General Introduction
Diabetes: an Introduction

*Diabetes mellitus* is the common term for various conditions that are characterized by high blood glucose levels (*hyperglycemia*). The hyperglycemia is caused by malfunctioning of the hormone insulin that is responsible for the transport and storage of glucose (blood sugar) in the body. Although there is only a thin line between the various types of diabetes, in general four types are distinguished: Diabetes Type I, Diabetes Type 2, Gestational Diabetes and Diabetes secondary to other conditions. Diabetes Type 1 and 2 are the most frequently diagnosed types of diabetes.

Diabetes Type 1 is defined as an auto-immune response which is characterized by a lack of insulin production in the pancreas. This lack of insulin production is caused by an autoimmune-mediated destruction of the insulin producing cells (β-cells of the islets of Langerhans) in the pancreas. The exact cause of this destruction is unknown. Since concordance for Type 1 diabetes in monozygotic twins is only around 30%, other than genetic factors are believed to play a significant role in the incidence of diabetes.

When the insulin production in the pancreas is too low relative to available glucose in the blood, blood glucose levels increase and hyperglycemia occurs. Having no or little endogenous insulin production confronts most diabetes Type 1 patients with a lifelong dependence on exogenous insulin to decrease high blood glucose levels. The exogenous insulin replacements are injected subcutaneously by the patient one to multiple times a day or enter the body by means of an insulin pump. Diagnosis of diabetes Type 1 may occur at any age, but generally occurs during childhood or in adolescence. The onset of Type 1 diabetes is characterized by classic symptoms, such as *polyuria* (increased urinary frequency), *polydipsia* (frequent thirst), weight loss, fatigue and *ketonuria/albuminuria*.

In patients with Diabetes Type 2 the pancreas usually still produces some insulin, but the production or uptake of insulin in the body is disturbed. Initially, many Type 2 diabetes patients show insulin resistance and no destruction of the beta cells, but beta cell failure may occur years after diagnosis. Sometimes diabetes Type 2 is defined as non-insulin-dependent-diabetes-mellitus (NIDDM) because most patients with Diabetes Type 2 do not instantly need exogenous insulin replacements after diagnosis. However, this definition might be misleading because the insulin production in the pancreas of many diabetes Type 2 patients decreases throughout the years and makes the body increasingly dependent on exogenous insulin. Furthermore, many diabetes type 2 patients eventually need exogenous insulin to keep their blood glucose levels within a normal range.
Because of the gradual decrease in insulin production by the pancreas, diabetes type 2 usually is diagnosed in mid-late adulthood (> 45 years of age). In contrast to diabetes Type 1, the diagnosis of diabetes Type 2 generally is not preceded by classic symptoms or health complaints and often occurs coincidentally with the diagnosis of a secondary condition. Concordance rates for diabetes Type 2 are much higher than for diabetes Type 1, approaching 100% in monozygotic twins. However, diabetes type 2 is believed to be caused by an interplay of genetic and environmental (lifestyle) factors. People with a genetic predisposition for diabetes type 2 who have a healthy lifestyle and a normal weight might never develop diabetes. However, people with a genetic predisposition for diabetes type 2 who are overweight and/or have an unhealthy lifestyle are most likely to develop diabetes at some point in their lives. Eighty to ninety percent of diabetes Type 2 patients is overweight (BMI > 25) or obese (BMI > 30). The increasing number of people who are overweight is seen as an important factor in the increasing incidence of diabetes Type 2.

Prevalence of Diabetes
Diabetes is reaching epidemic proportions throughout the world. It is estimated that more than 180 million people worldwide suffer from diabetes. Approximately 90-95% of these people are diagnosed with diabetes Type 2. Because of the increasing incidence of unhealthy lifestyles and overweight the number of 180 million diabetes patients worldwide is expected to have doubled by the year 2030. Although Type 2 diabetes generally was diagnosed in mid-late adulthood and therefore was known as maturity-onset diabetes, due to the increase in people with unhealthy lifestyles and overweight an increasing number of young adults and even children are diagnosed with diabetes Type 2.

Compared to other European or non-European countries the prevalence of diabetes in the Netherlands is relatively low. The number of diabetes patients in the Netherlands is estimated to be round 600,000 which represents about 3% of the total Dutch population. This number, however, is still increasing. About ninety percent of these people suffer from diabetes type 2. The prevalence of diabetes in the Netherlands is highest among people living in urban areas and the non-Caucasians.

Short and Long Term Consequences of Diabetes
When the pancreas does not produce (sufficient) insulin or when the body is not able to effectively use the insulin, blood glucose levels rise and hyperglycemia occurs. Without computerized monitoring of their blood glucose levels, most patients are unaware of their
hyperglycemia in the short term and do not experience any symptoms or health complaints. However, some patients report symptoms of hyperglycemia such as dryness of the mouth, fatigue or blurry vision. In the long term (> 15 years), hyperglycemia manifests itself through serious diabetes complications such as neuropathy (nerval damage), retinopathy (eye problems), nephropathy (renal damage/kidney failure), joint problems and cardiovascular damage. In extreme cases hyperglycemia can result in coma, seizures or death through ketoacidosis (acidified tissue and organs). However, most diabetes patients die of cardiovascular complications.

When the exogenous insulin replacement is too high relative to available glucose levels in the blood hypoglycemia occurs. Hypoglycemia often occurs as a consequence of insufficient dietary intake or excessive physical exercise relative to exogenous insulin replacement. Some patients are ‘hypo-unaware’ and do not experience any symptoms of hypoglycemia. However, most patients report symptoms of hypoglycemia ranging from hunger, perspiration, sleepiness, dizziness, confusion or nervousness to difficulty speaking. Hypoglycemia can be treated by the intake of fast-acting carbohydrates to prevent a further decrease of blood glucose levels. Left untreated, severe hypoglycemia can lead to coma or death.

Treatment and Self-Management of Diabetes

In general, treatment of both diabetes Type 1 and Type 2 patients focuses on decreasing and stabilizing blood glucose levels. For accurate feedback about patients’ blood glucose levels physicians generally rely on patients’ feedback provided by the computerized monitoring of blood glucose levels and on their glycosylated hemoglobin assay (HbA1c). HbA1c provides an estimate of a patient’s average blood glucose levels in the preceding six to eight weeks.

For Type 1 diabetes patients the medical treatment of diabetes usually comprises injections with exogenous insulin or the use of an insulin pump. For Type 2 patients the medical treatment usually starts with oral anti-diabetics (e.g. Biguanides, Sulphonylurea or Thiazolidinediones) and often gradually changes into an insulin based treatment over the years. Next to the medical treatment with anti-diabetics and/or insulin, great emphasis in the treatment of diabetes is put on diabetes self-care behaviors. The most important diabetes self-care behaviors are the self-monitoring of blood glucose levels (self-control) and management of food intake. Because blood glucose levels fluctuate throughout the day, diabetes patients (who use insulin therapy) are instructed to monitor their blood glucose levels multiple times a day. Regular self-control gives patients an important tool to adjust insulin injections to the level of blood glucose in
the blood. Adjusting insulin to the glucose levels in the blood prevents patients from injecting too much or too little insulin, which in turn prevents hypo- and hyperglycemia. Furthermore patients are advised to monitor their intake of carbohydrates and to adjust their medication/insulin to their intake of carbohydrates. Controlling dietary intake and alcohol consumption immediately influences the balance between available glucose levels in the blood (from foods or alcohol) and the uptake of glucose by insulin present in the body. Apart from the self-monitoring of blood glucose and the management of food intake, all patients are advised to live a generally healthy lifestyle. The increased chances of diabetes patients for developing a cardiovascular disease underline the importance of maintaining a healthy diet, engaging in regular physical exercise and quitting smoking.

For most diabetes Type 2 patients, the initial medical treatment with oral anti-diabetics is usually combined with treatment strategies for weight loss. Weight loss can increase insulin sensitivity, most especially when weight loss occurs in abdominal fat deposits. Treatment of diabetes type 2 patients, therefore, mostly focuses on changes in food consumption and an increase in physical activity.

The increasing awareness of the importance of lifestyle and health behaviors in the management of diabetes has changed perspectives in diabetes treatment throughout the years. Whereas the treatment of diabetes previously focused on adherence to medical and pharmacological regimes, current diabetes treatment generally focuses on the interplay between medical, pharmacological, lifestyle and psychosocial factors in diabetes. The high and immediate impact of lifestyle behaviors and self-control on blood glucose levels creates major opportunities for diabetes management without invasive medical procedures. Patients’ self-regulation skills with regard to these lifestyle behaviors and self-control techniques are the most important tools in the management of high or low blood glucose levels.

Acknowledging the importance of lifestyle and health behaviors in diabetes management has led to an increased awareness of the important role of psychology in diabetes care. Psychological theories about patient education and how to motivate/teach patients to change behavior have been increasingly applied to diabetes care throughout the years. The previous assumption that provision of medical information would automatically lead to behavior change has been abandoned and has been replaced by the idea that psychological strategies are needed to motivate patients for behavior change. Understanding why patients do or don’t perform self-management behaviors has become increasingly important.
Self-regulation Theory and Diabetes Self-Care

One of the modern theoretical perspectives of looking at self-management behaviors is the self-regulation perspective. Self-regulation theory provides a theory-based framework from which practical guidelines for interventions and specific working mechanisms for behavior change can be derived. Self-regulation can be defined as ‘a sequence of actions and/or steering processes intended to attain a personal goal’. These actions and/or steering processes, also referred to as change and maintenance mechanisms, can be divided into three phases: a) a phase of goal selection, goal setting and goal representation, b) a phase of active goal pursuit, and c) a phase of goal attainment and maintenance or goal disengagement.

In the phase of goal selection, goal setting and goal representation, goal autonomy plays a key role. Intervention health goals such as weight loss, quitting smoking or engaging in physical exercise are often set for, and not by, the individual and are often defined without relating them to the individual’s pre-existing personal goals. As a consequence, the individual is confronted with other goals in his personal life which are conflicting with the achievement of the coerced health goal. Disengagement with the health goal often is the result. Deci and Ryan have repeatedly demonstrated that ‘autonomous regulation’, that is setting and pursuing self-formulated goals, produces notable effects in terms of life-style changes, medication adherence and diabetes management outcomes. Goal selection is also highly influenced by illness perceptions such as experienced illness symptoms, perceived causes for the illness, perceived control over the treatment and cure, the expected timeline of the illness, and experienced daily consequences of the illness. These five dimensions have been proven to relate to the self-management of various chronic conditions including diabetes. In a study by Griva, Myers and Newman beliefs of control over diabetes were consistently associated with treatment adherence. Broadbent, Petrie, Main and Weinman demonstrated that higher personal control over diabetes was associated with lower HbA1c whereas experiencing more diabetes symptoms was associated with higher HbA1c-levels.

The transition from goal selection and goal setting to active goal pursuit is facilitated by both cognitive and affective processes. Positive and negative affect function as emotional reinforcements of goal facilitating and goal inhibiting behaviors respectively. The cognitive processes which facilitate goal achievement are categorized into three types: (a) feedback mechanisms, which refer to the ability to evaluate and monitor goal progress on the basis of results, (b), feed forward mechanisms, which consist of expectations with regard to the outcome of goal pursuit as well as efficacy expectations, and (c), activation of control processes, such as
control over distracting emotions, being able to focus on goal-related information, being able to motivate oneself and using failure as an opportunity for learning. Feedback mechanisms, such as the self-monitoring of nutrition and exercise behavior prove to be effective intervention components in many diabetes interventions. Moreover, for most insulin-dependent diabetes patients the self-monitoring of blood glucose levels has become a daily routine.

The inclusion of feed forward mechanisms in health interventions is usually represented by the inclusion of self-efficacy components. Self-efficacy has been frequently shown to relate to behavior change and disease management in various chronic conditions, including diabetes.

To the best of our knowledge, the activation of control processes as such have not been examined within a diabetes context. Motivations to perform diabetes (self-care) behaviors have been frequently assessed as part of a self-determination intervention however; motivation in this context is usually defined as prior-to-treatment motivation, rather than motivation in the action phase of goal pursuit.

Maintenance of (new) health behaviors is one of the biggest challenges for both patients and health care providers. Numerous interventions have shown the relative simplicity of changing health behaviors in the short term and the extreme difficulty of maintaining those behaviors in the longer term, also in the context of diabetes self-care. To increase chances of maintenance, various diabetes interventions have included relapse prevention techniques.

All of the above-mentioned interventions indicate that self-regulation theory has found its way into the field of diabetes self-care. However, a systematic use of important mechanisms from all three phases of self-regulation to facilitate goal achievement was not yet found within the field of diabetes research. It is therefore that this thesis will use the orienting principles for self-regulation interventions to evaluate the effect of existing diabetes weight loss interventions and to conduct a self-regulation weight reduction intervention for diabetes type 2 patients.
Research questions and Outline of the Thesis

The central focus of this thesis is to explore the role of self-regulation in overweight diabetes type 2 patients. The general research questions in this thesis are:
1) What is the role of self-regulation principles in diabetes weight loss interventions? (CH 2)?
2) Do self-regulation cognitions relate to diabetes self-efficacy and weight regulating behavior in overweight diabetes type 2 patients? (CH 3)
3) What are the effects of a pilot self-regulation weight reduction intervention for type 2 diabetes patients? (CH 4)
4) Can self-regulation cognitions predict drop-out from a weight reduction intervention for type 2 diabetes patients? (CH 5)

Overview of Chapters in Thesis

This thesis consists of six chapters, four of which are empirical. Chapter one briefly introduces the topic of diabetes and self-regulation theory. The meta-analysis in chapter two describes the general effect of diabetes weight loss interventions as well as self-regulatory moderators of these effects.

Chapter three uses the baseline data of the self-regulation pilot intervention. Cross-sectional relationships between self-regulatory cognitions, diabetes self-efficacy and weight regulating behavior are examined.

Chapter four presents the three and six month results of the self-regulation pilot intervention. The effect of the self-regulation intervention on weight, HbA1c, self-regulation and quality of life is examined in the intervention and control groups.

Chapter five briefly describes predictors of six month drop-out of the intervention study. Univariate and multivariate differences between drop-outs and stay-ins are examined. Furthermore, logistic regression analyses were conducted to find the best psychosocial predictors of drop-out.

In chapter six an attempt is made to integrate and discuss the main findings from this thesis from a theoretical, methodological and clinical point of view. A discussion of the results, limitations of the study, implications of the results and suggestions for future research are made.
References


