmonella rates for meat (excluding poultry) were slightly above 2 % in 2003 and 2006, while rates were somewhat higher in 2004 and 2005. The salmonella rate for pork has dropped continuously to less than 3 % of the surveillance samples. The salmonella rate of eggs remained relatively constant (0.44 % to 0.59 %).

5.2 Campylobacteriosis

Compared to other food-borne infections (e.g. salmonellosis), campylobacteriosis is seldomly associated with outbreaks. Sudden outbreaks have been observed repeatedly in association with the consumption of raw milk. In Germany, approximately 50 % of all campylobacteriosis cases are caused by poultry

consumption. Preventive household-based measures are to avoid the transmission of the agent to ready-to-eat meals. This measure gains even more importance when considering that for certain bacteria strains, assumably less than 500 germs are sufficient to cause an infection, and therefore the reproduction of the germs in food is not a premise for the transmission of the agent.

5.3 Enterohemorhagic Eschericia coli (EHEC)

Enterohemorhagic *Eschericia coli* (EHEC) can cause mild diarrhea to severe diseases, such as thrombocytopenic purpura (TTP) or haemolytic uremic syndrome (HUS). Children under the age of 5 years and elderly individuals are particularly susceptible to these diseases.

In 2003 and 2006, reported numbers of EHEC infections remained rather constant with 1 137 and 1 179 cases, respectively. In contrast, reported cases dropped to 839 in 2007. From 2003, cases caused by HUS have been assessed separately from those caused by EHEC because HUS is occasionally caused by other germs. HUS was detected in 43 to 82 cases in 2003 to 2007. Children under 5 years were affected in over 60 % of the cases. 5 patients died in 2004; 3 were reported in 2005 and 4 in 2006. The most relevant foods in terms of transmission have been raw foods of animal origin, such as raw meat, raw meat products, raw milk and raw dairy products. The germs are killed during processing of foods by pasteurization, cooking, broiling / roasting and high heat treatment. The germs are evidently more resistant against other food preservation methods.

5.4 Listeriosis

Individuals with an impaired immune response, pregnant women, the elderly or people with an underlying chronic disease can develop very serious clinical symptoms of listeriosis. The consumption of contaminated food is the primary cause for a listeriosis infection.

Listeria monocytogenes tolerates low temperatures, oxygen-poor environments, low pH values and high salt concentrations. It can be found in numerous products, such

as briefly matured but unheated meat products and sausages, soft cheeses made from raw milk, cold smoked fish products, and fancy salads or salads prepared with raw vegetables. For example, the detection rate for raw meat products or briefly matured sausage products is between 10 % and 20 % and for vacuum-packed smoked fish detection rates approach 30 %.

Data regarding reportable cases of human listeriosis show only small numbers of cases for 2001 to 2007. Incidences increased considerably between 2003 (256 cases) and 2006 (513 cases) and declined again in 2007 (356 cases). Despite this downward trend, listeriosis continues to encounter considerable attention because of its frequently fatal outcome with mortality rates of up to 10 %.

Pregnant women should abstain from consuming unheated animal foods, e.g. soft cheeses produced from raw milk, since these are frequently contaminated with listeria. Packed and cooled foods such as vacuum-packed fresh slices of boiled sausage, sliced salmon and other vacuum-packed smoked fish, should preferably be consumed well in advance of the expiration date.

5.5 Yersiniosis

Yersiniosis is the third most common bacterial food-borne infection in Germany. Most often, it is transmitted by food contaminated with *Yersinia enterocolitica*. From 2003 to 2007 there were between 6 573 and 4 987 registered cases per year. The consumption of raw, insufficiently heated pork is considered to be the cause of the disease in humans. Nevertheless, other sources of yersiniosis cannot be excluded.

5.6 Q-fever

Q-fever is transmitted from animal to man and is caused by *Coxiella burnetti*, a bacterium of the Rickettsia family. According to current knowledge, transmission via food is subordinate. However, transmission via raw milk and raw dairy products cannot be excluded entirely. It is assumed that there is a high number of unreported cases of Q-fever because often only mild symptoms of the disease become apparent.

5.7 Norovirus Infections

The highly infectious Norovirus is one of the most frequent causes of infectious upper-gastrointestinal diseases. Noroviruses often cause outbreaks of gastroenteritis in shared facilities such as hospitals, nursing homes, child day care facilities, schools and youth hostels. For individuals with an impaired immune system the infection can be fatal.

The reported cases for 2003 to 2006 ranged between 47 906 and 62 114. In 2007 the reported cases rose to 198 992.

5.8 Food Infections acquired through Foreign Travel

Every year, rare or non-endemic diseases are reported, which were mainly acquired abroad. These include *Typhus abdominalis*, paratyphus, shigellosis, brucellosis and cholera. It is assumed that in over 50 % a holiday abroad is the cause. The main reason for such diseases is the ingestion of unhygienic foods and drinking water. A further disease associated with travel is hepatitis A. More than 40 % of cases reported in 2004 were most likely acquired abroad. The alimentary transmission of hepatitis A viruses is associated with unhygienically produced meals and beverages as well as raw mussels that originate from contaminated water.

5.9 Bovine Spongiform Encephalopathy (BSE)

Human Bovine spongiform encephalopathy (BSE) and Creutzfeldt-Jakob Disease (CJD) are affiliated with the infectious spongiform brain diseases or transmissible spongiform encephalopathies (TSE). In 1996 Great Britain first established a connection between BSE and a new variant of Creutzfeldt-Jakob disease (vCJD) that particularly occurred among young people. Until April 2008, 204 vCJD cases were reported worldwide. Of these, 166 cases were reported in Great Britain. In Germany, no case of vCJD has been detected yet.

In Germany a total of 16 642 835 cattle were tested for BSE from 2001 to 2007. Within that time span, 402 cases were officially detected. In 2001 there were 125 cases and in 2007 there were 4. The strong decline clearly demonstrates the effectiveness of the implemented measures.

5.10 Communal Catering

Since 1994, *Bacillus cereus* is the dominating problem-causing germ in communal catering: in the last report covering the time between 1998 and 2001 it caused 62 % of cases and 67 % of outbreaks. For the current report time span (2002 to 2005) it caused 38 % of cases and 41 % of outbreaks. The heat-resistant spores are nearly ubiquitously present and can be transferred from soil particles to foods such as vegetables and spices. They begin to sporulate through heating of meals and they proliferate during cooling below 55 °C.

Noroviruses have an even greater significance as a cause of individual infections as does *Bacillus cereus*. However, usually the causal path leading to the illness cannot be reconstructed. During outbreaks, the high infectiousness of Noroviruses requires strict measures of hygiene, in particular isolation of the diseased individuals, the use of gloves and mouth masks, hand hygiene and disinfection as well as disinfection of areas in close proximity to the patient.

In practice, there are deficits in the implementation of hygiene management and the HACCP concept in establishments of communal catering. Frequently shortcomings have been observed even in the sensitive field of patient care where individuals with an impaired immune system are cared for.

6 Nutrition and ‘Fetal Programming’

Increasingly more epidemiological, clinical, and experimental studies indicate that the diet during prenatal, neonatal and infantile development has a crucial ‘conditioning’ role in the development of overweight and diabetes later in life, independent of genetic predisposition. ‘Perinatal programming’ is a relatively new area of research that focuses on the early pathogenesis of diseases that occur later in life. The central research parameters are the nutritional status and metabolism of the pregnant mother, as well as energy intake and diet in the child’s neonatal and early childhood development.

It is postulated that external influences such as nutrition or hormone activity during ‘critical periods’ determine the functioning of organs and organ systems later in life. This process is referred to as ‘perinatal programming’. If any interruption occurs in these critical periods during the ‘programming’, the chance to develop chronic diseases later in life is higher. The concept of perinatal programming provides an opportunity to prevent chronic conditions such as overweight and metabolic disorders at an early stage.

6.1 Nutritional Status of the Pregnant Mother and Intrauterine Body Weight Development of the Child

Apart from genetic factors, the development of the child *in utero* is subject to the influence of the diet or the nutritional status of the pregnant mother.
In epidemiological studies, birth weight is often used as an indicator or surrogate marker of the influence of the intrauterine milieu.

Data show that in the last 20 to 30 years, average birth weight has increased by up to 126 g per decade in Western industrialized countries. Because it is not possible to substantially alter the gene pool of the population of many countries within such a short time, other non-genetic causes must account for this.

Evidence suggests that the intrauterine milieu indeed is a stronger determinant of birth weight than genetic factors are. One impressive study was conducted in Britain

with children from surrogate mothers. Here the body mass index (BMI) of the surrogate mother showed a stronger correlation with the birth weight of the child than with that of the biological mother.

The body weight of the mother correlates positively with the birth weight of the child, as does the increase in body weight during pregnancy, independent of the weight at pregnancy onset. Epidemiological studies – including those in Germany – have shown that an excessive increase in body weight during pregnancy due to a disproportionate energy intake increases the risk for macrosomia 2 to 3-fold. The average increase in body weight during pregnancy has increased by 2 kg within the last 20 years. This increase was statistically significant.

6.1.1 Diabetes mellitus

Children of diabetic mothers show a considerably higher median birth weight and a markedly increased risk of macrosomia. Diabetes mellitus during pregnancy leads to an oversupply of glucose (for the fetus). Accordingly, positive correlations are observed between blood glucose concentrations of pregnant mothers with gestational diabetes mellitus (GDM) and neonatal body fat content of their children. A positive correlation between blood glucose concentration and the risk of macrosomia is evident even in non-diabetic pregnant women.

Recent investigations show that up to 20 % of all pregnant women in Germany have GDM. Since overweight is an important risk factor for the development of GDM, one must assume that the increasing prevalence of overweight will continue to amplify this already serious problem.

6.2 Prenatal and Neonatal Energy Supply and the Child's Long Term Development of Body Weight and Metabolism

6.2.1 Long-Term Influences of Prenatal Energy Supply

Results of epidemiological studies suggest that excessive body weight gain during pregnancy cannot only lead to a higher birth weight, but also to a 60 - 70 % higher risk of becoming overweight later in life. Only three studies have reported that low birth weight is associated with an increased risk for becoming overweight, a finding that corresponds to the 'small baby syndrome hypotheses'. These three studies describe an increased risk for underweight babies, but also for macrosomic newborns, resulting in an overall U-shaped relationship; none of the studies found a linear inverse relationship.

These findings contradict the 'mismatch' hypothesis, which postulates that prenatal undernutrition and low birth weight, followed by overnutrition and a Western lifestyle in adult life are responsible for the worldwide increasing prevalence of conditions, such as obesity and type 2 diabetes mellitus.

Compared to infants with a normal birth weight (2 500g-4 000g), children with a low (<2 500 g) or high (> 4 000 g) birth weight show a 40 % increased risk of developing type 2 diabetes mellitus later in life. Children of mothers with diabetes are more likely to be overweight later in life and are therefore more prone to develop associated diabetic metabolic disorders. Epidemiological, clinical, and experimental findings show that these associations are independent of the genetic predisposition.

Studies carried out in Europe and the US over the last 30 years document an increased prevalence of overweight for children of diabetic mothers.
This demonstrates that opportunities for diagnosis and treatment during pregnancy exist but are not utilized, at least with respect to long-term risks.

6.2.2 Long-Term Influences of Neonatal Energy Supply

Breastfeeding as compared to formula feeding is associated with a 25-40 % reduced risk of becoming overweight and developing diseases such as type 2 diabetes mellitus or cardiovascular diseases. In addition, other protective and positive long-term effects are described, e.g. with respect to the cognitive development.

It is possible that in addition to overall energy intake, the qualitative composition of the breast milk has a causal function concerning the programming of the risk for overweight and associated metabolic diseases of the child. Compared to breastfed babies, the metabolised energy and protein of formula fed infants is significantly lower. The question whether in particular the high protein content of infant formula – when compared to breast milk – could be a causal factor in the development of overweight later in life is currently being investigated in a multi-center European intervention study, the 'Childhood Obesity Project' (CHOP). Table 5 shows important claims to protect unborn babies from developing macrosomia and metabolic disorders in later life.

Table 5: Possibilities for prevention

- **Prevention should begin before birth!** Critical, long-term imprinting of the predisposition to develop certain diseases takes place during 'critical periods' in the womb and in the first weeks of life.
- Women should be informed by **broad education and counselling** that body weight should be normalised before conception and that overweight, excessive energy intake and extreme body weight gain during pregnancy should be avoided.
- All pregnant women should be **screened for gestational diabetes**; by incorporating it into the motherhood guidelines!
- **Pregnant diabetic women** should receive consistent care and therapy throughout their pregnancy.
- **Breastfeeding** should be recommended and promoted whenever possible!

7 Disease Prevention and Nutrition

7.1 Relationship between Nutrition and Carcinogenesis

Following up the Nutrition Report 2004 and the report of the World Cancer Research Fund in 2007, a systematic analysis of the relationship between nutrition and carcinogenesis was pursued. The current evidence was evaluated according to the guidelines of the German Nutrition Society (DGE)[3]. An overview is given in table 6.

Health policy recommendations should be based on convincing evidence. Alcohol consumption and cancers of various sites (oral cavity, pharynx, larynx, esophagus, rectum, breast, liver), for example, have this proven association. Therefore the recommendation to, drink little, if any alcohol is a definite measure for cancer prevention.

Probable evidence is defined as the existence of a strong relationship between a given dietary factor and the risk of cancer. This particular rating applies to the consumption of fruit and vegetables and decreased risk of malignant tumours of oral cavity, pharynx, esophagus, stomach and colon. There is also probable evidence that a high intake of red meat and meat products are associated with an increased risk of colon and rectum cancer. Whereas there is positive probable evidence that frequent intakes of dietary fibre reduce the risk of suffering such cancers.
Individual cancer prevention is achieved by adopting a diet rich in fruit and vegetables, consuming cereal products rich in dietary fibre, and consuming red meat and meat products in modest amounts (see the 10 rules of the DGE, page 50).

[3] Evidence based guidelines: Fat consumption and certain nutrition-related diseases. Summary and implementation of the guideline (English translation). See: http://www.dge.de/leitlinie/

Table 6: Nutrition and cancer risk – evidence evaluation 2008

	Evidence of the risk relationship	Cancer site
Fruit & vegetables		
Total	▼▼	oral cavity, throat, larynx, esophagus, stomach, colon
	▼	rectum, kidney
	♦	breast
	—	ovary, endometrium, cervix, prostate, liver, gall bladder, skin
Fruit consumption only	▼▼	lung
	▼	bladder , pancreas
Vegetable consumption only	▼	lung
	—	bladder, pancreas
Meat		
Meat, red	▲▲	colon, rectum
	▲	esophagus, breast, pancreas
	—	stomach, ovary, endometrium, cervix, prostate, bladder, kidney, liver, gall bladder, lung, skin
Meat products	▲▲	colon, rectum
	▲	esophagus, stomach, breast
	—	ovary, endometrium, cervix, prostate, bladder, kidney, pancreas, liver, gall bladder, lung, skin
Fish	▼	colon, rectum
	♦	breast, prostate
	—	oral cavity, throat, larynx, esophagus, stomach, lung, ovary, endometrium, cervix, bladder, kidney, pancreas, liver, gall bladder, skin
Poultry	—	all forms of cancer
Milk and dairy products	▼▼	colon, rectum
	▲	prostate
	—	oral cavity, throat, larynx, esophagus, stomach, lung, breast, ovary, endometrium, cervix, bladder, kidney, pancreas, liver, gall bladder, skin
eggs	▲	breast
	—	all other forms of cancer

fat and fatty acids		
fat, total	▲	breast (postmenopausal)
	♦♦	colon, rectum, lung, ovary, endometrium, prostate, pancreas
	—	oral cavity, throat, larynx, esophagus, stomach, cervix, bladder, kidney, liver, gall bladder, skin
saturated fatty acids	▲	breast (postmenopausal)
	♦♦	colon, rectum, lung, ovary, endometrium, prostate, pancreas
	—	oral cavity, throat, larynx, esophagus, stomach, cervix, bladder, kidney, liver, gall bladder, skin
long chain n-3 fatty acids	▼	colon, rectum
	♦	ovary, prostate
	—	oral cavity, throat, larynx, esophagus, stomach, lung, breast, endometrium, cervix, bladder, kidney, pancreas, liver, gall bladder, skin
Dietary fiber	▼▼	colon
	▼	stomach, rectum
	♦	breast (postmenopausal)
	—	oral cavity, throat, larynx, esophagus, lung, ovary, endometrium, cervix, prostate, bladder, kidney, pancreas, liver, gall bladder, skin
Glycemic index	♦	stomach, colon, rectum
	—	oral cavity, throat, larynx, esophagus, lung, breast, ovary, endometrium, cervix, prostate, bladder, kidney, pancreas, liver, gall bladder, skin
Alcohol	▲▲▲	oral cavity, throat, larynx, esophagus, colon, rectum, breast, liver
	▲▲	stomach
	♦	lung, ovarian, prostate
	♦♦	kidney
	—	endometrium, cervix, bladder, pancreas, gall bladder, skin

▲▲▲ (▼▼▼) convincing evidence for inreased (decreased) risk
▲▲ (▼▼) probable evidence for increased (decreased) risk
▲ (▼) possible evidence for increased (decreased) risk
♦♦ probable evidence for no risk relationship
♦ possible evidence for no risk relationship
(–) insufficient evidence for a risk-modifying effect

7.2 Phytochemicals and Health

In order to critically evaluate the results of epidemiological studies on phytochemicals and disease prevention, it is important to assess the quality of available data regarding phytochemical content of foods. Data from the United States Department of Agriculture (USDA) now include all relevant flavonoid groups and therefore allow comprehensive assessments concerning the intake of flavonoids and their associations with disease risks.

It is evident that not all relevant phytochemicals have been identified nor have all effects of known phytochemicals been studied. However, the scientific basis for a preventive effect of phytochemicals has become more comprehensive since the release of the Nutrition Report 2004. Again, no recommendations for the intake of single phytochemicals can be made based on available study results. The preventive effect is possibly due to the intake of a combination of phytochemicals. However, data regarding the synergistic effects of isolated phytochemicals are insufficient.

7.2.1 Intake of Phytochemicals and Selected Disease Risks

Flavonoids, carotenoids, glucosinolates, lignans and isoflavones contribute to the preventive effects of a diet rich in plant foods.

7.2.1.1 Flavonoids

Retrospective case-control studies have shown a decreased breast cancer risk with increased intakes of flavones and flavonols at flavonoid levels corresponding to those in one apple or half a cup of black or green tea. Also, a decreased risk of colon cancer was noted with increased intakes of anthocyanes, flavones, flavonols and isoflavones, a finding that was confirmed in a prospective study. In a prospective study, a decreased risk for coronary heart disease was detected with higher intakes of anthocyans and flavones. However, in a Greek case-control study this inverse association was found only for flavonols.

7.2.1.2 Carotenoids

In a prospective European study, a decreased cancer risk was associated with high plasma carotenoid concentrations.

Study results concerning an inverse relationship between plasma lycopene levels or lycopene/tomato intake and prostate cancer are unequivocal. The observed inverse relationship may be limited to a low intake (0 to 2 mg/day).

A current meta-analysis on primary prevention of colon cancer found no protective association with dietary intake of carotenoids from foods.

Prospective studies suggest that carotenoid-rich fruits and vegetables are important for the primary and secondary prevention of breast cancer.

Prospective studies indicate that high intakes of zeaxanthin or lutein are associated with a lower risk for age-dependent macula degeneration. Further studies are needed to draw firm conclusions.

7.2.1.3 Sulfides and Glucosinolates

An evaluation of 8 European case-control studies has shown that a high consumption of onions and garlic (the main sources of sulfides) was associated with a decreased cancer risk of up to 88 %.

In a case-control study, the group of women with the highest urinary excretion of isothiocyanates had a 50 % decreased breast cancer risk compared to the group with the lowest excretion. In comparison the amount of cabbage eaten, as essential provider of isothiocyanates, was not statistically significantly associated with breast cancer incidence. This leads to the conclusion that data of food surveys have to simultaneously be supported by biomarker analysis.

No protective effect of cabbage consumption was observed for bladder cancer, whereas for lung cancer high cabbage consumption was related to a genotype-dependent lowering risk effect.

7.2.1.4 Lignans and Isoflavones

Case-control studies have shown a decreased colon cancer risk with increased lignan intake or increased plasma concentrations of bacterial lignan metabolites. In postmenopausal women a high intake of lignan was associated with a statistically significant reduction in risk for breast cancer. The apparent preventive effect of lignans could be influenced by lignan structure, metabolic capacity of the gut flora and genotype.

For cancers of the lung, prostate, and cervix a statistically significant decreased risk was found with high lignan and isoflavone intakes. Overall, data regarding isoflavone intake and risks of prostate and breast cancer remain equivocal. One possible explanation are the varying effects of isoflavones that depend on the food source. A protective effect of lignans or isoflavones on cardiovascular disease has not been reported.

7.2.2 Health Promoting Effects of Phytochemicals

7.2.2.1 Vascular Effects

In human studies, intakes of flavonols and procyanidins cause an increase in plasma concentrations of flavonoids and vasodilation. In the first randomized, placebo-controlled trial the influence of the flavonol quercetin on blood pressure was investigated. Four weeks of quercetin supplementation among patients with mild hypertension caused a statistically significant decrease in blood pressure. New studies suggest that quercetin interferes with platelet aggregation thereby reducing the risk of thrombosis.

7.2.2.2 Anticarcinogenic Effects

Up to date investigations of potentially anticarcinogenic phytochemicals and their metabolites has been rudimentary. Falcarinol and pterostilben are intruiging examples of such substances.

Data show that individual substances such as lycopene are probably not responsible for the protective effect of fruit and vegetables.

Glucosinolate metabolites potentially prevent hormone-dependent cancers, such as breast cancer, through their estrogen(-like) effect. Lignans and other substances found in linseeds are thought to have anticarcinogenic properties.

7.2.2.3 Neurological Effects

Cell culture and animal experiments have shown that the positive influence of particular fruit and vegetables on cognitive function can be explained through phytochemicals (e.g. fisetin, epicatechin). The current data do not permit an evaluation of the extent to which certain phytochemicals prevent neurodegenerative disorders in humans.

7.2.2.4 Further Effects

Results of *in vitro* studies show an anti-inflammatory effect of phytochemicals.

7.2.3 Risk Potential of Isolated Phytochemicals

The consumption of enriched foods has the consequence of an increased intake of phytosterins. A high absorption of phytosterins increases the risk of atherosclerosis. Whether enriched foods increase the risk for cardiovascular disease in the general population is unlikely but remains unresolved.

Animal studies show that the administration of individual phytoestrogens, such as genistin, facilitates mechanisms of tumor development. However, that the same dose of phytoestrogens given in combination (e.g., isoflavones and lignins) shows a preventive effect. Uncertainty regarding such data allows to argue against recommending supplemental intake of phytoestrogens.

Current activities by the food industry to market functional foods enriched with phytochemicals bears the risk of oversupply with certain components. The safety of such activities cannot be assessed at present.

7.3 Pro- and Prebiotics – Influences on Health

Pro- and prebiotics act mainly by influencing the gut flora and by influencing immuno-modulating mechanisms mediated by the gut flora, but also through direct interactions with the intestinal immune system. The potential beneficial effects of pro- and prebiotics depend on the particular substance and the amount consumed, the individuals' health status, including immune function, and interindividual nature of the gut flora.

7.3.1 Probiotics

7.3.1.1 Diarrheal Diseases

Acute diarrhea, particularly diarrhea caused by viral or bacterial infections or by an imbalance of the gut flora, remains an important operational area for probiotics. In numerous clinical trials and meta-analyses decreased infection frequency and shortened duration of diarrhea has verified the effectiveness. Clinical trials have not substantiated a positive effect of probiotics on diarrhea caused by lactose intolerance. For diarrhea caused by chemotherapy or radiation therapy there is insufficient proof of the effectiveness of probiotics.

7.3.1.2 Inflammatory Diseases and Irritation of the Gut

Favorable effects of probiotic bacteria have been demonstrated predominantly for mild to moderate forms of *Colitis ulcerosa*. In contrast, probiotics seem to be less effective for *Morbus Crohn*. There is no published evidence for a complete remission of irritable colon by probiotics.

7.3.1.3 Infections of the Genito-Urinary Tract

Several reviews of numerous *in vitro*, animal, and human studies suggest a potentially positive effect of probiotic lactic acid bacteria.

7.3.1.4 Constipation

Clinical studies have demonstrated that the consumption of a bifido-containing fermented milk product causes a reduction in bowel transit time among patients with constipation.

7.3.1.5 Effects mediated by the Immune System

Probiotics can reduce the severity, duration, and frequency of bacterial infections of the gastrointestinal tract and the respiratory system in children and adults. In healthy adults, the intake of a bifido-bacteria and lactobacillus containing product decreased the severity and duration of the common cold throughout two winter seasons, when compared to the placebo group.

Clinical studies demonstrated rather promising results regarding probiotics administered as benign bacterial antigens for the prevention and therapy of allergic/atopic diseases. However, findings need to be verified and the conditions under which probiotics produce a positive effect need to be evaluated.

7.3.1.6 Cancer

In animal studies, probiotic bacteria inhibited growth or metastasis of chemically induced tumors. However, neither epidemiological nor clinical investigations show a tumor-protective effect of probiotics.

7.3.1.7 Cholesterol, Lipid Metabolism, Blood Pressure, and Coronary Heart Diseases

Most recent human studies generate no cholesterol-lowering effect of probiotics. However, various controlled trials have verified a blood pressure-lowering effect of certain fermented dairy products.

7.3.2 Prebiotics

7.3.2.1 Gut

Prebiotic effects, such as inhibition of potentially pathogenic microorganisms, stabilisation of the intestinal milieu by reductions of the pH and release of short-chain fatty acids have been substantiated *in vivo* and *in vitro*. In these studies, inulin, oligofructose, etc. and their synbiotic combination with probiotic bacteria promoted the bifidus and lactobacillus flora in the human gut flora and/or inhibited certain bacteria pathogenic to man and animals.
Initial results from animal studies indicate that the consumption of prebiotics may reduce the concentration of genotoxic, cancer initiating, or cancer promoting metabolites and enzymes in the gut, thereby decreasing the risk of colon cancer.

7.3.2.2 Immune-modulating Characteristics

Prebiotics influence the gut flora primarily through their immune-modulating properties. Favourable effects of prebiotics have also been displayed regarding allergic or atopic diseases.

7.3.2.3 Lipid Metabolism

In humans, inulin decreased serum concentrations of total-, LDL-, and VLDL-cholesterol, triglycerides, and fasting insulin. It is ambiguous whether and to what extent the risk for atherosclerosis and myocardial infarction can be lowered with prebiotics.

7.3.2.4 Promotion of Mineral Absorption and Bone Stability

In children and adolescents, long- and short-chain fructo-oligosaccharides increased calcium absorption, while the effect of fructo-oligosaccharides plus casein phosphor peptides on the absorption of calcium phosphate was not statistically significant in young adults. A risk reduction of osteoporosis with prebiotics has not yet been shown.

7.3.3 Pre- and Probiotics in Infant and Child Nutrition

Several studies have verified that galacto-oligosaccharides alone, galacto-oligosaccharides in combination with inulin and oligofructose, or in combination with probiotics as a symbiotic, caused a statistically significant growth of the gut bifidus population of pre-or full-term babies. A further finding was, that the characteristics of the feces matched those of breast-fed infants fairly well. Furthermore it has been demonstrated that prebiotics have improved growth and health in older or partially malnourished children.

10 Guidelines of the German Nutrition Society (DGE) for a Wholesome Diet

The German Nutrition Society (DGE) has compiled 10 dietary guidelines based on the most recent scientific knowledge, aimed to help you enjoy eating and maintain a balanced diet. A wholesome diet keeps you in good health and promotes vitality and well-being.

1. Versatile eating habits

Enjoy the diversity of foods available. Characteristics of a well balanced diet are a variable choice, an appropriate combination and adequate quantities of high-nutrient and low-energy food.

2. Ample cereal products – and potatoes

Bread, pasta, rice, grain flakes, preferably from whole grain, as well as potatoes contain hardly any fat but plenty of vitamins, minerals as well as dietary fibre and phytochemicals. Consume these foods preferably with low-fat ingredients.

3. Fruit and vegetables – take '5 a day'

Enjoy 5 portions of fruit and vegetables daily, as fresh as possible, cook for a short time only, or take 1 serving as a juice – ideally with each main meal and also as a snack between meals. You profit by consuming plenty of vitamins, minerals, dietary fibre and phytochemicals (e.g. carotenoids, flavonoids), which is optimal for your health.

4. Milk and dairy products daily; fish once to twice a week; meat, sausages and eggs in moderation

These foods contain valuable nutrients, e.g. calcium in milk, iodine, selenium and n-3 fatty acids in saltwater fish. Meat contains minerals and vitamins B_1, B_6 and B_{12}. However, 300 - 600 grams of meat and sausages per week are sufficient. Rather choose low-fat products, especially with meat and dairy products.

5. Fat and fatty foods in moderation

Fat provides essential fatty acids and foods containing fat also comprise fat-soluble vitamins. Fat is particularly high in energy, therefore too much dietary fat can promote overweight. Too many saturated fatty acids promote, in the long run, the development of cardiovascular diseases. Rather favour vegetable oils and fats (e.g. canola oil, soybean oil and margarines produced therefrom). Be aware of hidden fat found in several meat and dairy products, pastry, sweets, fast food and convenience products. Overall, 60 - 80 grams of fat daily is sufficient.

6. Sugar and salt in moderation

Only occasionally consume sugar and food or beverages containing various kinds of sugar (e.g. glucose syrup). Be creative in flavouring with herbs and spices, but use little salt. Rather favour iodized and fluoridated table salt.

7. Plenty of fluid

Water is of vital necessity. Make sure your daily fluid intake is approximately 1½ litres. Rather choose water, carbonated or non-carbonated, and other beverages low in calories. Consume alcoholic drinks only occasionally and only in small amounts.

8. Prepare tasty, carefully cooked dishes

Preferably cook food on low heat, if possible for a short time, using little amount of water and fat. This will preserve the natural taste, conserve the nutrients and avoid the formation of harmful substances in food.

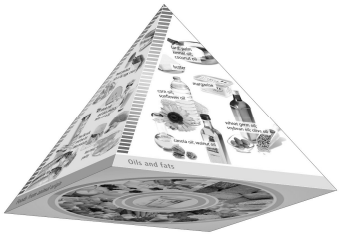
9. Take your time and enjoy eating

Eating consciously helps to eat properly. Prepare and serve dishes pleasing to the eye. Allow plenty of time for eating. It can be fun, as it encourages versatility in the choice of food and promotes the sense of satiation.

10. Watch your weight and stay active

Combine a balanced diet along with plenty of physical exercise and sport (30 – 60 minutes daily). An ideal weight will promote well-being and good health.

The German 3-D-Food Pyramid



This pyramid visualizes the German dietary guidelines. The 3-D-pyramid has the advantage to combine quantitative and qualitative recommendations for specific food groups.
The base of the 3-D-pyramid will show the German nutrition circle, illustrating the quantity of different food groups. The sectors of this circle are calculated on the basis of our German Dietary Reference Intake data (DRI). The four side surfaces of the 3-D-pyramid show different food groups with an hierarchical, strong quality based arrangement:

- foods mainly from plant origin
- foods mainly from animal origin
- oils and fats
- beverages

The quality of specific food groups are symbolized in the draft by a smooth colour transition from green to red.

German Nutrition Society
www.dge.de

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