INTRODUCTION

Diabetes is increasing worldwide, and the prevalence is expected to increase with an additional 204 million people by 2045, without concerted preventive actions (1). The increase is ascribed to the increase in type 2 diabetes (T2D) and is largely a result of excess body weight and a sedentary lifestyle (2). Diabetes increases the risk of morbidity and mortality and is associated with a range of diseases, including kidney failure and cardiovascular disease (3). Being a chronic disease associated with serious complications, attempt to halt the progression at the pre-diabetic stage is key to T2D prevention (4). Strategies for treatment of obesity and obesity related diseases, includes dietary modulation, increased physical activity and behavioural strategies, but other strategies such as pharmacotherapy and surgery also exists (5–7).

Several dietary strategies aiming at preventing and treating overweight and obesity have been proposed to achieve sustainable weight loss and weight loss maintenance (8). In addition, a range of studies (9–11) have been used to investigate which macronutrient composition that are superior in the treatment of overweight and obesity. There is still no consensus about the optimal macronutrient composition among experts. Furthermore, lifestyle intervention has been shown to delay the progression from pre-diabetes to T2D with a lower-fat and higher complex carbohydrate diet (12–14). However, a high protein diet may be useful for short-term weight loss (4,11,15–19), but long-term studies investigating the role of high-protein in T2D prevention, particular in high risk groups are still required. For these reasons, a large three-year PREVIEW RCT is now underway to investigate the effect of a high-protein, lower glycaemic index for the prevention of T2D (20).

An increase in protein intake has been a part of the dietary advices in a number of diseases and health problems during the last 10 years (21–23), and this tendency has been constantly growing. In weight loosing programs a high protein intake is widely recommended as the appetite seems to decrease (24). On the other hand, there has been conflicting evidence of the effects of high-protein diets as a potential modulator of kidney function due to an acute increase in renal plasma flow and glomerular filtration rate (GFR) (25). This has raised concerns that ingestion of high-protein diets may increase glomerular pressure and hyperfiltration which may lead to progressive loss of kidney function in the long term (25,26). However, these potential mechanisms are mainly suggested by animal studies (27–31), but also indicated in a few studies in humans (32).
The question of nephro-toxicity is especially important in individuals/patients with high risk of kidney disease as a complication, among those the metabolic syndrome and atherosclerosis. For this reason, we wanted to evaluate the potentially unwanted effects in older, overweight or obese pre-diabetic, participants being a very prevalent high-risk group for developing kidney problems.

Potentially, an increase in the intake of protein could affect the production of short-chain-fatty-acids and other substances in the colon and thereby the risk of colonic cancer (33,34). Especially red and processed meat has been shown to be risk factors in epidemiological investigations (35–37). Furthermore it is unclear whether the total amount of protein is more important than the source of the protein (38). We wanted to investigate if protein or protein sources, especially red and processed meat intake could affect these potential cancerogenic mediators.

The relationship between dietary protein and T2D is still unclear. Aside from the total protein content in the diet, the protein source may be influential. A high intake of protein of animal origin may increase T2D incidence (39). T2D is associated with higher meat consumption, especially red and processed meat (40–42). However, consumption of dairy products is associated with a reduced risk of T2D (43–45), and/or a high consumption of plant protein, especially legumes (46). To evaluate the influence of different protein sources (plants or animals) we constructed and evaluated a score as a useful tool for that kind of analysis.