Diabetes Barometer 2005

Klas Winell, Antti Reunanen




DEHKO

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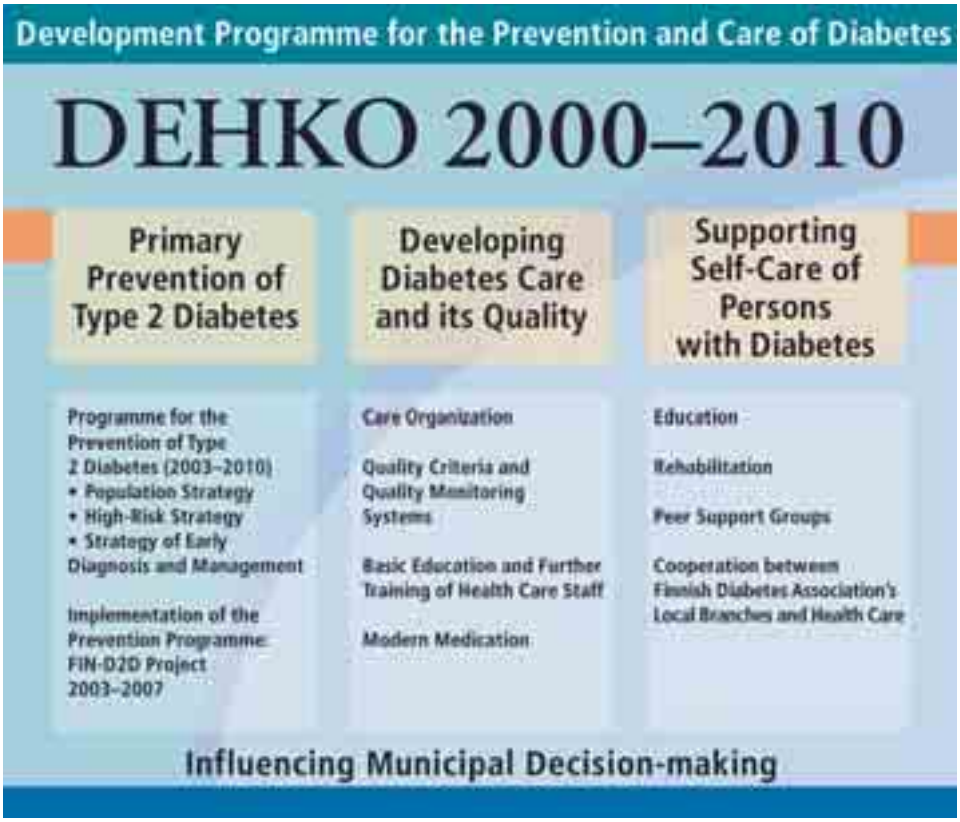

Diabetes Barometer
Published by Finnish Diabetes Association
ISBN 952-486-023-6
ISBN 952-486-024-4 Net version
Design and layout by Aino Myllyluoma
Printed by Kirjapaino Hermes Oy, Tampere 2006

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Summary

This Diabetes Barometer, the first compilation report of the National Diabetes Programme (DEHKO 2000–2010), deals with health outcomes among, and care of, Finns with diabetes. The Barometer describes trends during recent years in the light of research findings and presents desirable development trends for the future. The intention is to revise the Barometer at three-year intervals.

The Barometer is a response to the need for adequate background information about diabetes in order to facilitate decision-making on health policy. It has been written both for use by the Finnish Diabetes Association and for wider use in decision-making by national and local-level bodies pondering development of health-care structures.

The trends revealed in the Barometer are alarming. The number of persons with diabetes is increasing even faster than had been estimated earlier. The diabetes epidemic, caused by increasing overweight among the population, seems to have taken everyone by surprise. If overweight among the population continues to increase at the current pace, almost every other adult will be at risk of developing type 2 diabetes. This is why we need to take prompt actions to prevent weight gain among the population.

Care resources will diminish because of this epidemic. If we don't succeed in curbing the outbreak of type 2 diabetes, our possibilities to take good care of everyone with diabetes will weaken. Prevention of type 2 diabetes calls for widespread information in the media providing guidance on healthy lifestyle; awareness of the risks involved and the means for averting obesity must be increased through active campaigning both locally and nationally. Those at high risk for diabetes need the guidance of health care professionals; in addition, there is a need for guidance in physical exercise and nutrition. Better preconditions must be created to promote physical exercise and healthy eating habits.

The Barometer shows that the situation for people who already have diabetes has improved in many ways. The risk of diabetes-related complications or premature death among people with diabetes has fallen. Complications of diabetes, both cardiovascular diseases and microvascular complications, e.g. renal diseases and ophthalmic diseases, are diminishing. It appears likely that the DEHKO goals for reductions in the occurrence of complications will be met by the year 2010. These additional diseases are the major source of costs arising in care for people with diabetes, and efforts to reduce their occurrence must be intensified, for both humane reasons and economic reasons.

A high blood sugar level is already in itself a risk for cardiovascular diseases. Many patients with type 2 diabetes also have other risks caused by metabolic syndrome, such as changes in blood lipids, high blood pressure and obesity, which in turn increase the arterial disease risk. Optimal care has reduced the total risk load of people with diabetes. Especially positive has been the lowering of blood sugar and lipid levels among people with type 2 diabe-

tes. Positive changes have been less clear for blood pressure and nonexistent for reducing smoking.

There has been hardly any change in the glycemic control of persons with type 1 diabetes during the last ten years. Too few persons with type 1 diabetes have optimal metabolic control. Glycemic control is especially poor among adolescents and young adults.

In care for people with diabetes, there is a need to improve counselling in nutrition and exercise. Examination of feet and treatment of foot problems must also be improved. There are major regional and local differences in diabetes care. In order to reduce these differences, attention must be paid to equity of resources and comprehensive continuing education of health care professionals.

Care systems should be developed further so that people with diabetes in the future have better preconditions for self-care than at present. Special priority should be given to ensuring the self-care and related skills among patients with type 1 diabetes whose glycemic control is poor. Special services should be developed for young people nearing adulthood, so that the extended period of poor glycemic control during adolescence could be shortened.

People with diabetes should have better possibilities for rehabilitation and peer support. Peer support from others with diabetes can provide answers to the diabetes-related problems occurring in daily life. Persons with a long-term disease need constant encouragement to improve care. Some persons with diabetes also need the help of mental health professionals so that they could cope with the fatigue caused by living with a chronic condition.

1. Terms and abbreviations

Barometer	A popularised description of a trend revealed by research findings
Body mass index	The ratio between a person's weight and height; calculated by dividing weight by the square of height (kg/m^2)
Care chain	A service entity consisting of various health-care professionals and care organizations working in cooperation
Electronic medical record	Computer software including the patient record
Central obesity	Waist circumference ≥ 94 cm for men and ≥ 80 cm for women
Complication	A disorder or an injury caused by the underlying disease
DEHKO	Development Programme for the Prevention and Care of Diabetes in Finland 2000–2010
Diabetes	A group of metabolic disorders associated with an elevated blood glucose level (venous plasma fasting value ≥ 7.0 mmol/l [≥ 126 mg/dL] or a two-hour glucose tolerance test result of ≥ 11.1 mmol/l [≥ 200 mg/dL])
Distribution of care equipment	A statutory service arranged by health centres for persons with a chronic disease. Through this service, persons with diabetes receive equipment for the self-monitoring of blood glucose levels and for injections.
Foot therapist	A person specifically trained for foot care; a podiatrist
HbA_{1c}	Glycosylated hemoglobin, describes the blood glucose level over a period of 2–3 months
High-risk strategy	A strategy in the programme for the prevention of type 2 diabetes in Finland. The aim is to prevent diabetes in individuals with a particularly high risk of developing type 2 diabetes.
Hypoglycemia	Abnormally low level of sugar in the blood
Incidence of a disease	The number of new cases of the disease. Often given as a ratio per 100,000 inhabitants during the year in question.
Infarction	Necrosis caused by a localised obstruction of blood supply, e.g. an artery occlusion
Insulin derivative	Insulin whose properties have been altered by modifying its amino acid composition
KELA	The Social Incuranse Institution of Finland
Ketoacidosis	Abnormal increase in the acidity of the body caused by a high level of blood glucose
Metabolic syndrome	The definition has varied. According to the latest definition of the International Diabetes Federation (IDF) (2005), metabolic syndrome involves central obesity plus any two of the following four factors: raised blood pressure, reduced HDL cholesterol, raised triglyceride level, raised fasting plasma glucose.
Person at risk	A person who has a trait increasing the risk of developing the disease
Prevalence of a disease	Number of people having the disease. Usually given as a ratio per 100,000 inhabitants during a certain period.
Risk factor	An inherent or a lifestyle-related factor increasing the risk of developing a disease
Self-care	Daily combination of medication, physical activity, meals and one's own daily routines
STAKES	National Research and Development Centre for Welfare and Health
Adaptation counselling	Providing mental and information-related support to a person with diabetes
Statin	A drug lowering the level of lipids in blood
Type 1 diabetes	Juvenile diabetes
Type 2 diabetes	Adult-onset diabetes
Waist circumference	Circumference of the body measured 2 cm above the navel

2. Introduction and objectives

The main objective of the Diabetes Barometer is to provide both the health-care authorities and the Finnish Diabetes Association's decision-makers with background information for health policy outlines. The authors present their own views of the findings or needs for development at the end of each concluding section.

The idea of the barometer was presented in the DEHKO report "Diabetes Care Quality and Monitoring Systems", which concerned the diabetes registry. As the report was being prepared, it became obvious that there is a need for periodic summaries on the development of diabetes prevention and care in Finland. This also serves the assessment of how DEHKO has been implemented.

The principal objective of the barometer is to provide a popularised description of the occurrence, prevention and care of diabetes and its complications and of the associated trends in Finland. Every section ends with a short description of the scientific evidence underlying each summary. Since the Diabetes Barometer is a report of the diabetes situation in Finland, the references are mainly based on Finnish research reports.

3. Prevalence of diabetes

3.1 Trends in the number of persons with diabetes

Diabetes in Finland has become a public-health problem that already affects 10 per cent of Finland's adult population. Diabetes care encompasses about 280,000 persons, of whom the great majority have type 2 diabetes. In addition, about 200,000 Finns have the disease without knowing it. At the present rate, the number of people receiving diabetes care in Finland will double every 12 years, and so far nothing indicates that the increase in diabetes would be coming to a halt.

The number of those with type 1 diabetes totals about 40,000 people. They account for roughly 15 per cent of the total population with diabetes.

The prevalence of both type 1 and type 2 diabetes among the Finnish population is rising rapidly. The reasons behind the increase of type 1 diabetes are not yet known; however, it is assumed that infectious diseases play a role alongside hereditary factors. The factors contributing to the rise in type 2 diabetes include increased obesity and insufficient physical activity among the population.

About 500,000 Finns have impaired glucose tolerance and run a marked risk of developing type 2 diabetes. In fact, 5–10 per cent of these people contract diabetes every year.

The frequency and rapid increase of type 2 diabetes require prioritisation of preventive measures. Resources are needed for counselling about nutrition and physical activity, and for setting up physical activity groups. Additional input is needed in the health-care system for the screening, education and care of persons at risk.

Research data

Research data concerning the prevalence of diabetes can be obtained from population research projects and register research. The former is a more reliable source of information, and the best available information about Finland is from the year 2000, when a comprehensive Health 2000 study was carried out. Information suited to register research can be obtained from KELA's (the Social Incurance Institution of Finland) registers on reimbursement for medication, from STAKES's (National Research and Development Centre for Welfare and Health) discharge register, and from the cause of death register kept by Statistics Finland.

The information about the type of diabetes is uncertain both in studies based on register data and in studies based on interviews. Sometimes it may also be difficult to determine the type of diabetes in clinical examination.

The Health 2000 study reported that 6.6 per cent of Finns of 45–74 years of age who were included in the study had diabetes and were aware of the disease. In addition, 6.2 per cent had diabetes that had not been diagnosed previously.

Altogether 39.4 per cent of subjects showed signs of glucose metabolism disorders, in varying degrees (1). The number of people treated for type 1 diabetes has increased by nearly 4 per cent yearly during the past ten years or so. Of the persons with type 2 diabetes who had been treated for their diabetes, diet was the only type of treatment for 30 per cent of the subjects. It has been estimated on the basis of the study that there were 218,000 persons with diabetes in Finland at the end of 2003 (2).

In 2004, altogether 195,027 Finns were refunded by KELA for their diabetes medication. This was 7.2 per cent more than the year before (3). At the end of 2004, in total 161,305 persons with diabetes were entitled to special refund for their diabetes medication, and the number of people who were granted the right to special reimbursement increased by 5.7 per cent on the figure for the previous year (4).

The incidence of type 1 and type 2 diabetes is distributed among an ever wider age range. Even children develop type 2 diabetes, and drug therapy for type 1 diabetes is started among older people (Figure 1) (5).

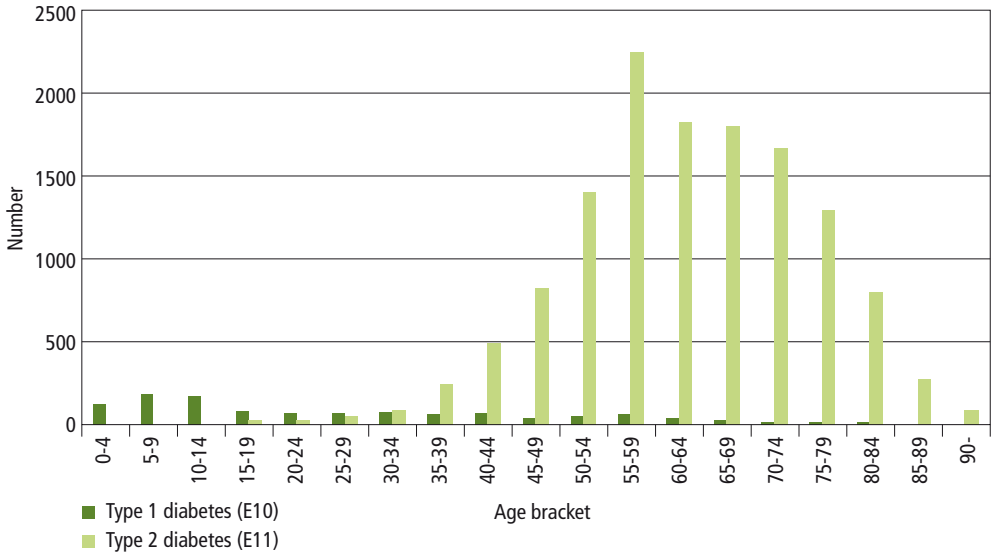


Figure 1. Start of the special refund entitlement for new diabetes medication in various age brackets in 2004.

A glucose tolerance test was carried out in three areas of Finland for 2,642 persons aged between 45 and 64 years. Type 2 diabetes was determined for 10 per cent of men and for 7 per cent of women, while 11 per cent of men and 9 per cent of women had impaired glucose tolerance and 14 per cent of men and 5 per cent of women had impaired fasting glucose (6).

Among persons with impaired glucose tolerance, 75 per cent also had metabolic syndrome (7). The Diabetes Prevention Study showed that if nothing is done, between 5 and 10 per cent of patients who have impaired glucose tolerance develop diabetes each year (8).

A study conducted on the basis of KELA's medication registers and STAKES's hospital discharge register indicated that there were 184,721 persons with diabetes in Finland at the end of 2002. Of them, 13 per cent had type 1 diabetes and 74 per cent had type 2 diabetes. The diabetes type was uncertain for 13 per cent (9). The same study concluded that the number of people who receive treatment for type 2 diabetes has increased on average by nearly 7 per cent per year for the past 15 years.

The prevalence of diabetes in the other Nordic countries is similar to that in Finland. In Central Europe and Russia there are more people with diabetes than in Finland (10). Diabetes among children is increasing rapidly in Finland in all age groups. Since 1990, the incidence has risen by over 40 per cent (11). International comparison shows that the incidence of diabetes in children is exceptionally high in Finland, and Finland tops the international statistics (Figure 2) (10).

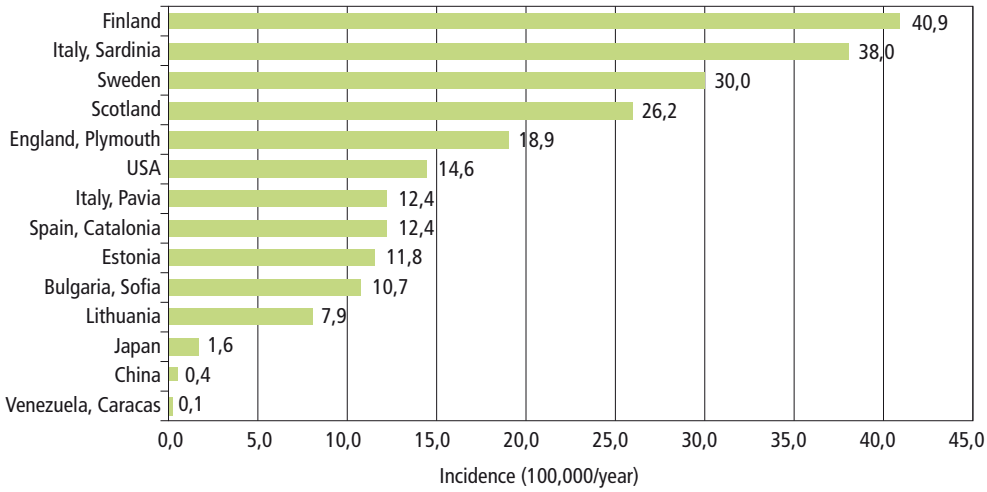


Figure 2. International comparison of the incidence of diabetes in children in 2003.

3.2 Regional prevalence of diabetes

Regional differences exist in the prevalence of diabetes. The prevalence of type 1 diabetes is the greatest in Eastern Finland and the lowest in Northern Finland. Type 2 diabetes is the most common around central and southeastern parts of Finland, while the lowest figures are observed on the western coast.

Regional differences stem from hereditary factors, the environment and lifestyle.

Research data

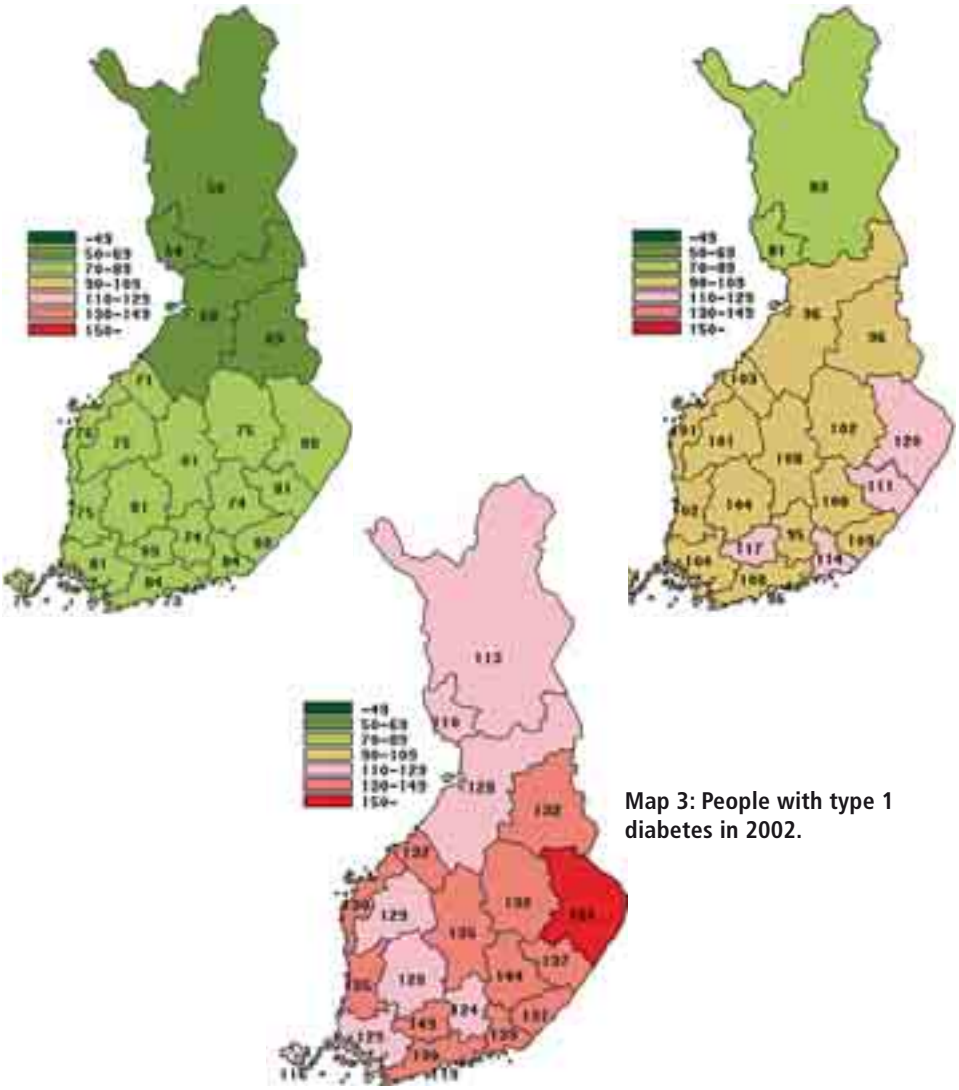
Type 1 diabetes is becoming more common in all of Finland. Regional differences exist in its prevalence (Maps 1–3). The greatest prevalence is found in Northern Karelia, Kanta-Häme and Southern Savo. The lowest figures are in Länsi-Pohja, Lapland, Åland and Helsinki (Figure 3) (9).

The prevalence of type 2 diabetes is the greatest in Ostrobothnia and Eastern Savo. The lowest prevalence is in Åland (Figure 4) (9).

There were major regional differences in the numbers of people who were entitled to special reimbursement for their diabetes medication. When the population was standardised for age, 1.8 per cent of the population in Åland and 3.7 per cent of the population in Eastern Savo received special reimbursement for diabetes medication (12).

Map 1: People with type 1 diabetes in 1988.

Map 2: People with type 1 diabetes in 1995.



Map 3: People with type 1 diabetes in 2002.

Figure 3. Prevalence of type 1 diabetes by hospital district in 1988, 1995 and 2002. Standardised for age and gender, the year 1994 for the whole of Finland = 100.

Map 4: People with type 2 diabetes in 1988.

Map 5: People with type 2 diabetes in 1995.

Map 6: People with type 2 diabetes in 2002.

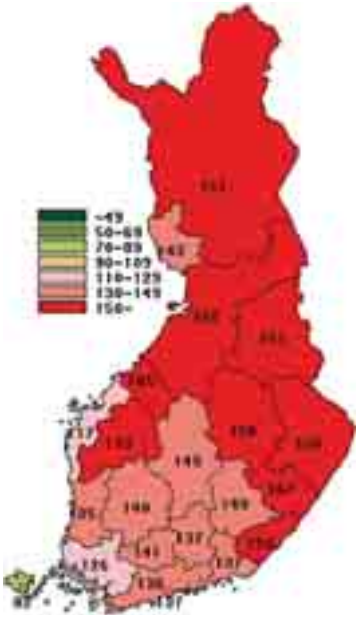


Figure 4. Prevalence of type 2 diabetes by hospital district in 1988, 1995 and 2002. Standardised for age and gender, the year 1994 for the whole of Finland = 100.

4. Prevention of diabetes

The risk factors of type 1 diabetes are not known well enough for preventing the disease. However, the causes of the disease are being researched actively, and study projects aimed at prevention are under way.

The risk factors of type 2 diabetes include obesity and insufficient physical activity. Obesity is by far the most important factor.

In both diabetes types, hereditary factors affect the risk of developing the disease.

Metabolic syndrome is common among the Finnish population. The syndrome is often associated with impaired glucose tolerance. People who have the syndrome run a high risk of developing type 2 diabetes and artery diseases.

The average weight of Finns is rising constantly, and especially the share of markedly obese people among the population is on the increase. The situation has even been characterised as an obesity epidemic. What gives cause for the greatest concern is that there are more and more overweight children and young people.

Finns' intake of energy from food exceeds their energy consumption even though some positive changes in the content of food have taken place. The mix of nutritive elements in food is not yet in keeping with recommendations. Increased physical activity during free time and reduced smoking have not been sufficient to offset the negative effects caused by larger amounts of food and reduced physical activity associated with work.

Special measures must be taken to prevent overweight and obesity among children and young people. Children must be ensured possibilities for regular meals and for regular and sufficient physical activity.

Research data

The occurrence of type 2 diabetes can be prevented or at least postponed (13). Even moderate changes in lifestyle are enough to produce good results (14).

The Finrisk study revealed that 39 per cent of men aged between 45 and 64 years and 22 per cent of women of the same age have metabolic syndrome (7).

Finns' nutritional situation has improved, but food still contains more hard fats and less fibrous hydrocarbons than recommended (15).

The increase in obesity that is taking place in all age groups already meets the criteria of an epidemic. The rise in obesity among children and young people is particularly worrisome (16).

4.1 Obesity and nutrition

The average body mass index (BMI) of the Finnish population continues to rise. One in five Finns is obese and even more Finns have central (abdominal) obesity. Obesity is a significant risk factor of type 2 diabetes, and since obesity is becoming more common, type 2 diabetes is expected to increase dramati-

cally among the population.

If a person's weight rises from the normal weight by 40 per cent (e.g. a normal weight of 72 kg becomes 100 kg), the risk of developing type 2 diabetes increases 100-fold. Central obesity, associated with a great amount of visceral fat, is considered to be an even greater diabetes risk than a general rise in weight.

The constant rise in people's weight is explained by changes in the social and technological environment and by an abundant supply of food combined with a pleasure-seeking lifestyle. Arduous physical activity has become less common. Fat and alcohol are consumed in excessive amounts. Overweight feeds upon itself; a beginning rise in weight leads to obesity unless the circle is cut. At the individual level, the vicious circle of obesity needs to be cut by reducing the intake of calories and by increasing the burning of ingested calories.

In general, Finnish food has improved; for instance, the use of vegetables has increased. Finns' blood cholesterol values have shown a downward trend.

Use of green vegetables, fruit and berries, whole-meal products, vegetable oils and margarine reduces the risk of type 2 diabetes.

Research data

Obesity can be described using the body mass index (BMI) or the waist circumference. The BMI of the Finnish population has been growing steadily for the past 20 years. Among men between 30 and 59 years of age, 32 per cent are of normal weight (BMI under 25). For women, the corresponding figure is 47 per cent. Altogether 21 per cent of men and 20 per cent of women are obese (BMI at least 30) (17). For Finnish men, the average BMI has risen from 26 to 27 during the past 30 years. The rise has also been statistically significant during the past five years. No corresponding increase in the average BMI has been observed among women (18).

A health behaviour study conducted among the adult population found that 47 per cent of men and 61 per cent of women were within the normal weight limits (19). According to the Health 2000 study, about 21 per cent of Finns between 30 and 64 years of age were obese; the percentage was virtually the same for both men and women. Among people 65 years of age or older, 21 per cent of men and 31 per cent of women were obese. According to the same study, 31 per cent of men and 42 per cent of women had a high waist circumference (at least 102 cm for men and 88 cm for women). The percentages for men and women with a high waist circumference, who were at least 65 years of age, were 32 per cent and 52 per cent (20). The proportion of obese men was the highest in Western Finland (24 per cent of all men over 30) and the lowest in Southern and Northern Finland (19 per cent). The proportion of obese women was the highest in Eastern Finland (28 per cent) and the lowest in Southern Finland (22 per cent) (20).

Obesity is increasing because we get more energy from our food than our metabolism consumes. The factors contributing to this trend include changes in society and technology, the abundant supply of food, and a pleasure-seeking lifestyle. Obesity reduces physical activity and reinforces social exclusion; both of these increase obesity even further (16).

Owing to insulin resistance, obesity activates insulin secretion (21).

The risk of being affected by type 2 diabetes increases as a person's weight rises, and the increase is exponential with the rise in the body mass index. When the BMI rises from the normal level to over 35, the risk of developing diabetes increases nearly 100-fold (22).

Nutritional recommendations stress a high intake of carbohydrates and a low intake of fat (15). Better weight loss was achieved with a low-fat diet where carbohydrates were replaced by large amounts of protein (23).

Alcohol is a major contributor to energy intake. Alcohol consumption has risen constantly. In 2002, one fifth of men and 4 per cent of women consumed more than 14 units of alcohol per week (one unit = 12–15 g of alcohol) (18). Alcohol prevents the burning of fat in the same way as carbohydrates do.

It has been found that the use of green vegetables, fruit and berries, and vegetable-based oil and margarine has an inverse correlation with the risk of type 2 diabetes. The same inverse relation was determined for the intake of whole-meal products when the follow-up period was limited to 10 years (24). Vitamin E from vegetables showed a strong inverse correlation with the incidence of type 2 diabetes (25).

Dietary patterns adopted in childhood continued into adulthood (26).

The cholesterol level of the Finnish population fell steadily from 1972 to 1997. According to the measurement carried out in 2002, this positive trend had come to a halt. In 2002, the average cholesterol level for men between 30 and 59 years of age was 5.7 mmol/l and that for women was 5.4 mmol/l (18).

4.2 Physical activity and weight control

In the long term, physical activity during free time has increased considerably. At the same time, physical activity associated with work and with trips to and from work has diminished. More than half of the population engages in some physical activity. Most people don't get as much physical exercise as their metabolism would require. The patterns of physical activity learned in childhood and in adolescence continue in adulthood.

Organs require both prolonged, fat-burning exercise and exercise that strengthens muscles. Physical activity plays a minor role in energy consumption, but abundant physical activity is needed because it has a positive effect on glucose metabolism. In consequence, physical activity plays an important role in the prevention of type 2 diabetes.

Research data

According to the Finrisk study, 20–28 per cent (depending on the region) of Finns have less than 4 hours of physical activity per week. In total, 51 per cent of men between 30 and 59 years of age and 58 per cent of women of the same age have at least 20–30 minutes of physical activity a day at least 2–3 times a week during their free time. The number of women who have physical activity during their free time roughly doubled within the last 30 years, while the corresponding increase among men was about 50 per cent. However, the situation did not change much between the years 1997 and 2002 (18).

According to the health behaviour study conducted among the Finnish adult population, about 60 per cent of adult Finns (15–64 years of age) have at least 30 minutes of physical activity a day during their free time on at least two days a week. The number of physically active people increased by about 50 per cent within a period of 25 years. The share of men who have at least 15 minutes of physical activity on their way to and from work has decreased correspondingly. This change is not as sharp among women (19).

The number of people who feel that their work is physically taxing has diminished markedly during 30 years. The number of women who feel that way has almost halved, to about 22 per cent, and for men, too, the drop has been almost as steep, from 55 to 35 per cent (18).

According to the Health 2000 study, 22 per cent of men between 30 and 64 years of age and 26 per cent of women of the same age had sweat-inducing physical exercise for at least half an hour on four days a week. The corresponding percentages among people 65 years of age or older were 39 and 32 per cent, respectively (20). Among both men and women, people in Western Finland had the least physical activity (ca. 23 per cent). The highest percentage of physically active women was recorded in Central Finland (29 per cent).

A follow-up study conducted after 21 years had passed showed that people who had had much physical activity in childhood and in adolescence were also physically active in adulthood (27).

Physical activity plays a relatively small role in energy consumption. An hour of physical exercise a day increases energy consumption by about 10 per cent, and an hour a week by 1–3 per cent (28). However, physical activity is an important factor in the prevention of type 2 diabetes. When the effects of nutrition and weight were standardised, the amount of physical activity during free time proved to be a significant factor explaining the reduction in the occurrence of diabetes (29).

4.3 Other factors affecting the incedence of diabetes

Susceptibility to diabetes runs in the family. Diabetes among first-grade relatives is a warning sign of the risk. Smoking increases and moderate consumption of alcohol reduces the incidence of type 2 diabetes. About a quarter of the working-age population smokes daily. Smoking has diminished over a long time span, but the positive trend has levelled off within the past ten years. By tackling the issue actively, health-care personnel can influence smoking.

A low birth weight increases the risk of developing type 2 diabetes. There is some evidence indicating that coffee would reduce the incidence of type 2 diabetes. Mental health problems reduce physical activity, increase weight and thereby also the incidence of type 2 diabetes.

Research data

There are about 1.3 million Finns who smoke regularly. Among men between the ages of 16 and 64 years, 26 per cent smoke daily, while the figure for women of the same age is 19 per cent (17). Within the past 30 years, smoking among men

between the ages of 30 and 59 years decreased in the regions covered by the Fin-risk study, the fall being from about 50 per cent to about 35 per cent. During the same period, smoking among women of the same age doubled (18). According to the health behaviour study conducted among the adult population, the share of adults who smoke daily has remained nearly the same for the past ten years (19). The Health 2000 study showed that 32 per cent of men and 22 per cent of women between 30 and 64 years of age were smokers. Among men and women who were 65 years or older, 16 and 5 per cent were smokers (20).

Smoking among women is the most common in Southern and Northern Finland (19–20 per cent of women over 30 years of age), and the least common in Eastern and Western Finland (14 per cent). The proportion of smoking among men is the highest in Central Finland (32 per cent) and the lowest in Northern Finland (27 per cent) (20).

Cessation treatment may help smokers to cut their nicotine addiction or habitual smoking. Even a short discussion with health-care personnel about the benefits of quitting smoking brings about a significant reduction in smoking (31).

Moderately high consumption of coffee would seem to reduce the incidence of type 2 diabetes (32).

A low birth weight increases susceptibility to type 2 diabetes. Speed of growth and development of weight in early childhood also affect the risk of diabetes. The later the BMI takes an upward turn after a falling phase, the smaller the risk of the disease (Figure 5). Thus, susceptibility to type 2 diabetes is already programmed during pregnancy (33).

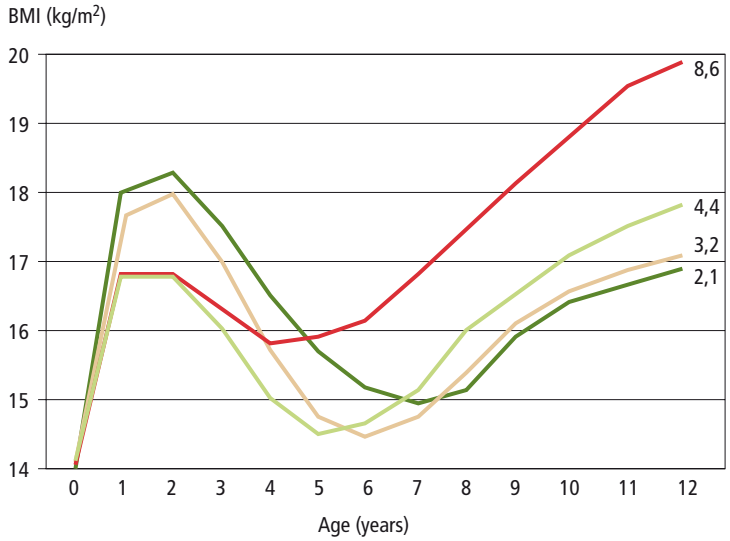


Figure 5. Prevalence of type 2 diabetes in adulthood in relation to the age when the BMI starts to rise again after falling in early childhood (known as the adiposity rebound). The prevalence of diabetes is 8.6 per cent in the group where the adiposity rebound occurred at the age of 4 years or younger, and 2.1 per cent in the group where the adiposity rebound occurred at the age of 7 years or older.

5. Current practices in the prevention and care of diabetes

5.1 Prevention

One of the main policy objectives of the Development Programme for the Prevention and Care of Diabetes in Finland (DEHKO 2000–2010) is to prevent type 2 diabetes. To this effect, a programme has been drawn up within DEHKO for the prevention of type 2 diabetes. Encompassing the years 2003–2010, the programme is based on three strategies: the population strategy, the high-risk strategy, and the strategy of early diagnosis and management. By taking actions aimed at the entire population, the population strategy strives to affect the risk factors of type 2 diabetes and to prevent metabolic syndrome. The primary health-care system and the occupational health-care system implement the high-risk strategy and the strategy of early diagnosis and management, the aim of which is to prevent the onset of type 2 diabetes, to diagnose diabetes at an early stage and to bring people with diabetes into the sphere of active treatment.

The prevention programme is put to practice in the FIN-D2D Project (2003–2007), implemented in five hospital districts. The project develops models of action for risk assessment, education and early treatment. By the end of 2005, a total of 70,000 people had undergone risk assessment within the project. People who get a high risk score are referred for intervention. The efficacy and cost-effectiveness of the FIN-D2D Project are assessed, and the models of action and experiences of the project will be spread throughout Finland for use by the health-care system.

To be successful, prevention requires more personnel for education and for leading physical activity groups. Since half a million people are at risk of contracting diabetes, additional resources are needed so that the lifestyles of the population can be influenced as necessary.

Research data

Middle-aged, overweight persons who had impaired glucose tolerance were given lifestyle counselling pertaining to nutrition, fats and physical activity. A controlled study showed that type 2 diabetes can be prevented (13).

The Programme for the Prevention of Type 2 Diabetes is described in the DEHKO Publication Series (34, 35). Within the FIN-D2D Project, risk assessment was performed for 48,000 persons in 2004 alone. By the end of 2005, the goals set for screening had been exceeded, and the number of people screened had reached 70,000. However, the number of people who have been referred for the intervention implemented within the project is smaller than had been expected. By the end of 2005, nearly 12,000 people had participated in the intervention.

As such, screening by means of a risk test could also be seen as intervention, but according to the definition given in the project plan, intervention means intensive intervention carried out within the health-care system. It is estimated that half of the persons screened would need intensive intervention (36).

5.2 Type 1 diabetes

Treatment for type 1 diabetes replaces the insulin that the body lacks. Insulin is dosed so that it imitates the body's natural insulin secretion. This type of treatment has increased constantly along with the development of insulins. Long-acting and fast-acting insulins enable individual treatment that is adapted to each person's own life and daily rhythm.

The use of human insulins has diminished quickly, and insulin derivatives have taken their place. Insulin analogues with a prolonged action time are a more common type of treatment among children and young people than long-acting human insulins. One reason for the change is the smaller number of night-time hypoglycemias associated with the use of the new insulins. The insulin pump is still a rare form of treatment.

Persons with type 1 diabetes often have metabolic syndrome as well. Since this increases their risk of developing artery diseases, this information should also affect care practices. Metabolic syndrome is more common among people who have kidney problems and who have poor glycemic control.

Dosing of meal insulin is based on carbohydrate calculation, and good carbohydrate calculation is a prerequisite for good care of type 1 diabetes. People with diabetes do not manage carbohydrate calculation very well. Counselling methods should be developed further so that people with type 1 diabetes would learn to use modern insulin treatment which, if carried out properly, allows changes in the daily rhythm of meals and in food contents.

Research data

According to the statistics on reimbursement for costs of medication, people with diabetes have reduced their use of human insulin and have begun to use insulin analogues. The use of insulins with a prolonged action time has increased rapidly (37). Insulin analogues make up about 60 per cent of the insulin used by children and adolescents with diabetes (38).

Long-acting insulin analogues are recommended if the patient often has episodes of hypoglycemia at night (39).

The FinnDiane study investigated the frequency of metabolic syndrome among people with type 1 diabetes. The prevalence in a group of 2,415 patients was found to be about 40 per cent. Renal changes and poor glycemic control increased the prevalence of metabolic syndrome (40). According to experience gained at the Diabetes Centre, many persons with diabetes unfortunately do not know how to calculate their intake of carbohydrates well enough, and cannot utilise the information in dosing their insulin in connection with meals (41). Major differences between care units were discovered in the insulin treatment of diabetes among

children in 2003. The study showed that there are care units where not a single child uses continuous insulin pump therapy, whereas at some other units one child in three had insulin pump therapy. Treatments with two or three injections a day were still relatively common in treating children (42).

5.3 Type 2 diabetes

The control of type 2 diabetes can be improved by increasing physical activity, by losing weight and by cutting the amounts of fat and the total energy content in foods. Care aims at overall reduction in the risk of complications and death caused by diabetes. Compared to the nondiabetic population, people with type 2 diabetes have an approximately four times greater risk of dying of cardiovascular diseases.

All factors of metabolic syndrome, which is often associated with type 2 diabetes, can be affected by lifestyle choices and medicines. Changes in lifestyle are necessary for reducing the risk load. The goal of medication may be to reduce blood glucose, blood pressure, blood lipids, smoking or obesity. A person's individual need for medication must be assessed by means of risk charts or calculators.

Reduction of blood glucose levels and blood pressure may diminish renal and ophthalmic disorders and myocardial infarctions caused by diabetes, as well as mortality from diabetes. Losing weight improves the glycemic control of a person with type 2 diabetes, and physical activity reduces blood glucose and improves lipid levels and blood pressure. Physical activity must include both aerobic activity, such as walking, and anaerobic activity, such as working out in a gym.

Research data

Strict control of blood pressure reduces all ophthalmic complications among people with type 2 diabetes (43). The higher the blood glucose level was, the greater was the risk of death from a myocardial or cerebral infarction (44). Each fall of 10 mmHg in the systolic blood pressure reduced the number of deaths caused by diabetes by 15 per cent, myocardial infarctions by 11 per cent and microvascular complications by 13 per cent (45). Each reduction of one per cent in HbA1c diminished the number of deaths caused by diabetes by 21 per cent, myocardial infarctions by 14 per cent and microvascular complications by 37 per cent (46).

A meta-analysis of six studies that used statin in the primary prevention of type 2 diabetes showed that persons with diabetes benefit from statin. The risk of cardiovascular diseases is reduced significantly, RR 0.78 (CI 0.67–0.89). The NNT was 35. The benefit calculated on the basis of eight secondary prevention studies was even greater. The NNT was 14 (47).

The CARDS study showed that persons with type 2 diabetes benefit from the use of atorvastatin. The group that had been given the effective drug had 36 per cent fewer coronary events and 48 per cent fewer cerebral infarcts than the placebo group during a period of two years (48).

6. Organization of diabetes care

6.1 Care for children with diabetes

In Finland, care for diabetes among children has been concentrated in central hospitals and in a few regional hospitals. Children with diabetes are treated in 33 units. At the end of 2003, the smallest of these units was responsible for 25 children and the largest unit for 453 children.

The units with the highest treatment figures had twice as many visits by children to doctors and nurses per year than the units with the lowest treatment figures. The differences were even greater for adaptation training courses and for counselling given by nutritionists.

The range of variation in resources allocated to care for diabetes among children is too wide. All children with diabetes must have the opportunity to have counselling given by a nutritionist and to receive adaptation training.

Research data

In 2004, DEHKO surveyed the resources allocated to the care of children's diabetes and the control of diabetes among children in 2003. There was great variation in the care received by children (Table 1). The greatest differences were observed in nutritionists' services. In one hospital, none of the children with diabetes received nutritional counselling during the year, whereas in another hospital all children with diabetes received counselling. There were also ten-fold differences in the way self-care training was arranged for children and/or for their families (42).

Table 1. Personnel resources allocated to the care of children with diabetes in 2003 (N = number of care units that provided information).

Indicator	Mean	Range of variation
Visits to a physician per patient (N = 15)	3.9	2.6–5.3
Visits to a nurse per patient (N = 14)	4.3	3.1–6.2
Visits to a nutritionist per patient (N = 9)	0.6	0–1.0
Attended a self-care training course (%, N = 23)	15.0%	3.3–32.8%

6.2 Adults with diabetes

In some areas of Finland, care for people with type 1 diabetes has been concentrated in the outpatient clinics of hospitals, whereas in some other areas responsibility for long-term care rests largely with health centres. In most cases, responsibility for the care of people with type 2 diabetes rests with health centres, but the responsibility of the occupational health-care system is rising.

Large health centres have a concentrated system of care for people with type 1 diabetes; small health centres have also concentrated their care for type 2 diabetes. Education and lifestyle counselling are mainly the responsibility of diabetes nurses. Most hospitals have a nutritionist, but only a small percentage of patients get a nutritionist's services. Only one in five health centres offers a nutritionist's services. The services of a physical education instructor are even rarer.

There are great differences in how time has been allocated for seeing adults with diabetes. The number of people coming under each doctor's and nurse's responsibility may vary many times over. Only one health centre in three arranges counselling in groups.

Research data

Of the hospitals that answered the questionnaire concerning the quality of care, 85 per cent had arranged a separate consulting service for people with diabetes. Comparison between the number of people with type 1 diabetes on the list and the number of doctors' weekly diabetes consultations revealed that a physician was responsible for 10–39 persons with diabetes per one weekly hour (on average 21). A nurse was responsible for an average of 29 persons with diabetes (range 4–92) per each weekly working hour reserved for diabetes consultation.

The work input that doctors and nurses allocate to a separate consulting service for diabetes has an even wider range of variation in health centres. The times that doctors have for separate diabetes consultation vary by a factor of 30 and the times that nurses have by a factor of 70.

28 per cent of the health centres (or their local health-care stations in big cities) that answered the questionnaire arranged counselling in groups (42).

6.3 Nutritional counselling and nutritional therapy

Only one in five health centres has a nutritionist's post. Most hospitals have a nutritionist. Only a small percentage of persons with diabetes have the opportunity to receive counselling given by a nutritionist.

Nutritional counselling is important in diabetes care. Supplementary training must be provided in order to ensure that public-health nurses will in future have even better professional competence to provide nutritional counselling.

Research data

In one unit where children with diabetes are treated, none of the children received counselling by a nutritionist during one year; in another unit, counselling was given to all children with diabetes. On average, children saw a nutritionist 0.6 times during one year (42).

One in eight health centres cannot provide any nutritionist's services. 21 per cent of health centres have a nutritionist's post. In 70 per cent of health centres, these services can be acquired from other health-care units or purchased from outside service-providers. In practice, counselling given by a nutritionist is available only to a limited extent, and people with diabetes get their nutritional counselling from a public-health nurse. A group of 1,047 persons with diabetes were followed in 13 health centres. Of them, four per cent had seen a nutritionist during the preceding 12 months (42). Of the 954 persons with type 2 diabetes included in the health centre quality network, 12 per cent had received thorough education in the use of fats during their consultation with the public-health nurse, whereas 36 per cent had received no education concerning the use of fats during the consultation under study (49).

80 per cent of hospitals have their own nutritionist's post. 20 per cent of hospitals also purchase nutritionist's services from outside service-providers (42).

6.4 Physical counselling

Physical instructors, physiotherapy assistants and physiotherapists participate very seldom in physical counselling given to people with diabetes. Counselling is mainly given by physicians and nurses. Apparently very little education is given, and its quality could be improved.

Research data

Less than 10 per cent of health centres and hospitals answered that they frequently refer persons with diabetes to a physiotherapy unit or to a physical instructor for physical education. Half of health centres and hospitals reported that they never refer persons with diabetes for physical counselling (42).

A total of 34 per cent of people with type 2 diabetes included in the follow-up survey of the health centre quality network in 2004 received no education pertaining to physical activity during the nurse's consultation that had been selected for the survey. Nine per cent received thorough education (49).

6.5 Examination of the fundus of the eye

Two health centres out of three provide regular imaging of the fundus either themselves or through a hospital in the region. The usual monitoring period is 1–2 years.

Too many persons with diabetes are still left outside regular monitoring. The best results are achieved in the centres where patients are asked to come

for imaging and where the time for the next imaging session is determined individually, depending on the type of diabetes, the duration of the disease and the previous fundus imaging result.

Research data

A process quality survey conducted on 13 health centres in 2004 showed that, during the past 12 months, the fundus of the eye had been examined or imaged for half of the 1,047 persons with diabetes included in the survey (42).

The follow-up survey of the health centre quality network in 2004 encompassed 954 persons with type 2 diabetes in 16 health centres. Out of them, 49 per cent had had a fundus examination within the past 12 months and 67 per cent had had an examination within the past 24 months. 21 per cent had never had a fundus examination, and for 3 per cent more than four years had elapsed since the last examination (49).

6.6 Examination and care of the feet

In Finland, great differences still exist in the prevention of foot problems and in the organization of foot care for people with diabetes. One third of people with diabetes do not have their feet checked annually. Most health centres do not have a clear division of tasks or guidelines for monitoring the condition of the feet. Many health centres do not offer a podiatrist's services, and there are shortcomings in the chain of care provided for the foot problems of people with diabetes.

Although hospitals have posts for podiatrists, they are not common in health centres. A vascular surgeon is not included in the foot team at every hospital.

There are more major amputations of lower limbs in regions where vascular surgery is less common. The service chain for care of the feet among people with diabetes – from the risk charting of the feet to the treatment of foot ulcers and severe circulatory disorders – should be put right quickly throughout Finland.

Research data

77 per cent of people with type 2 diabetes had had an annual check-up of the feet in 2004 (49). 19 per cent of people with type 1 diabetes and 22–25 per cent of people with type 2 diabetes had had foot care at a podiatrist during the past 12 months (42, 49). 35 per cent of people with type 2 diabetes had never been to a foot therapist (49). Among people with diabetes in specialised medical care, 5–70 per cent had had foot care at a podiatrist during the past year (on average 29 per cent) (42).

Most specialised medical care units provide a podiatrist's services in-house. Health centres acquire these services from outside service-providers. Many persons with diabetes are still referred to private podiatrists where they pay for the care themselves (Table 2) (42).

Table 2. Provision of podiatrist's care in health centres and in specialised medical care.

	Health centre	Specialised medical care
In-house services	21%	75%
Referred elsewhere within the public health-care system	22%	15%
Purchased services	49%	38%
Other arrangements	7%	3%
Patients pay themselves	32%	20%
Only private services are possible	14%	-
No possibilities for podiatrist's care	5%	-

According to the Diabetes in Finland study, 11,070 persons with diabetes had had a lower limb amputation in Finland in 1988–2002 (9). Comparison between hospital districts showed a strong inverse correlation between vascular surgery activities and amputations performed above the ankle. In other words, a hospital district that had many vascular surgeries had a small number of major amputations (50).

6.7 Mental health services

Mental health experts are rarely used as help in diabetes care. However, use of antidepressants is more common among people with diabetes than among the rest of the population. Mental health problems may be the underlying cause of low motivation for care and poor metabolic control.

Research data

The personnel of four health centres out of 260 reported that they often use a psychologist as help in care for people with diabetes. In 35 per cent of health centres, the personnel said that they consult a psychologist only in rare cases. The rest of the health centres do not use psychologists as help. 5 per cent of care units in specialised medical care often consult a psychiatrist or a psychologist about care for a person with diabetes; 73 per cent seldom do this and the rest never do (42).

Among people with diabetes, there are twice as many users of antidepressants as there are among the control population of the same age, the same gender and living in the same municipality (51).

6.8 Equipment for self-monitoring

The self-care of a person with diabetes is based on blood glucose measurements; these show which adjustments in medication, physical activity and diet may be necessary. A diary on foods eaten and on physical activity taken may be used to support self-care.

There is great local variation in the availability of care equipment. Some health centres provide all diabetic people with the monitoring equipment they need, whereas some have limited their provision of care equipment. Irrespective of the type of diabetes, the equipment needed for measuring blood glucose must be provided without charge for each person with diabetes. The number of the equipment needed is assessed individually by a doctor.

Research data

Three out of four health centres knew the number of persons with diabetes who were within the system of care equipment distribution. When this number was proportioned to the population, the percentage of people encompassed by the distribution of equipment for diabetes care was 6.8 per cent at its highest and 0.7 per cent at its lowest. The same survey charted the costs of the strips used for measuring blood glucose levels. On average, the number of strips distributed by health centres was about half the number that had been assumed on the basis of recommendations given by the Medical Advisory Board of the Finnish Diabetes Association. However, there was great variation in the distribution practices between health centres (42).

The Supreme Administrative Court has specified the Public Health Act as concerns self-monitoring. According to the Court's decisions, self-monitoring of blood glucose levels is part of the care given or monitored by a doctor, and the decision on the number of care equipment must be based on criteria associated with care, not on administrative guidelines (79).

6.9 Rehabilitation

The goal of rehabilitation is to empower a diabetic person and to affect environmental factors so that it is possible to lead a good life. Learning to live with a long-term disease requires knowledge and skill, as well as adaptation to the demands set by the disease. The complications stemming from diabetes cause functional limitations that require rehabilitation. They may also lead to early retirement.

Counselling in diabetes is one element of rehabilitation. Other elements include peer support and guidance in various life situations. Owing to changing information and varying life situations, children and adolescents with their families need expert help on repeated occasions. People with diabetes and their families get very little rehabilitation of the kind that aims at the self-management of a chronic disease and living with the disease.

People with diabetes should have more opportunities for regular, life-long rehabilitation. In diabetes care, counselling should be integrated with all other rehabilitation targeted at people with diabetes.

Research data

A study carried out in three municipalities showed that although diabetes is so common, only 2 per cent of rehabilitation services were allocated to people with diabetes (52).

Annually, 4–67 per cent of children and/or families participated in adaptation training courses (53). Between 3 and 33 per cent of children with diabetes and/or their families had participated in courses of self care in 2003 (42).

The Finnish Diabetes Association arranges seven family courses per year for children under 12 years of age and their families, and five courses for youngsters. Folkhälsan arranges one course for youngsters, a so called family course and a couple of other courses for persons with type 2 diabetes. In these courses the working language is Swedish. The Diabetes Centre offers adaptation training for about 200 persons with type 1 diabetes and about 150 persons with type 2 diabetes per year. Demand for these courses is roughly twice as great. Other rehabilitation institutes offer little rehabilitation aimed at people with diabetes. People with diabetes are integrated with other disease groups or other rehabilitation courses, for instance, on the basis of their complications (54).

7. Control of diabetes

The glycemic control of people with type 1 diabetes has remained unchanged for the past few years. Positive developments have taken place in the glycemic control of people with type 2 diabetes.

Other factors increasing the risk of artery diseases have also developed positively among people with type 2 diabetes; thus, their overall susceptibility to diabetes-related complications has diminished. However, more efficient assessment of the overall risk would still be needed when making individual care plans.

7.1 Glycemic control

The glycemic control of a person with diabetes can be described by using the level of glycosylated hemoglobin and the number of times the person has had hypoglycemia or ketoacidosis. Only one in five persons with type 1 diabetes and two out of three persons with type 2 diabetes have good glycemic control. Nearly every fifth person with diabetes has poor glycemic control. In particular, the situation among adolescents and young adults gives cause for concern.

Especially the glycemic control of people with type 1 diabetes should be improved. This calls for more efficient counselling. More effective counselling services are needed when people who have long had diabetes are taught how to make use of the new possibilities offered by self-care.

Research data

Glycosylated hemoglobin (HbA_{1c}) describes the average blood glucose content during a period of 2–3 months. It does not show if the person with diabetes has had blood glucose values that are too low or too high. The latter are revealed by following the occurrences of hypoglycemia and ketoacidosis. In the main, these are problems encountered by people with type 1 diabetes but they may also appear among people with type 2 diabetes.

Hospitals that treat diabetes among children were asked to provide their juvenile patients' HbA_{1c} values in 2003. Answers were received from 25 hospitals, of which 19 reported children's HbA_{1c} levels. The results showed that one quarter of children had good and one fifth had poor glycemic control (Table 3) (42).

Table 3. Percentages of children with diabetes who had optimal and poor glycemic control in 19 units providing care for children with diabetes in 2003.

Children with diabetes	Mean	Range
HbA_{1c} < 8.0%, percentage of patients	26%	16–35%
HbA_{1c} > 10.0%, percentage of patients	19%	8–45%

The units providing care for children with diabetes did not know exactly how often the children had had occurrences of hypoglycemia and ketoacidosis. Only 12 hospitals were able to report these figures. The incidence of difficult hypoglycemias requiring help from others was 1.0–8.6 per 100 years of care. Between 0 and 6 per cent of children in care had had ketoacidosis during the past year.

The average levels of HbA_{1c} among children treated in the Tampere University Hospital have fallen constantly since 2000; in 2005 the figure was 8.3%. Similarly, the share of children with good glycemic control has increased (now 44 per cent) while the share of children with poor glycemic control has decreased (now 9 per cent) (55).

For adults with type 1 diabetes, the median HbA_{1c} was 8.5% (56) and 8.2% (42) in two different surveys. In a nationwide measurement, the glucose level as shown by HbA_{1c} had not changed when compared to the value measured in 1993 (56). 21 per cent of persons with type 1 diabetes had a HbA_{1c} value of less than 7.5% and 19 per cent had a value exceeding 10% (56).

In three different studies on glycemic control, the median HbA_{1c} of people with type 2 diabetes was 7.6% (56), 7.0% (42) and 7.2% (49). In a nationwide study on glycemic control, 35 per cent of persons with type 2 diabetes had a HbA_{1c} value of less than 7.5% and 20 per cent had a value of 9% or more (56). In two other studies, 64 per cent (42) and 72 per cent (57) of persons with type 2 diabetes had good glycemic control ($HbA_{1c} \leq 7.5\%$). Correspondingly, 10 per cent and 8 per cent had poor glycemic control ($HbA_{1c} > 9\%$).

The nationwide study on glycemic control also surveyed the prevalence of hypoglycemias. Data were obtained on slightly less than half of the patients. 81 per cent of persons with type 1 diabetes had experienced hypoglycemia. Hypoglycemia was more common among people who had better glycemic control, as shown by their HbA_{1c} level. People with type 2 diabetes who controlled their disease through diet or oral medication had hardly any experiences of hypoglycemia, whereas 47 per cent of persons using insulin had had hypoglycaemia during the past year (56).

7.2 Blood pressure

Among people with diabetes, elevated blood pressure increases the risk of developing cardiovascular diseases. It also increases the risk of renal and ophthalmic complications.

Especially people with type 2 diabetes tend to have rather high blood pressure, and hardly any improvements have taken place in blood pressure

levels of this patient group. Particular attention should be paid to blood pressure among people with diabetes, owing to the risk of complications.

Research data

The UKPDS study showed that each reduction of 10 mmHg in systolic blood pressure decreased the number of diabetes deaths by 15 per cent, myocardial infarctions by 11 per cent and microvascular complications by 13 per cent (45).

The Current Care Guideline sets < 140/80 mmHg as the target level of blood pressure for people with diabetes. For people suffering from diabetic microalbuminuria and nephropathy, the target level is < 130/80 mmHg (58).

In the study on the glycemic control of people with diabetes, the median blood pressure reading among people with type 1 diabetes was 130/80 mmHg. Half of people with type 1 diabetes reached the then current target level of BP < 130/85 mmHg. The median blood pressure reading among people with type 2 diabetes was 150/84 mmHg. 18 per cent of the people studied remained at the target level, while for 65 per cent either the systolic or diastolic reading exceeded the level of 160/90 mmHg (56).

In the Diabro study, the mean blood pressure reading among women with type 1 diabetes was 131/78 mmHg; among men it was 134/80 mmHg. The mean blood pressure reading among women with type 2 diabetes was 147/81 mmHg; among men it was 145/84 mmHg (59).

In the health centre quality network, 38 per cent of persons with type 2 diabetes had sBP < 140 mmHg, and 23 per cent had sBP > 160 mmHg. Similarly, 33 per cent had dBP < 80 mmHg and 12 per cent had dBP > 95 mmHg. The network has been following the blood pressure levels of people with diabetes for a long time. Figure 6 shows the percentage of people with type 2 diabetes who have a poor systolic pressure reading in relation to the whole study sample, which has comprised about a thousand persons each year (49).

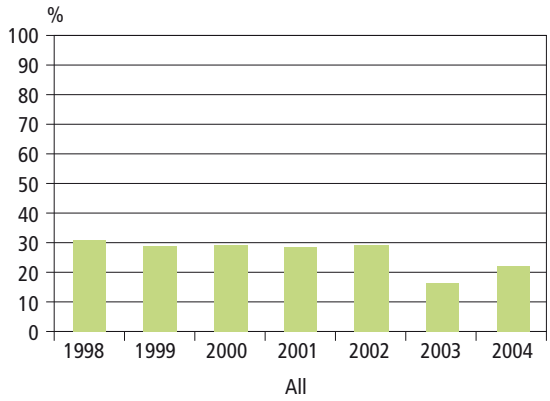


Figure 6. Patients with type 2 diabetes whose systolic blood pressure exceeds 160 mmHg. Shown as a percentage of all patients.

7.3 Blood lipids

The blood lipid values of people with diabetes should be kept at a low level because, among them, elevated values are associated with a considerably greater risk of artery disease than among the rest of the population. The cholesterol levels of people with type 2 diabetes have developed positively in the past few years. Although medications lowering cholesterol levels have become more common, only less than half of people with type 2 diabetes have reached the target levels for cholesterol.

Research data

The 4S study showed that people with diabetes benefit from the lowering of cholesterol levels more than the nondiabetic population. The risk of myocardial infarction was 55 per cent smaller among diabetic subjects taking simvastatin than among the placebo group. Among the nondiabetic population, the risk was 32 per cent smaller (60). The HPS study showed that when the LDL levels of people with type 2 diabetes are lowered, an absolute reduction of about 5 per cent is achieved in their risk of coronary events, irrespective of the initial LDL cholesterol level (61).

The median LDL cholesterol value among people with type 1 diabetes was 2.7 mmol/l. For 43 per cent, the value was under 2.6 mmol/l. For 88 per cent, the fasting triglyceride content was under 2 mmol/l, and for 94 per cent the HDL cholesterol was over 1 mmol/l. For people with type 2 diabetes, the median LDL cholesterol was 3.1 mmol/l, while 28 per cent had an LDL cholesterol value of less than 2.6 mmol/l. Two out of three had a triglyceride content of under 2 mmol/l, and three out of four had an HDL cholesterol value of over 1 mmol/l (56).

In the Diabro study, the mean LDL cholesterol value of people with type 2 diabetes was 3.2 mmol/l (men) and 3.3 mmol/l (women). The total cholesterol level was on average 5.2 mmol/l (men) and 5.5 mmol/l (women); the average HDL cholesterol level was 1.1 mmol/l (men) and 1.2 mmol/l (women) and the average triglyceride level was 2.0 mmol/l (men and women) (59).

In a study encompassing 13 health centres, 46 per cent of persons with type 2 diabetes reached a good level as defined by quality criteria (≤ 2.6 mmol/l) and 18 per cent had a poor level as defined by the criteria (LDL > 3.5 mmol/l). Among people with type 1 diabetes, 61 per cent had a good level and 6 per cent had a poor level, as defined by the criteria (42).

In the health centre quality network, 45 per cent of the subjects studied had a good balance (LDL ≤ 2.6 mmol/l) while 17 per cent had a poor balance (LDL > 3.5 mmol/l). When measured using the LDL cholesterol levels, the metabolic control of people with diabetes has improved annually during the past five years (Figure 7) (49).

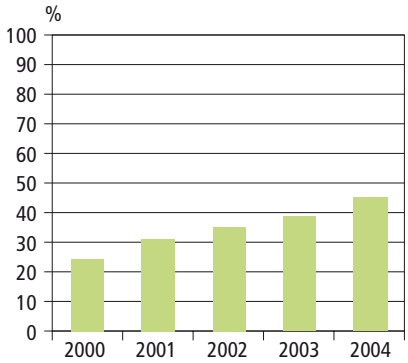


Figure 7. Patients with type 2 diabetes, whose LDL cholesterol is 2.6 mmol/l or less, shown as a percentage of all patients.

7.4 Smoking

Smoking is particularly harmful for people with diabetes because it sharply increases the risk of artery diseases. In consequence, every effort should be made to encourage smokers with diabetes to give up smoking. People with diabetes smoke less than the rest of the population, but the share of smokers has remained the same for a long time.

Research data

Smoking doubles the risk of myocardial infarction (62). People who have a serious underlying disease are particularly sensitive to smoking (31).

In the quality network survey for the prevention of artery diseases, encompassing 15 health centres in 2004, 12 per cent of persons with type 2 diabetes were smokers (49). In another quality survey encompassing 13 health centres, 20 per cent of persons with type 1 diabetes were smokers. Three out of four smokers were men. The same survey revealed that 12 per cent of persons with type 2 diabetes were smokers. Two out of three smokers were men (42).

8. Complications of diabetes

8.1 Objectives in the prevention of complications

The DEHKO programme has set the following objectives for decreasing complications among people with diabetes between the years 2000 and 2010: reduction of cardiovascular diseases by at least one third; halving the number of lower limb amputations; reduction of retinopathy by at least one third; and reduction of nephropathy by at least one third (63).

Diabetes is an additional risk factor in cardiovascular diseases. Despite this fact, care for risk factors among people with diabetes has not been any more intensive than among other patients (17).

8.2 Trends in all of Finland

8.2.1 Myocardial infarctions

One quarter of patients in hospital care because of a myocardial infarction have diabetes. The relative share of people with diabetes among all infarction patients keeps rising.

If the number of myocardial infarctions among people with diabetes falls at the same rate as it has been falling during the past 15 years, the DEHKO objective of reducing the number by one third will be achieved by the year 2010. To bring the risk of cardiovascular diseases among people with diabetes down to the same level as that among the rest of the population, risk factors among people with diabetes must be dealt with much more actively than at present.

Research data

The Diabetes in Finland study indicates that the number of myocardial infarctions among people with diabetes fell steadily between 1988 and 2002. The incidence of the first myocardial infarction is shown in Figure 8.

However, people with diabetes account for an increasingly large share of myocardial infarction patients. In 2002, people with diabetes accounted for about one quarter of all myocardial infarctions. The incidence of myocardial infarctions among people with diabetes has decreased by 4.6 per cent per year for men and by 4 per cent per year for women. The most positive trend has occurred in the age group of 55–64 years. During the period under review, the average age when men with diabetes had their first infarction was 69 years; for women the average age was 77 years.

In 2002, altogether 3,600 persons with diabetes received hospital care because of an infarction. Of them, 36 per cent died because of the infarction. However, the mortality caused by myocardial infarctions among people with diabetes has also shown a constantly falling trend (Figure 9) (9).

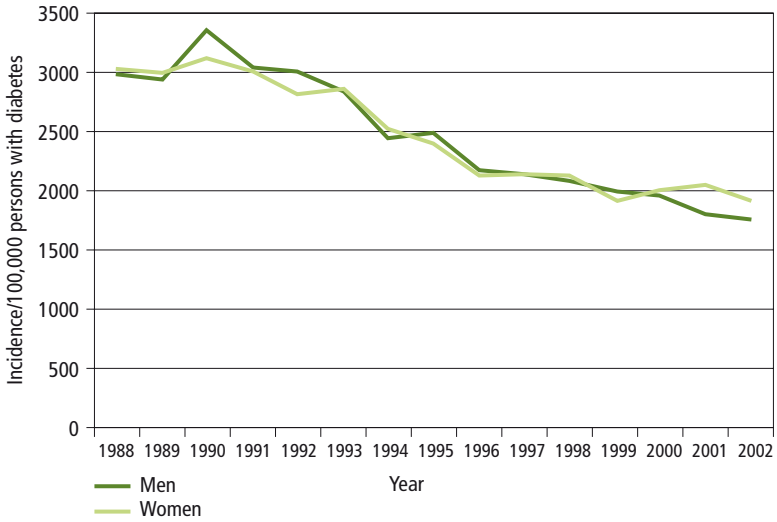


Figure 8. Change in the incidence of the first myocardial infarctions in 1988–2002 by gender, standardised for age and proportioned to the number of persons with diabetes.

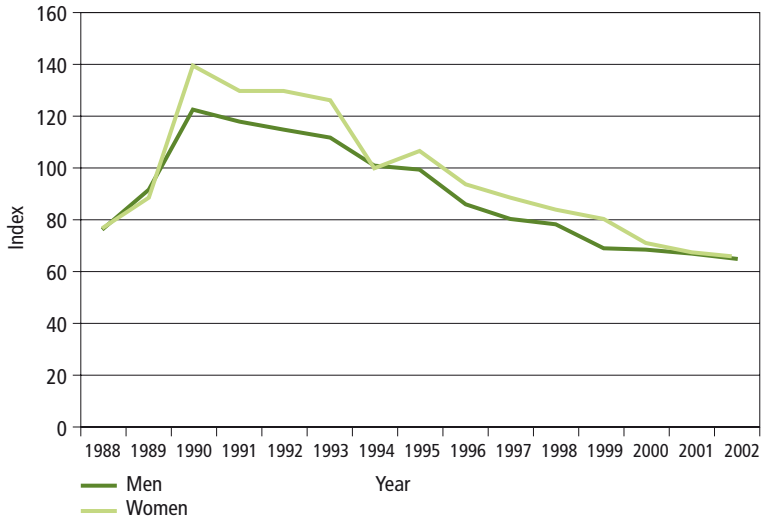


Figure 9. Index describing the number of deaths caused by myocardial infarction among people with diabetes, by gender, in 1988–2002 (the year 1994 = 100).

8.2.2 Cerebral infarctions

People with diabetes account for more than one fifth of all cerebral infarctions treated in hospital. The percentage has remained the same for the last ten years. However, the number of the first cerebral infarctions among people with diabetes has been falling constantly.

Mortality caused by the first cerebral infarction fell by over 60 per cent between the years 1990 and 2002. DEHKO's objective of cutting the number of

cerebral infarctions among people with diabetes by one third by the year 2010 will probably be met.

Research data

On the basis of the hospital discharge register data used in the Diabetes in Finland study, cerebral infarctions among people with diabetes have been falling constantly (9). Between 1988 and 2002, the total number of the first cerebral infarctions among people with diabetes was 34,310, of which 22 per cent led to death. During the period under study, infarctions leading to death decreased by 10 per cent among women and by 7 per cent among men.

In 2002, men with diabetes were on average 71 years old, and women with diabetes 78 years old, when they had their first cerebral infarction. The number of first cerebral infarctions was 2,167 among people with diabetes in 2002. The number of the first cerebral infarctions has been falling constantly. The sharpest decrease has taken place among women between 55 and 64 years of age. 65 per cent of cerebral infarctions among women with diabetes and 35 per cent of infarctions among men with diabetes occurred when the person was at least 75 years of age.

Standardised for age, the mortality of men after their first cerebral infarction fell by 65 per cent and that of women by 61 per cent between 1990 and 2002 (Figure 10).

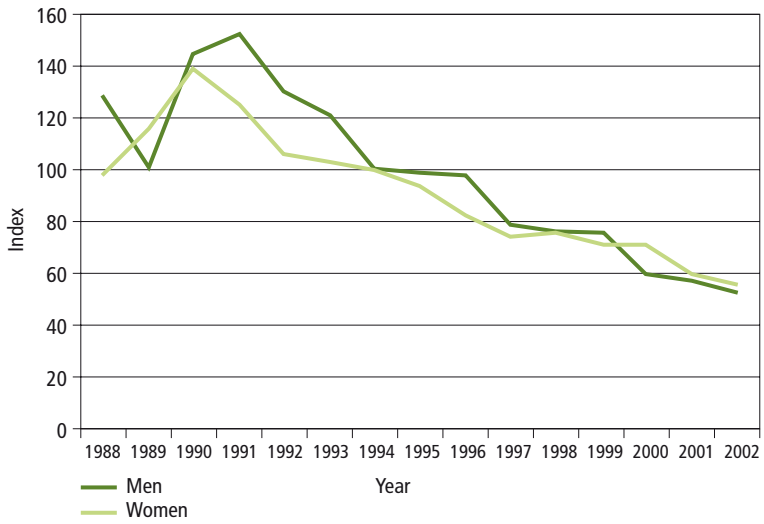


Figure 10. Deaths caused by the first cerebral infarctions among people with diabetes, standardised for age, in 1988–2002 (the year 1994 = 100).

People with diabetes accounted for 22 per cent of all cerebral infarctions treated in hospital in 2002. The percentage of women with diabetes among all cerebral infarction patients fell, but the percentage of men rose (9).

8.2.3 Lower limb amputations

The risk of a lower limb amputation can be as much as 20 times greater for a person with diabetes than for a nondiabetic person. More than half of the lower limb amputations performed in Finland are done for people with diabetes.

There are constantly fewer amputations of lower limbs among people with diabetes because treatment for risk factors has improved and the examination, monitoring and care of the feet have become more effective. More frequent vascular surgery among people with diabetes also has a positive effect on this trend. In addition to the fact that amputations in general have declined, the ratio between minor and major amputations has also become more favourable.

Between 2000 and 2002, the number of the first lower limb amputations among people with diabetes fell in Finland by 12 per cent. It is therefore possible to meet DEHKO's objective of halving the number of lower limb amputations by 2010.

Research data

The Diabetes in Finland study showed that altogether 11,070 lower limb amputations were performed for persons with diabetes in 1988–2002. Persons with diabetes accounted for 54–60 per cent of all lower limb amputations done in Finland between 1988 and 2002. During the last years, people with diabetes have had nearly 1,000 lower limb amputations per year.

Figure 11 illustrates the reduction in the first amputations, which was 58 per cent during the period under study. The annual incidence of the first lower limb amputation was about 40 per 10,000 persons with diabetes. New amputations were less common among women than among men with diabetes. At the time of the first amputation, the median age for men was 69 years and that for women was 77 years. The median age at the time of the first amputation had not changed during this 15-year period.

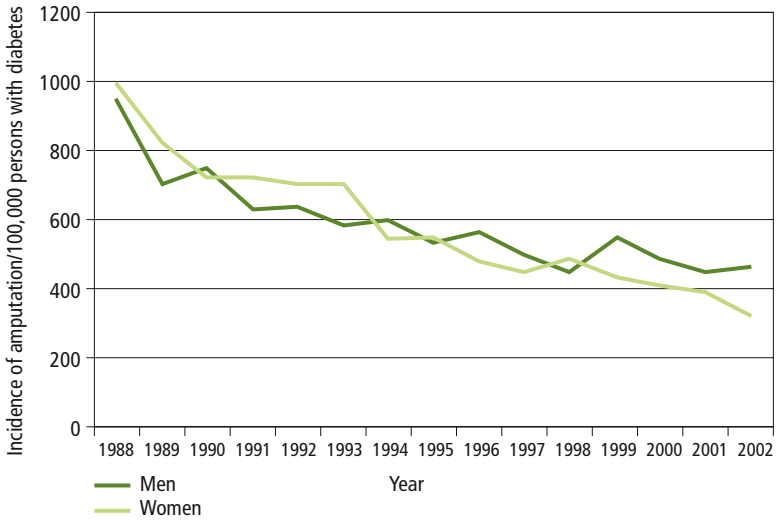


Figure 11. The number of the first lower limb amputations per 100,000 persons with diabetes, by gender, in 1988–2002.

The study revealed that the ratio between major (above the ankle) amputations and minor (ankle and below) is constantly becoming more positive (Table 4).

Table 4. The first minor and the first major lower limb amputations among people with diabetes, and the ratio between the two, in 1988–2002.

Year	Minor amputations Number	Major amputations Number	Minor and major amputations Ratio
1988	271	657	0,41
1989	261	597	0,44
1990	268	604	0,44
1991	259	581	0,45
1992	298	579	0,51
1993	332	546	0,61
1994	314	520	0,60
1995	315	528	0,60
1996	359	496	0,72
1997	353	464	0,76
1998	353	476	0,74
1999	422	498	0,85
2000	401	459	0,87
2001	411	453	0,91
2002	419	448	0,94

During the period under study, the vascular surgical procedures performed for persons with diabetes accounted for 15–28 per cent of all lower limb vascular surgery in Finland. During the period, a vascular surgical procedure was performed for 6,537 persons with diabetes. Of these, 4,370 operations were performed without amputation. 79 per cent of amputations were carried out without performing vascular surgery for the patient (9).

A study compared the frequency of lower limb vascular surgery among persons with diabetes and the number of major amputations on lower limbs in 14 hospital districts. The results showed that hospital districts with a high number of vascular reconstructions had few major lower limb amputations (50).

8.2.4 Diabetic nephropathy

Renal damage caused by diabetes is a serious condition because it weakens the patient's prognosis. Even a small amount of protein in urine means that measures should be taken to achieve a low blood glucose level and low blood pressure. Development of diabetic nephropathy also depends on genetic susceptibility.

People with diabetes account for an ever larger share of patients suffering from severe renal dysfunction. Numerically, type 2 diabetes causes more cases of renal dysfunction than type 1 diabetes. The share of people with type 1 diabetes whose kidneys lose their capacity to function has been falling constantly.

Research data

Care aimed at reducing hyperglycemia may lower the risk of renal disease (64, 65). In care for type 1 diabetes, the goal should be to achieve as low a blood glucose level as possible that can be attained without hypoglycemia. In care for type 2 diabetes, the goal should even be normoglycemia (HbA1c < 6.0%) in cases where albuminuria has been detected (66).

Effective control of blood pressure protects the kidneys of a person with diabetes. The more albuminuria can be reduced, the better the medication protects against progressive renal disease (66).

According to the Finnish Registry for Kidney Diseases, diabetes is the most common reason for chronic uremia in Finland. In 2002, people with diabetes accounted for 35 per cent of new patients admitted for active care (dialysis and kidney transplant) (Figure 12). Type 2 diabetes is a more common reason for chronic uremia than type 1 diabetes (67).

Among people with type 1 diabetes, 2.2 per cent had reached an end-stage renal disease after 20 years of diabetes, and 7.8 per cent after 30 years of diabetes. Compared to previous results, the number of cases where the kidneys had ceased functioning had been cut in half (68).

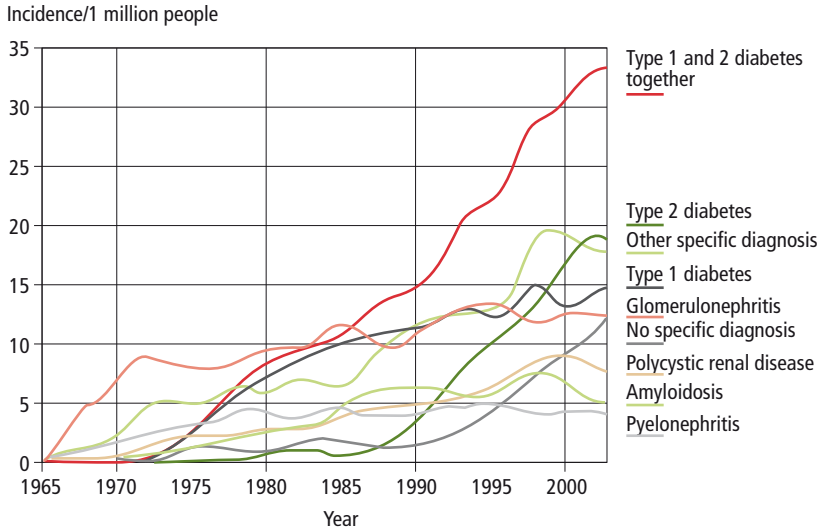


Figure 12. Incidence of active care for renal disorders, for each type of disease (Finnish Registry for Kidney Diseases 2003).

Aldose reductase gene polymorphism may be a factor contributing to the development of microalbumin secretion among people with type 2 diabetes (69).

8.2.5 Diabetic ophthalmic disease

Diabetes is a major cause of visual impairments. Sometimes diabetic ophthalmic diseases may develop before diabetes is even diagnosed. However, people with diabetes today have fewer severe retinal changes than they used to have.

Research data

Over 8 per cent of the new visual impairments reported for the Finnish Register of Visual Impairment in 2003 were caused by diabetes (70). Visual impairment is caused more often by nonproliferative than by proliferative retinopathy. The absolute numbers of entries into the Register of Visual Impairment fell between 1983–2004 even though the number of people with diabetes is increasing (71).

When new cases of type 2 diabetes were followed for 10 years, 21 per cent of the patients showed evidence of maculopathy impairing their vision (72). Diabetic retinopathy increased rapidly after five years of diabetes, and after 10 years 55 per cent of the patients had retinopathy. Retinopathy was more common among subjects who had poor glycemic control (72).

The incidence of proliferative retinopathy in type 1 diabetes is declining. It is now about 13 per cent after 20–25 years of living with the disease (73).

8.3 Regional comparison

Regional differences in the prevalence of complications are becoming narrower. The incidence of amputations, myocardial infarctions and strokes among people with diabetes are decreasing and are becoming more uniform between hospital districts.

Regional developments have not, however, been even. They depend not only on hereditary factors but also on lifestyle differences among the population and on local possibilities for care.

To prevent the complications of diabetes, it is important to ensure that sufficient resources and expertise are available for health care throughout the country.

8.3.1 Myocardial infarctions

The occurrence of myocardial infarctions among people with diabetes in Finland follows the same east-west division as for the rest of the population. The incidence of infarctions has fallen in all of Finland. However, comparisons between hospital districts reveal that changes have taken place at different speeds. Changes have been the slowest in Kainuu and the fastest in Länsi-Pohja.

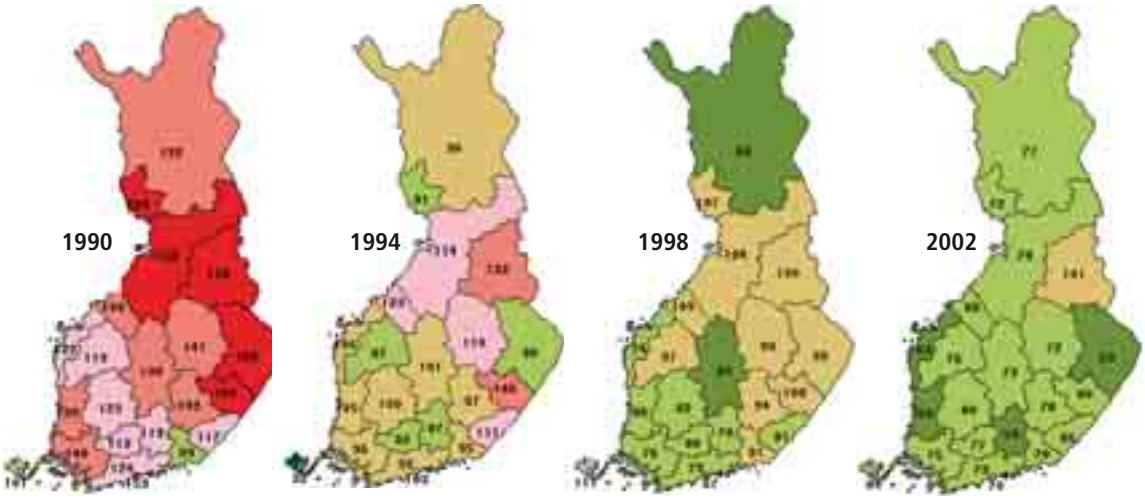
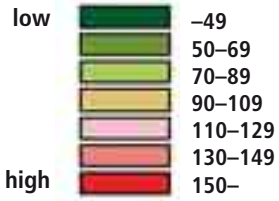


Figure 13. Myocardial infarctions among people with diabetes in 1990–2002, by hospital district. The figures have been standardised for age and gender in the diabetic population, and 100 is the index for the whole of Finland in 1994.



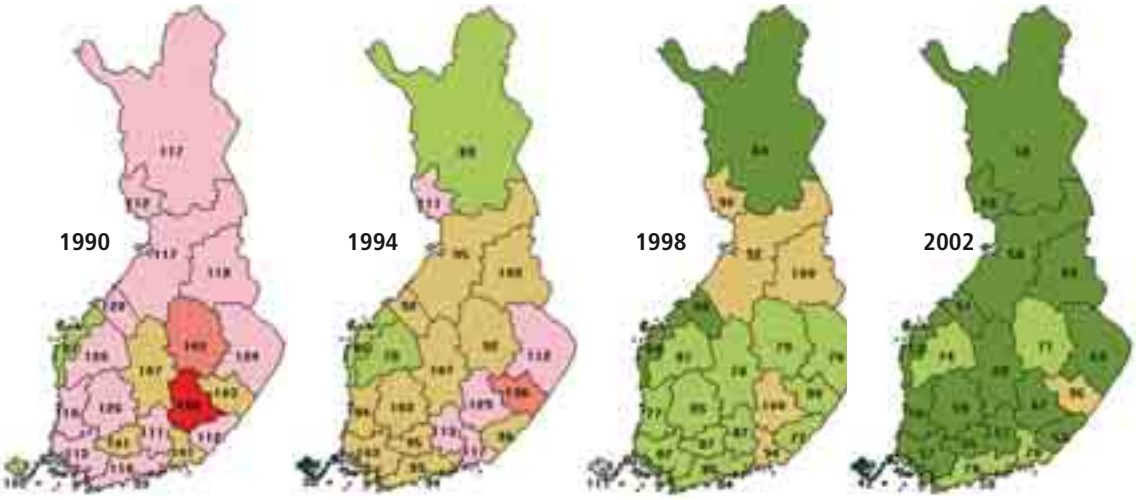


Figure 14. Cerebral infarctions among people with diabetes in 1990–2002, by hospital district. The figures have been standardised for age and gender in the diabetic population, and 100 is the index for the whole of Finland in 1994.

Research data

Several factors affect register-based regional comparison of the complications of diabetes: the prevalence of diabetes; the diagnostics of diabetes and its complications; care practices; and practices for entering diagnoses into registers. Myocardial infarctions among people with diabetes have decreased in all hospital districts. The positive trend has been the fastest in Western Finland and the slowest in Eastern Finland (9).

8.3.2 Cerebral infarctions

The numbers of strokes among people with diabetes have decreased in all of Finland. The positive trend has been the fastest in Southern Savo and the slowest in Eastern Savo. Effective control of blood pressure is a particularly good way of reducing the number of strokes.

Research data

The register study conducted by STAKES and KELA revealed a declining number and positive developments for cerebral infarctions in all hospital districts. The positive trend has been fairly even in the whole of Finland. It was particularly positive in Eastern Finland (9).

8.3.3 Lower limb amputations

In the late 1980s, the lowest numbers of amputations performed for persons with diabetes were recorded in Ostrobothnia and around the city of Vaasa. The hospital district of Vaasa has a long tradition in the prevention and active care of foot problems among persons with diabetes.

In the 2000s, the most positive changes have taken place in Northern Finland. Well-functioning chains of care are needed for the prevention and care of foot problems among people with diabetes in all of Finland, in order to keep this serious complication under control.

Research data

The study conducted by STAKES and KELA showed that the wide variation in the incidence of amputations between hospital districts had evened out during the 15-year follow-up period. The number of amputations is falling everywhere in Finland, but regional differences exist. The study surveyed the number of the first amputations in each hospital district, in proportion to the diabetic populations standardised for age and gender (Figure 15) (50).

Possibilities for obtaining vascular surgical care have been different in different parts of the country. This has been reflected in the frequency of surgical procedures and apparently also in the number of amputations. Compared to the incidence of amputations, no corresponding decrease in variation could be verified for vascular surgery. This may be explained by the fact that not all endovascular procedures are entered into the discharge register (9).

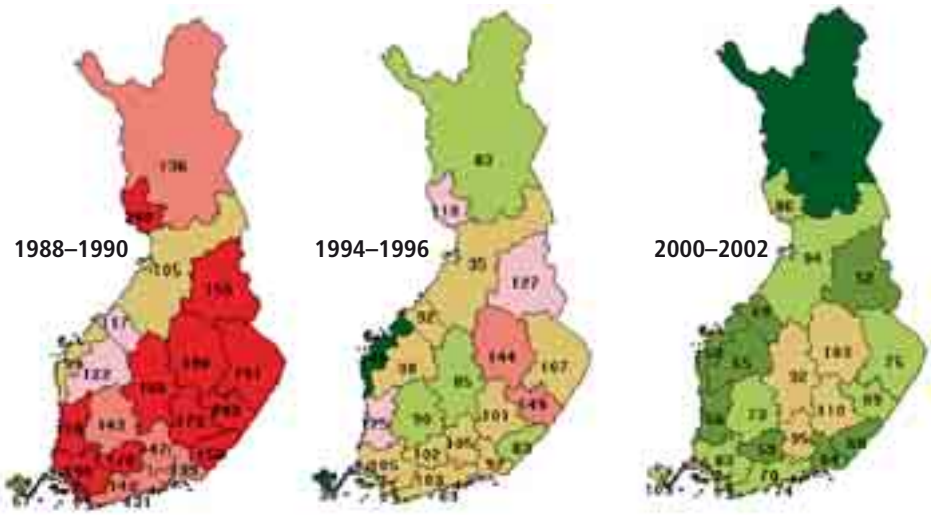
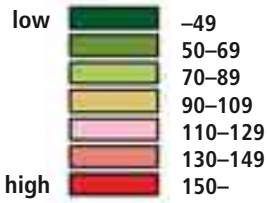


Figure 15. The first amputations performed for persons with diabetes, by hospital district, in 1988–2002 (index for all of Finland in 1994–1996 = 100).



9. Mortality among persons with diabetes

Diabetes is a major strain on the body. It causes arterial and renal diseases that increase mortality. Premature death is associated with both types of diabetes. Type 1 diabetes has a stronger impact on mortality.

The mortality of persons with diabetes has diminished by about 4 per cent a year. Continuation of this positive trend calls for increasingly better care of diabetes and its complications.

Research data

Diseases of the circulatory system are the most common cause of death among people with diabetes, whether type 1 or type 2. On the basis of an index standardised for age and gender, the mortality of people with type 1 diabetes fell by 12 per cent from 1994 to 2002. The corresponding figure for people with type 2 diabetes was 24 per cent. The average age of death of people with type 2 diabetes rose by one year during the same period.

The standardised mortality ratio (SMR) showed that in both types of diabetes, the difference in the age of death between the diabetic and nondiabetic populations narrowed in 1994–2002. Standardised for age, the mortality index fell by 3.6 per cent per year for men and by 4 per cent per year for women ($p < 0.0001$). The change can partly be explained by earlier diagnosis of diabetes. The SMR for type 1 was 327 in 2000, while the SMR for type 2 was 166 (9).

10. Diabetes and the economy

The costs caused by diabetes to society and individuals are considerable. Merely the costs of medications used to lower blood glucose levels totalled EUR 82 million in 2004. In addition, many persons with diabetes needed medications to control other simultaneous risk factors, such as hypertension and high cholesterol values.

The emergence of complications increases the costs of care some 10–20 times for a person with diabetes. In consequence, all efforts at improving the care to prevent complications is cheaper than treatment of the complications – and is also a great relief to the individual.

Although diabetes significantly increases the risk of arterial diseases, persons with diabetes have not received more intensified care than other risk patients.

Possibilities for equal care among people with diabetes have weakened. Especially for people of limited means, cuts in health-care expenditure have meant reduced opportunities for care.

Research data

Kangas studied the costs of health services used by persons with diabetes and by a control group in Helsinki in 1997. Persons with diabetes accounted for 14 per cent of all somatic inpatient days, and 9 per cent of all outpatient visits were made by persons with diabetes. The costs of care for people with type 1 diabetes were four times higher, and for people with type 2 diabetes two times higher, than the costs of care for controls of the same age and the same gender and living in the same areas. The additional costs of diabetes involving complications were 10 to 20 times greater than the costs of the disease without complications (74).

No differences in mortality between social groups were detected among people with diabetes in the early 1980s (75). In the 1990s, differences between social groups could be detected in all age brackets. The differences stemmed from the risk of death caused by diabetes and from cardiovascular morbidity (76).

Diabetes causes an additional risk in the coronary heart disease. However, care for people with diabetes has not been intensified in any particular way as concerns the coronary heart disease (77).

11. Patient satisfaction

In general, people with diabetes are satisfied with their care. Dissatisfaction stems from lack of services.

As yet no systematic follow-up has been conducted on how satisfied people with diabetes are with their care. It would be important to carry out such a follow-up, but this would require a generally approved questionnaire adapted to patients with diabetes.

Similarly, it would be important to develop quality of life surveys for people with diabetes so as to obtain more comprehensive data on the overall effect of various care forms on the lives of people with diabetes.

Research data

39 per cent of persons with diabetes were very satisfied with their care, and less than 1 per cent of respondents were very dissatisfied. The share of very satisfied respondents was greater among people with type 2 diabetes. The physician's experience, the patient's own motivation and the availability of consultation times were mentioned as important factors affecting the care. The services of nutritionists and podiatrists gave cause for dissatisfaction. The reason for the dissatisfaction was that these services were not available (78).

12. Summary of how DEHKO's objectives have been met

The main objectives of DEHKO are to prevent type 2 diabetes and to improve the quality of diabetes care and self-care. The project for implementing the Programme for the Prevention of Type 2 Diabetes (FIN-D2D Project 2003–2007) started in 2003. It has gained much publicity and has aroused broad interest. In conjunction with the project, municipalities have launched various activities aimed at preventing obesity and increasing physical activity. The project will end in 2007, and results are expected within a couple of years.

Continuous development of the quality of diabetes care is becoming more widespread. Especially health centres and units providing care for children with diabetes have got off to a good start. The Diabetes in Finland study conducted by STAKES, KELA and the Finnish Diabetes Association shows that monitoring the regional occurrence of complications also monitors the quality of diabetes care. Complications have declined in accordance with targets. A fall of one third can be expected in the incidence of cardiovascular diseases, and the relative number of amputations is expected to fall by half. Indirect evidence suggests that renal and ophthalmic complications will also diminish by one third during the ten-year period.

The electronic patient records used are not yet compatible. Patients' data cannot be transferred electronically to a care unit using a different system. Advancement of the national development project of electronic health records will probably ease the situation in 2007.

Chains of care have been developed and recorded in most parts of the country. Time will tell whether they improve the availability of care for a person with diabetes. Uniform practices are particularly important at the onset of complications, especially when rapid action can help prevent greater damage. In particular, the care chains of foot care and retinal changes should be improved.

The standard of care for people with type 1 diabetes has not improved sufficiently. There is a need for more effective counselling, which creates the prerequisites for good self-care. Care for people with type 2 diabetes has progressed well, but there is still room for improvement in assessment of the risk of complications and in care for complications.

Cooperation between the health-care system and diabetes associations is budding and is seeking well-functioning solutions.

13. Final comments

The first Diabetes Barometer is now ready for readers. Its serviceability as a tool supporting health policy decision-making will be tested at the same time. If the goals set for the barometer are met, it will be repeated in three years' time. We hope to receive feedback and ideas for development from our readers (e-mail klas.winell@diabetes.fi).

Diabetes prevention has just kicked off, but the work is essential for the well-being of the population because type 2 diabetes is increasing at a frightening pace. There is nothing to indicate that its greatest risk factor, obesity, would be diminishing. Quite the contrary, every report on the population's health shows that the situation is getting worse. Some radical changes in eating habits and in physical activity are therefore needed. The consensus meeting on obesity in 2005 laid down policies which, if followed, are likely to improve the situation.

Care for type 2 diabetes has improved during the past ten years, but unfortunately the same change has not been achieved in care for type 1 diabetes. Improvement of care for type 1 diabetes must therefore be designated as a field of priority. It must also be assessed whether counselling on type 1 diabetes should be completely reorganized so that definite steps forward could be achieved in self-care.

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ISBN 952-486-023-6