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Fat intake and prevention of selected nutrition-related diseases

Summary of the revised version (2015) of the evidence-based fat guideline of the German Nutrition Society (DGE)

Jessica Dinter, Heiner Boeing, Eva Leschik-Bonnet, Günther Wolfram for the German Nutrition Society (DGE)

Summary

The evidence-based DGE guideline "Fat intake and prevention of selected nutrition-related diseases" is based on a systematic literature review. It demonstrates which role the intake of fat and fatty acids plays concerning the prevention of nutrition-related diseases, such as obesity, type 2 diabetes mellitus, dyslipoproteinaemias, hypertension, metabolic syndrome, coronary heart disease, stroke, and cancer.

It is as before that for the prevention of obesity and dyslipoproteinaemias the level of fat intake should be considered. Replacing saturated fatty acids with polyunsaturated fatty acids, a high intake of long chain n-3 fatty acids and avoiding trans fatty acids are suitable for reducing the risk of coronary heart disease. Such an intake of fat also reduces the risk of dyslipoproteinaemias.

Keywords: evidence-based guideline, quantity of fat, fatty acid quality, prevention, nutrition-related diseases

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Introduction

Ever since there have been recommendations on health-promoting nutrition, there has been discussion on the "right" intake of fat. During recent decades and up to the present day, scientists and the media have been interested in a variety of aspects such as different groups of fatty acids (saturated fatty acids, trans fatty acids etc.) or forms of nutrition (Mediterranean diet, vegan diet etc.), alternatingly and with changing level of intensity.

The wealth of information on fat is great, as is the people's uncertainty due to diverging nutritional recommendations and information. With supplying evidence-based guidelines, the objective of the German Nutrition Society (DGE) is to present scientifically sound statements which are based on a transparent basis.

The role of fat and individual fatty acids in the primary prevention of nutrition-related chronic diseases was firstly evaluated by the DGE in form of an evidence-based guideline in 2006 [1]. The guideline was updated in January 2015 after a new systematic literature review [2].

The present article presents the methods and results of the guideline, together with practical tips on implementing the recommendations to prevent disease that can be derived from the guideline. It is also explained how the insights of the DGE guideline on fat intake contribute to the derivation of food-based recommendations for prevention.

Methodological approach

The guideline answers the question of how intake of nutritional fat and fatty acids influences the development of obesity, type 2 diabetes mellitus, dyslipoproteinaemias, hypertension, the metabolic syndrome, coronary heart disease (CHD), stroke and cancer. For this purpose, a new systematic literature review was carried out with previously defined search terms. It focused on meta-analyses, systematic reviews, as well as original reports of intervention and cohort studies.

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The relevant literature was classified by scientific validity (◆ Overview 1). Randomised, controlled intervention studies and their meta-analyses were ascribed the greatest validity (level of evidence I), followed by prospective cohort studies and meta-analyses of these (level of evidence II). Finally, the preventive effects (or lack of these) were estimated.

To classify the evidence for a preventive effect (or lack of this) the strength of evidence was assigned according to the criteria of the World Health Organization (WHO) [3]. The strength of evidence for a preventive effect (or lack of this) was divided into the categories "convincing", "probable", "possible" or "insufficient" (see original version of the DGE guideline on fat intake: → www.dge.de/wissenschaft/leitlinien/).

OVERVIEW 1: Relevant levels of evidence in the revised DGE guideline on fat intake

Level of evidence I
Ia Meta-analyses of randomised, controlled intervention studies
Ib Randomised, controlled intervention studies
Ic Non-randomised/non-controlled intervention studies

Level of evidence II
IIa Meta-analyses of cohort studies
IIb Cohort studies

Results of the 2015 version of the evidence-based guideline on fat intake

The derivation of the recommendations for the prevention of diseases only considered results with a solid data base. These are those results, which were rated with convincing or probable evidence. The 2015 version of the evidence-based guideline on fat intake shows that for the primary prevention of the considered nutrition related diseases, the *quality* of fat intake is of most importance, and the *quantity* of fat intake is of importance in some cases:

There is probable evidence that high fat intake favours the development of obesity when total energy intake is not controlled for. When total energy intake is controlled so that the energy balance is evened, there is probable evidence that fat intake does not play a role in the development of obesity. In general, fat is the nutrient with the highest energy density, so that limiting fat intake facilitates limiting energy intake.

There is convincing evidence that reduced intake of total fat and saturated fatty acids reduces total plasma cholesterol and plasma LDL cholesterol. Therefore, limiting the intake of total fat and saturated fatty acids is a suitable measure to reduce the risk of dyslipoproteinaemias.

Regarding the quality of fat intake, it is particularly favourable if saturated fatty acids are replaced by polyunsaturated fatty acids. In this case, there is probable evidence that the risk of coronary heart disease is reduced and convincing evidence that the plasma concentrations of total and LDL cholesterol are reduced.

Moreover, there is convincing evidence that increased intake of monounsaturated fatty acids in exchange for carbohydrates can reduce plasma triglyceride concentrations and the ratio of total and LDL cholesterol to HDL cholesterol, as well as increasing plasma HDL cholesterol concentrations.

Increased intake of long chain n-3 fatty acids is also favourable, as there is probable evidence that this reduces the risk of coronary heart disease. There is convincing evidence that increased intake of long chain n-3 fatty acids reduces plasma triglyceride concentrations and probable evidence that this reduces blood pressure. However, these effects are not to be expected with the levels of long chain n-3 fatty acids in a normal diet.

High intake of trans fatty acids is unfavourable, as there is convincing evidence that this increases the risk of dyslipoproteinaemias (with increased plasma concentrations of total and LDL cholesterol and triglycerides and decreased plasma concentrations of HDL cholesterol) and probable evidence that this increases the risk of coronary heart disease.

Changes from the 2006 version

Apart from a few exceptions, the up-dated version of the evidence-based guideline on fat intake confirms the results of the first version. It also contains new, but no fundamentally different results.

For the long chain n-3 fatty acids, the evidence for a reduction in the risk of coronary heart disease and hypertension is attenuated from convincing to probable. Also, there now is probable evidence that there is no association between the intake of long chain n-3 fatty acids and the risk of stroke, while there was probable evidence for a reduction in the risk of ischemic stroke in the first version of the guideline.

Moreover, the evidence that increased intake of trans fatty acids increases the risk of coronary heart disease has been attenuated from convincing to probable.

The more detailed evaluation of dyslipoproteinaemias shows a con-

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Meal	Food	SFA-Content [g]	PUFA-Content [g]	Alternative Food	SFA-Content [g]	PUFA-Content [g]
Breakfast	2 slices of wholemeal bread, 50 g each	0.2	0.6	2 slices of wholemeal bread, 50 g each	0.2	0.6
	20 g jam	0.0	0.0	20 g peanut butter	1.8	2.8
	30 g soft cheese min. 45 % fat (dry weight)	4.5	0.1	30 g cottage cheese	0.7	0.0
	1 tomato	0.0	0.1	1 tomato	0.0	0.1
Snack	200 g yogurt, 3.5 % fat	4.5	0.3	200 g yogurt, 1.5 % fat	1.9	0.1
	1 apple	0.0	0.0	1 apple	0.0	0.0
Lunch	125 g beef	5.2	0.5	125 g herring fillet	4.1	5.5
	200 g broccoli	0.1	0.2	200 g broccoli	0.1	0.2
	250 g potatoes prepared with	0.0	0.0	250 g potatoes prepared with	0.0	0.0
	10 g margarine	3.0	2.0	10 g rape oil	0.9	2.4
Snack	1 banana	0.1	0.1	1 banana	0.1	0.1
	2 slices crispbread	0.1	0.1	2 slices crispbread	0.1	0.1
	30 g quark, min. 20 % fat (dry weight)	0.9	0.0	30 g quark, min. 10 % fat (dry weight)	0.4	0.0
Dinner	2 slices brown bread, 50 g each	0.3	0.4	2 slices brown bread, 50 g each	0.3	0.4
	30 g salami	3.9	1.2	30 g turkey breast	0.2	0.2
	30 g Gouda, min. 60 % fat (dry weight)	6.9	0.4	30 g Gouda, min. 40 % fat (dry weight)	4.1	0.2
	10 g butter	5.4	0.2	10 g mustard	0.0	0.1
	150 g raw vegetables	0.0	0.2	150 g raw vegetables	0.0	0.2
"TV-Snack"	20 g milk chocolate	4.1	0.2	20 g walnuts	1.3	10.4
				1 kiwi	0.2	0.3
Total		39.2	6.6		16.4	23.7

Tab. 1: **Exchange of individual foods (encircled) to reduce the intake of saturated fatty acids and to increase the intake of polyunsaturated fatty acids in daily diet**
PUFA = polyunsaturated fatty acids; SFA = saturated fatty acids

tradictory picture concerning the preventive effect of the amount and type of fat when all subfractions are considered together (total cholesterol, LDL and HDL cholesterol, triglycerides, ratio of total to HDL cholesterol, ratio of LDL to HDL cholesterol). In the first version of the guideline, the evidence was only derived for the overall risk of dyslipoproteinaemia.

In accordance with the results of the first version, the revised guideline shows that plasma concentrations of total and LDL cholesterol are increased and thus negatively affected by higher intake levels of total fat and saturated fatty acids.

Altogether, it may be concluded that the evidence for a risk-reducing effect of an increased intake of long chain n-3 fatty acids concerning coronary heart disease and hypertension has been weakened. The evidence has also been weakened that increased intake of trans fatty acids increases the risk of coronary heart disease. Nevertheless, both risks are still present and relevant.

Practical implementation of the results

How do the results of the guideline affect the practical recommendations for food selection?

In order to optimise fatty acid composition, saturated fatty acids in the diet should be replaced by polyunsaturated fatty acids. This exchange is achieved for example by increasing the intake of vegetable fats and vegetable foods and, at the same time, by reducing the intake of animal fats and animal foods. ◆ Table 1 shows how exchanging individual foods can lead to a reduction in saturated fatty acids and an increase in the intake of polyunsaturated acids [4].

Fish is rich in polyunsaturated fatty acids, particularly long chain n-3 fatty acids and albeit of being of animal origin, it should not be eaten in small quantities, but once or twice a week as stated in the 10 guidelines for a wholesome diet by the DGE [5]. A particularly good way of attaining an optimal ratio of polyunsaturated to saturated fatty acids is to replace a meat meal with a fish meal. Fatty salt-water fish is an excellent source of long chain n-3 fatty acids. For example, a single portion of mackerel (125 g) contains 2.2 g long-chain n-3 fatty acids [4].

The quality of the fatty acids in nutrition can also be improved by careful selection of snacks. For example, one portion of walnuts contains considerably more polyunsaturated fatty acids and less saturated fatty acids than the same quantity of milk chocolate.

The results of the guideline also show that to promote health one should strive to minimise the in-

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take of trans fatty acids. Foods that are rich in trans fatty acids include deep-fried products, pastries (e.g. products with puff pastry), sweets and convenience products [6]. It is recommended that consumption of these foods should be reduced.

As reducing total fat intake has favourable effects, strategies should be applied to restrict total fat intake. One possible approach is to restrict the intake of animal foods, as these often contain a high proportion of fat, particularly hidden fat. A second approach is to select low fat variants of animal foods – fish is the exception. For example, a single portion of lean turkey meat (125 g) contains 14.5 g less fat than a portion of beef (125 g) [4].

Another way to restrict total fat intake is to have a high intake of vegetables and fruit. These foods contain high levels of water and dietary fibre and have a high energy density. Plant foods should generally be preferred, as they contain less fat than animal products, are free of cholesterol and have a more favourable fatty acid composition than most animal foods.

The results of the guideline may be summarised as follows:
Both the level and quality of fat intake are important for the prevention of obesity, coronary heart disease and dyslipoproteinaemias. In order to reduce the risk of these diseases, total fat intake should be restricted and the intake of saturated fatty acids and trans fatty acids should be reduced in favour of unsaturated fatty acids, particularly long-chain n-3 fatty acids.

Contribution of DGE guidelines to the derivation of food-based recommendations

The revised DGE Guideline on Fat Intake [2], together with the 2011 DGE Guideline on Carbohydrate Intake [7] and the D-A-CH Reference Values for Nutrient Intake [8] are the essential basis for the derivation of food-related recommendations for primary prevention. The DGE guidelines on fat and carbohydrate are based on systematic literature reviews and represent a general overview of the available scientific data. Based on those results of the DGE guidelines for which there is probable or convincing evidence together with the D-A-CH Reference Values for Nutrient Intake, practical recommendations for food selection and specific aids for orientation, such as the 10 guidelines for a wholesome diet by the DGE [5] are communicated considering German eating habits.

Conclusion

The results of the guideline show that total fat intake has an influence on the risk of obesity and dyslipoproteinaemias, but the risk of type 2 diabetes mellitus, hypertension, the metabolic syndrome, coronary heart disease, stroke or cancer is not affected by the level of fat intake.

Regarding the role of fat in the development of obesity, it must be emphasised that there is only an effect when total energy intake is not controlled for. If energy consumption is equivalent to the energy requirement and the energy balance is evened, the relation between the energy-supplying nutrients is irrelevant for the prevention of obesity. On the other hand, if nutrition is considered under *ad libitum* conditions and total energy intake is not controlled for, fat's high energy density becomes important and the risk of developing obesity increases on a diet with a high level of fat. Current scientific data shows that there is a positive association between the energy density of the diet and body weight [9]. As fat is the nutrient with the highest energy density, restricting fat intake can decrease the energy density of the diet and can contribute to maintenance or reduction of body weight. As obesity is a risk factor for many other diseases, it is a central aim of primary prevention to avoid obesity. Moderate fat intake within a dietary pattern with low energy density can help to maintain body weight and reduce the risk of the diseases listed above, even though the risk of these diseases is not directly affected by fat intake.

The media have long been interested in how fatty acids can influence the development of diseases. The results of the guideline show that a high intake of saturated fatty acids leads to increases in plasma concentrations of total and LDL cholesterol, but either does not affect other subfractions (ratio of total to HDL cholesterol), or may even have a favourable effect (triglyceride concentration). The level of intake of saturated fatty acids does not influence the prevention of the other diseases. However, saturated fatty acids should be reduced in favour of polyunsaturated fatty acids, as this reduces the risk of coronary heart disease. In practice, this means to adapt fat intake to energy requirements and replace saturated fatty acids with polyunsaturated fatty acids for example by preferring fish over meat or by using plant oil more often when preparing meals rather than using animal sources of fat or highly hydrogenated fats (◆ Figure 1).

The results of the guideline confirm the health advantages of eating fish regularly. The long-chain n-3 fatty acids in fish reduce the risk of coronary heart disease.

In accordance with the results of the DGE guideline, the intake of trans fatty acids should be kept as low as possible, as a high intake of trans fatty acids – as in pastries or convenience products – can increase the risk of dyslipoproteinaemia

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The 2015 DGE Guideline "Fat Intake and Prevention of Selected Nutrition-Related Diseases" was prepared by:

Angela Bechthold	German Nutrition Society, Bonn
Prof. Dr. Heiner Boeing	German Institute of Human Nutrition, Potsdam-Rehbrücke
Jessica Dinter	German Nutrition Society, Bonn
Prof. Dr. Sabine Ellinger	Faculty of Food, Nutrition and Hospitality Sciences, University of Applied Sciences, Niederrhein, Mönchengladbach
Prof. Dr. Hans Hauner	Else Kroener-Fresenius Center, Technical University of Munich, Munich
Prof. Dr. Anja Kroke	Department of Nutritional, Food and Consumer Sciences, University of Applied Sciences, Fulda
Dr. Eva Leschik-Bonnet	German Nutrition Society, Bonn
Prof. Dr. Jakob Linseisen	Institute of Epidemiology, Helmholtz Centrum, Munich
Prof. Dr. Stefan Lorkowski	Institute of Nutrition, Friedrich Schiller University Jena and Competence Cluster for Nutrition and Cardiovascular Health(nutriCARD), Jena-Halle-Leipzig
Prof. Dr. Matthias Schulze	German Institute of Human Nutrition, Potsdam-Rehbrücke
Prof. Dr. Peter Stehle	Institute of Nutritional and Food Sciences, University of Bonn, Bonn
Prof. Dr. Günther Wolfram	Technical University of Munich, Freising-Weihenstephan

Fig. 1: **The oils and fats side of the Three-Dimensional DGE Food Pyramid shows the foods at the base of the triangle which are to be preferred for reasons of nutritional physiology.**

and coronary heart disease. A 2013 report from the Federal Institute for Risk Assessment (*Bundesinstitut für Risikobewertung*; BfR) concluded that the level of intake of trans fatty acids in Germany does not represent a risk to health [6]. This has mainly been achieved by increased efforts to reduce the level of industrial trans fatty acids in foods. However, according to the BfR, 10% of consumers have eating habits which lead to a high level of intake of trans fatty acids. In future, it should be attempted to contact these consumers and inform them of the disadvantages of a high intake of trans fatty acids. It is not yet sufficiently examined whether there are important differences between trans fatty acids from ruminants or from processed plant fats with respect to biological effects and hence with the development of diseases.

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Dipl.-Oecotroph. Jessica Dinter[1, 2]
Prof. Dr. Heiner Boeing[3]
Dr. Eva Leschik-Bonnet[1]
Prof. Dr. med Günther Wolfram[4]

[1] Deutsche Gesellschaft für Ernährung (DGE), Godesberger Allee 18, 53175 Bonn
[2] E-Mail: dinter@dge.de
[3] Deutsches Institut für Ernährungsforschung (DIfE), Potsdam-Rehbrücke
[4] Department für Lebensmittel und Ernährung der TU München, München

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