Editorial

Prevention of type 2 diabetes – where is the evidence?

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Diabetes is an "old disease". The first description of diabetes written on papyrus about 3500 years ago is found in the Ebers papyrus, which was discovered in Egypt in 1873 by the German archeologist Georg Ebers. Humans, like most mammals, may develop diabetes, if sufficient environmental exposure to physical inactivity, unhealthy diet and obesity are present. Genetic effects are important for the individual risk of type 2 diabetes (T2D) but twin studies have shown that the genetic effects combined explain less than 50% of the risk of T2D (*1*). Today we know almost 100 susceptibility genes associated with T2D but the relative importance of each of these genes is low (*2*), and together they explain only a small part of the disease risk. Thus, genetic screening cannot be used for the prediction of T2D for individuals. On the other hand, healthy lifestyle can also prevent T2D in people who are genetically at high risk, e.g. those with positive family history (*3*). Thus, the importance of lifestyle factors for the development and prevention of T2D is overwhelming.

The strongest evidence in medicine is considered to come from randomized controlled trials (RCTs). They are also important in providing the link to causal inference that in most observational studies cannot be derived. At the same time, observational studies are necessary for the identification of factors associated with an increased or decreased risk of a disease, and for generation of hypotheses on potential means for prevention based on modifiable risk factors.

Observational studies have by now identified a large number of factors that are associated with the development of T2D or with the protection against it. Most of them are related to physical activity, diet and obesity. It has also been shown unequivocally that exposures (poor nutrition, infections, smoking, etc.) during fetal life and early infancy resulting in insufficient development (often shown as low birth weight) also predict T2D later in life (*4*). Traditionally, T2D has been considered to be a disease of the elderly. However, with increasing obesity and sedentary lifestyle in children, there are increasing numbers of cases of T2D already occurring at a young age in many populations (*5*).

In the past two decades several innovative RCTs have repeatedly shown that interventions on modifiable risk factors can reduce the incidence of diabetes in high-risk groups. The evidence has been summarized in several systematic reviews and meta-analyses (*6,7*). There is compelling scientific evidence from RCTs that T2D can be prevented or its onset delayed. The key for prevention is a multimodal package of lifestyle changes that is a sum outcome of dietary and physical activity behaviours. The power of lifestyle was dramatically illustrated by the Finnish Diabetes Prevention Study (DPS) that explicitly showed that when the study participants with impaired glucose tolerance reached all five modest lifestyle intervention targets, none of them progressed to T2D (*8*).

Importantly, lifestyle intervention lasting for 3–6 years has been shown to have a carry-over effect on T2D incidence that lasts for several years; up to 15 in the Finnish Diabetes Prevention Study (*9*) and 20 years in the China Da Qing Diabetes Prevention Study (*10*). The observed sustained risk reduction seems to be a result of sustained lifestyle changes, but the legacy effect of improved glycaemia during the early intervention may also have contributed to the long-term effect. The follow-up data from the Chinese study indicate moreover that vascular risks are also reduced by lifestyle management.

Several prognostic questionnaires exist for detecting people at risk of T2D (*11*). One of the screening tools with an adequately high sensitivity and specificity is the Finnish Diabetes Risk Score (FINDRISC) developed in Finland (*12*). The FINDRISC has been successfully implemented in the Finnish primary health care system and used also in many other countries. The FINDRISC was also tested in the Omani population and as a result a slightly modified Omani Diabetes Risk Score was developed (*13*) which may be a suitable screening tool for the Arab populations in the Middle East.

Lifestyle interventions aiming at translating evidence from efficacy RCTs on T2D prevention into "real world" intervention programmes have also been carried out in various populations. Such data were recently combined in a meta-analysis considering the relationship between intervention effectiveness and adherence to guidelines (*14*). The primary meta-analysis included 22 studies with outcome data for weight loss at 12 months. The pooled result of the direct pairwise meta-analysis shows that lifestyle

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interventions resulted in a mean weight loss of 2.12 kg. Evidence from this meta-analysis suggests that pragmatic T2D prevention programmes are effective. Effectiveness varies substantially between programmes but can be improved by maximizing guideline adherence to lifestyle changes.

In conclusion, there is no doubt that we can easily identify people at high risk of T2D and that lifestyle interventions can half their risk of T2D. Such evidence for efficient prevention strategies is rare for any noncommunicable disease. Yet, we must find the ways to make T2D prevention work at the population level. People cannot simply "outsource their lifestyle problems" completely to to health care personnel, although health personnel can advise people at high risk. The main issue is about healthy diet and sufficient physical activity. This needs all sectors of the community to be involved in so as to reduce the high burden of T2D.

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