Assessment of a possible connection between milk consumption and the development of type 2 diabetes mellitus

Updated BfR Opinion No. 017/2013 of 2 July 2013*

The Federal Institute for Risk Assessment (BfR) is publishing this opinion on a potential connection between the rising consumption of milk and dairy products and the development of type 2 diabetes mellitus. Individual observers have expressed the hypothesis that the rise in diabetes is due to the increased consumption of milk and dairy products. The theory is that above all the amino acid leucine, which is a natural ingredient of milk, plays a particular role by activating the body's own signal systems.

The BfR has evaluated the available scientific studies and comes to the conclusion that there is no evidence for a positive relationship between milk consumption and type 2 diabetes mellitus. There are, for example, no scientifically valid studies on humans that support this theory. Numerous epidemiological studies refute a positive connection between milk consumption and type 2 diabetes mellitus. What is rather the case is that favourable effects are believed to exist with regard to the development of type 2 diabetes mellitus.

Restricting consumption of milk and dairy products is not a meaningful strategy to prevent diabetes. Milk and dairy products should be part and parcel of a balanced diet, with preference generally being given to low-fat products.

BfR risk profile:
Milk consumption and diabetes (Opinion No. 17/2013)

A	**Affected group**	**General population**			
B	**Probability of health impairment due to the consumption of milk**	It is not assumed that a positive relationship exists between milk consumption and type 2 diabetes mellitus			
C	**Severity of health impairment due to the consumption of milk**	**No Impairment**	Slight impairment [reversible/irreversible]	Moderate impairment [reversible/irreversible]	Serious impairment [reversible/irreversible]
D	**Robustness of the available data**	**High: The most important data are available and are free of contradictions**	Average: some important data is missing or is contradictory	Low: much important data is missing or is contradictory	
E	**Possibility of consumer control**	**Control not necessary**	Can be controlled by taking precautionary measures	Can be controlled by refraining from consumption	Not controllable

Text fields with dark blue background highlighting characterise the properties of the risk assessed in this opinion (for more detailed information, please refer to the text in BfR Opinion No. [No./Year] dated [Day/Month/Year).

Explanations

The risk profile is designed to visualise the risk outlined in the BfR Opinion. It is not designed to permit risk comparisons. The risk profile should only be read in conjunction with the opinion.

FEDERAL INSTITUTE FOR RISK ASSESSMENT (BfR)

* Diese aktualisierte Stellungnahme ersetzt die Stellungnahme des BfR vom 4. Januar 2012

1 Subject of the assessment

The Federal Institute for Risk Assessment (BfR) is publishing this opinion on a potential connection between the rising consumption of milk and dairy products and the development of type 2 diabetes mellitus. It is doing so in response to the hypothesis expressed by individual observers that high protein consumption, in particular of the essential amino acid leucine, through the consumption of milk and dairy products is associated with an increased risk of the development of type 2 diabetes mellitus.

2 Findings

The data on a possible connection between milk consumption and type 2 diabetes mellitus is contradictory, but the majority of studies show that milk and dairy products have a protective effect with regard to the development of type 2 diabetes and metabolic syndrome. Metabolic syndrome is characterised by, among other things, insulin resistance and is seen as a risk factor for coronary heart diseases and other illnesses. Reducing the consumption of dairy products is not considered a meaningful strategy for diabetes prevention.(Low-fat) Milk and dairy products should be part and parcel of a balanced diet.

3 Statement of reasons

Individual hypotheses on the development of type 2 diabetes mellitus due to the consumption of milk and dairy products have no scientific basis. There are, for example, no scientifically valid studies on humans that support this theory.

Numerous epidemiological studies refute a positive relationship between milk consumption and type 2 diabetes mellitus. A meta-analysis published in 2011 showed an inverse association between daily consumption of dairy products, above all low-fat dairy products, and type 2 diabetes mellitus. Milk and dairy products can therefore be assumed to have positive effects with regard to the development of type 2 diabetes mellitus (Tong et al., 2011).

4 Risk assessment

Due to their high concentration of saturated fatty acids, milk and dairy products have occasionally been viewed critically in the past with regard to the development of overweight and cardiovascular diseases. However, epidemiological studies have ruled out a negative effect of dairy products on the development of these diseases (Snijder et al., 2007, Soedamah-Muthu et al., 2011). On the contrary: low-fat dairy products in particular have even been found to reduce the risk of metabolic syndrome and cardiovascular disease (Pereira et al., 2002, Elwood et al., 2007, Azadbakht et al., 2005, Elwood et al., 2008). They are also considered to reduce the risk of type 2 diabetes mellitus (Ferland et al., 2011, Margolis et al., 2011, Wennersberg et al., 2009).

5 Discussion

The assumed favourable effects of dairy products with regard to the risk of developing type 2 diabetes mellitus can partly be attributed to the effect on factors that promote the disease such as body weight (Hu, 2008) and glucose homeostasis (Tremblay and Gilbert, 2009). Certain ingredients of milk, such as calcium and milk protein, have been discussed as having positive effects on body weight and blood pressure (Tremblay and Gilbert, 2009).

However, the findings of prospective cohort studies do not indicate any role of dairy products in weight control (Hu, 2008, Rajpathak et al., 2006). The "Dietary Approaches to Stop Hypertension (DASH)" study established a connection between the consumption of 3 portions of low-fat milk and other dairy products daily and lower blood pressure, showing this effect to almost twice that achieved by a diet low on dairy products but containing a high amount of fruit and vegetables (Sacks et al., 2001).

Milk proteins like those in whey can have insulinotropic properties and improve glucose tolerance due to their relatively low glycemic load (GL) (King, 2005). Moreover, other ingredients in dairy products, including medium-chain fatty acids, calcium, vitamin D and magnesium can reduce insulin resistance (Tremblay and Gilbert, 2009, Larsson et al., 2007, Pittas et al., 2007, Azadbakht et al., 2005).

While the consumption of dairy products can also be associated with a lower GL, some studies found a GL-independent association between the consumption of dairy products and type 2 diabetes mellitus (Liu et al.,2006, Choi et al., 2005).

Individual observers have expressed the hypothesis that branched-chain essential amino acids are responsible for the development of diabetes because they activate the body's own signal systems. These amino acids include leucine, for example, which occurs naturally in milk.

Amino acids activate the enzyme "mammalian target of rapamycin" (mTOR) enzyme (Dennis et al., 2011). The mTOR enzyme is part of the mTOR protein complex 1 (mTORC1), which integrates different signal paths of growth factors, the energy household and the oxygen concentration of the cell, regulating the translation of proteins and thereby controlling cell growth and cell cycle. The mTORC1 complex promotes nutrient-induced insulin resistance by downward regulation of the insulin receptor substrate proteins (Fraenkel et al., 2008). However, no scientifically valid studies that provide evidence of activation of mTORC1 by dairy products are known.

Milk consumption stimulates insulin-like-growth-factor 1 (IGF-1) and activates the incretin, glucose-dependent insulinotropic polypeptide (GIP) in dependence on milk protein (Nilsson et al., 2007). Activation of GIP to stimulate insulin release was observed in particular following the administration of milk proteins. This resulted in a reduced postprandial glucose rise (Frid et al., 2005). This mechanism is being discussed as the factor behind the protective effect of milk and dairy products with regard to the development of type 2 diabetes mellitus. It is therefore not possible to understand how the stimulation of GIP caused by amino acids is supposed to lead to poorer blood sugar regulation.

An increase in protein consumption has been observed in Germany since the 1950s, which means that leucine is also being consumed in larger quantities. During the same period, however, calorie intake and the intake of macronutrients, in particular fat, have also increased. There is no evidence whatsoever that the rise in leucine intake has led to an increased incidence of type 2 diabetes mellitus. What is rather seen as the cause is the massive increase in overweight and obesity as the expression of a dysregulated energy balance. There are no epidemiological studies or intervention studies showing a statistically validated relationship between leucine intake and diabetes mellitus.

6 Framework for action / Measures

The BfR does not see any need for action.

7 References

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