

# Following in the Footsteps of the North Karelia Project

## Prevention of Type 2 Diabetes



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### ABSTRACT

The prevalence as well as actual number of people with type 2 diabetes has been increasing in Finland during the past decades, in parallel with an increase in overweight and obesity. Besides obesity, population aging is among the main drivers of increasing numbers of diabetic patients. Type 2 diabetes brings along complications, most importantly cardiovascular diseases, and increasing type 2 diabetes prevalence has also been suggested to lead to a new upward turn in cardiovascular diseases. Therefore, it is important to implement activities to prevent type 2 diabetes. We present the trial evidence for the prevention of type 2 diabetes with emphasis on the Finnish Diabetes Prevention Study findings. Furthermore, we discuss the practical implementation of screening of individuals for high type 2 diabetes risk and prevention of type 2 diabetes in Finland at the population level and describe how they have contributed to European level initiatives.

Diabetes is acknowledged by the World Health Organization to be among the 4 major noncommunicable diseases along with cardiovascular diseases (CVD), cancers, and respiratory diseases [1]. In 2008, over half a million Finnish people (around 11% to 15% of Finnish women and men aged 40 to 70 years) were estimated to have diabetes. Half of them were not yet aware that they had the disease [2].

The most important lifestyle-related risk factors for type 2 diabetes (T2D) are obesity, a sedentary lifestyle, and unhealthy diet [3]. Beneficial changes in dietary composition, especially the markedly reduced intake of total and saturated fat and an increased consumption of vegetables have occurred in Finland during the past decades. These dietary changes have led to the marked reduction in CVD mortality and morbidity in Finland. This beneficial trend in consumption of saturated fats seems to have come to an end and turned for the worse again during the recent years. Leisure time physical activity has increased; however, physical activity at work and walking or bicycling to work have decreased gradually, which indicates that total physical activity may not have increased [4].

Obesity and overweight have increased in Finland during the last few decades. However, the long increasing trend in the prevalence of obesity seems to be levelling off [5]. There is some evidence that the T2D prevalence trend is following the obesity pattern (Fig. 1A). The steep increase in incidence of drug-treated T2D observed in Finland between the years 2006 and 2011 could reflect the concurrent diabetes screening and prevention activities established in Finland—it is known that when screening is increased, more previously unknown cases are identified

(Fig. 1B). After the peak in 2011, the incidence has declined significantly. The prevalence and incidence estimates of T2D are, however, inaccurate in the sense that there is no reliable way to collect cumulative T2D morbidity data in Finland. The changing diagnostic criteria, increased awareness leading to more screening activities, and new treatment guidelines and availability of new drugs may also have had an effect on both incidence and prevalence.

### PREVENTION OF TYPE 2 DIABETES: CLINICAL EVIDENCE

The first controlled, individually randomized trial to test the possibility of T2D prevention by lifestyle intervention was the Finnish Diabetes Prevention Study (DPS) [6]. The DPS was a multicenter study that started in 1993, was coordinated by the National Public Health Institute, and completed in 5 centers in different areas in Finland. Altogether, 522 middle-aged, overweight men and women with high T2D risk (defined as IGT detected during 2 consecutive 75-g oral glucose tolerance tests) were recruited and randomly allocated into a “standard care” control group or intensive lifestyle intervention group [7,8].

The lifestyle intervention was delivered primarily by study nutritionists during individual counselling sessions and highlighted by study physicians at annual clinical visits [8]. The intervention goals were to reduce body weight (5% or more reduction from baseline weight), limit dietary fat (<30% of total energy consumed) and saturated fat (<10% of total energy consumed), and to increase both dietary fiber intake (15 g/1,000 kcal or more) and physical

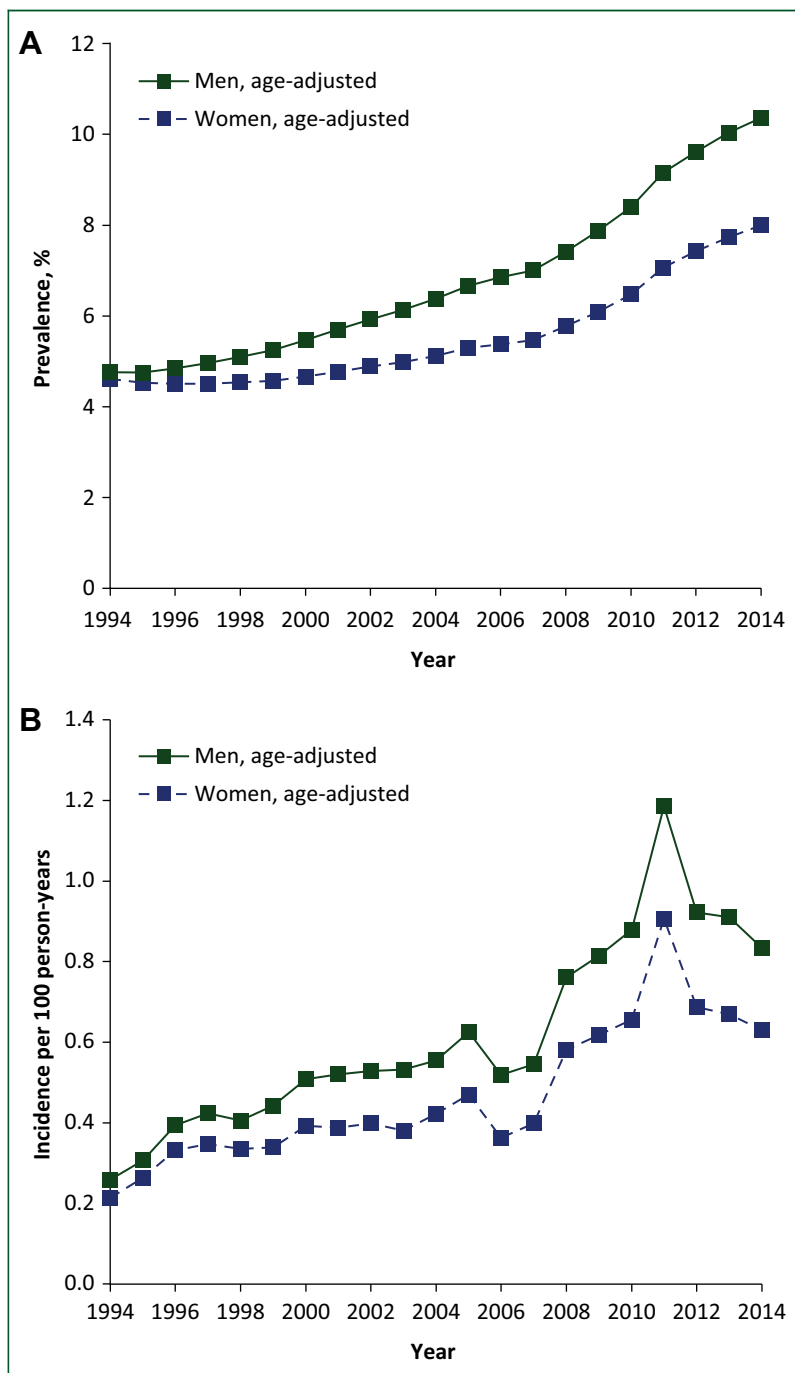
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**FIGURE 1.** Prevalence (A) and incidence (B) trends of special reimbursements for diabetes medicines granted by the Social Insurance Institution of Finland from 1994 to 2014 among men and women aged 35 and older.

activity ( $\geq 30$  min/day). T2D status was assessed annually by a repeated 75-g oral glucose tolerance testing.

The intervention group showed significantly greater improvement in each intervention goal compared with the

control group. After 1 and 3 years, mean weight reductions were 4.5 and 3.5 kg in the intervention group, and 1.0 kg and 0.9 kg in the control group. Cardiovascular risk factors improved more in the intervention group [8,9]. After a mean follow-up of 3.2 years, the risk of T2D was reduced by 58% in the intervention group compared with the control group [6]. The reduction in the incidence of T2D was directly associated with the number of achieved lifestyle goals. Increasing physical activity was shown to be an independent predictor of T2D risk reduction [10]. Furthermore, those who consumed a moderate-fat, high-fiber diet achieved the largest weight reduction and, even after adjustment for weight reduction, had the lowest T2D risk during the intervention period [11]. After discontinuation of the counselling, the differences in lifestyle variables between the groups still remained favorable for the intervention group. During the total follow-up period until 13 years, the risk of T2D was still 39% lower among the former intervention group participants, compared with the former control group participants [12]. The effect was statistically significant within both men and women (Fig. 2).

After the DPS, several clinical trials, most importantly the U.S. Diabetes Prevention Program, have confirmed the finding. In 2002, it reported exactly the same risk reduction of 58% [13]. It has also been reported that lifestyle intervention is both more effective and cost-efficient than prevention using glucose-lowering medication [14].

### SCREENING FOR HIGH T2D RISK

A practical problem in “real-world” T2D prevention is how to identify individuals with increased T2D risk and discern who would benefit from intensified actions to prevent development of T2D. There are several tools available to identify people at increased risk of incident type T2D [15]. One of the commonly used tools is the FINDRISC (Finnish Diabetes Risk Score) [16]. It was developed using the longitudinal follow-up data of the FINRISK survey 1987 and 1992 population-based cohorts with new cases of drug-treated T2D as the endpoint, ascertained using the Social Insurance Institution’s Drug register. With 8 simple questions (age, body mass index, waist circumference, family history of diabetes, antihypertensive medication use, consumption of fruit and vegetables, physical activity, history of high blood glucose), a relatively good estimate of 10-year T2D risk can be achieved. The FINDRISC has been validated for use, as such or after adaptations, in several countries [17-23].

The FINDRISC is unique in that it focuses on predicting future T2D with several factors that are fast and easy to measure with noninvasive methods, known to be associated with the risk of type T2D. It is easily comprehensible and directs a person’s attention to the modifiable risk factors of T2D. Interpretation of the individual’s T2D risk is easy and can be expressed as a probability in a relatively accurate way. Using the FINDRISC can

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