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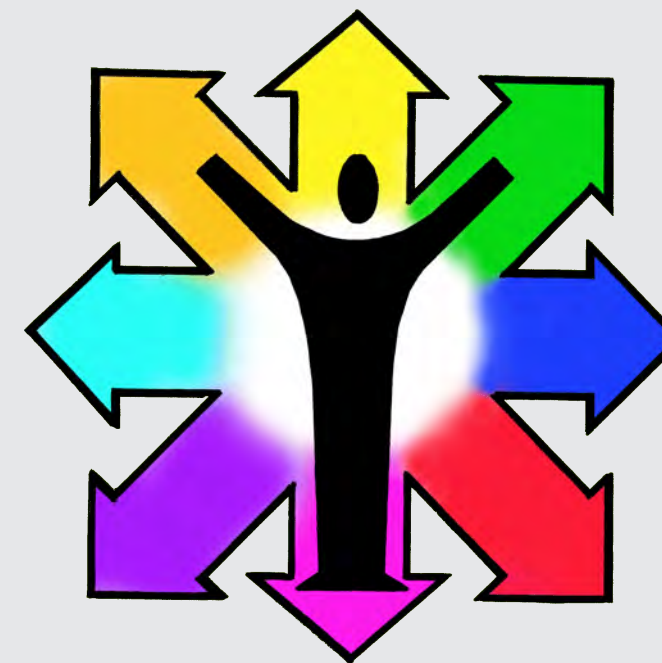
Thesis for doctoral degree (Ph.D.) 2008

Health Promotion in Diabetes Care - studies on adult type 1 diabetes patients

Susanne Amsberg

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2008

## Health Promotion in Diabetes Care - studies on adult type 1 diabetes patients



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# **Health Promotion in Diabetes Care**

## **- studies on adult type 1 diabetes patients**

Susanne Amsberg



**Karolinska  
Institutet**

Stockholm 2008

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*Grant me the serenity to  
accept the things I cannot change,  
courage to change the things I can,  
and the wisdom to know the difference*

*Ge mig styrka att  
acceptera det jag inte kan förändra,  
mod att förändra det jag kan  
och förstånd att inse skillnaden*

*Utvald del ur "Sinnesrobönen", Reinhold Niebuhr, 1926,  
fritt översatt av Susanne Amsberg*



## ABSTRACT

**Introduction:** A landmark report has shown that improving glycaemic control among type 1 diabetes patients markedly reduces diabetes-related complications. In clinical practice, however, many patients have problems in adhering to the treatment, and thus remain in poor glycaemic control. Research suggests a more behaviour-oriented approach to diabetes, but there is a lack of evidence on the efficacy of interventions, especially for those adult type 1 diabetes patients who are in poor glycaemic control. Diabetes-related distress has been associated with poor adherence to treatment and poor glycaemic control. There is a need for validated measures in this area, to identify patients who experience diabetes-related distress. Additionally, injection technique is crucial for the management of diabetes, and lipohypertrophy is a common side effect which deserves further attention.

**Objectives:** The overall aim of this thesis was to evaluate a behavioural medicine intervention among poorly controlled adult type 1 diabetes patients, and to gain a deeper knowledge in an area of diabetes self-management.

**Methods:** Quantitative design was used for the studies, and the clinical settings comprised two diabetes care units in Stockholm, Sweden. *Study I:* The Swedish version of the Problem Areas in Diabetes (Swe-PAID-20) scale was evaluated regarding its psychometric properties by type 1 diabetes patients, as well as by an expert panel of diabetes specialist nurses. *Study II:* A behavioural medicine intervention based on Cognitive Behaviour Therapy (CBT) was evaluated in a randomised controlled trial among poorly controlled adult type 1 diabetes patients. *Study III:* Using the same sample as in study II, descriptive statistics were produced, and predictive and comparative analyses performed, in order to find predictors of or associations with improvements in glycaemic control as a response to the intervention. *Study IV:* In a randomised crossover trial insulin absorption in lipohypertrophic injection sites was investigated in type 1 diabetes patients.

**Results and conclusions:** *Study I:* A three-factor solution of the scale was found, comprising sub-dimensions of diabetes-related emotional problems, treatment-related problems and support-related problems. Cronbach's alpha for the total score was 0.94 and varied between 0.61 and 0.94 in the three subscales. The findings also supported the convergent and content validity. The Swe-PAID-20 seems to be a reliable and valid outcome for measuring diabetes-related distress in type 1 diabetes patients. *Study II:* Significant differences were observed with respect to HbA<sub>1c</sub>, well-being, diabetes-related distress, frequency of blood glucose testing, fear of hypoglycaemia, perceived stress, and depression, all of which improved more in the intervention group compared with the control group. The CBT based behavioural medicine intervention appears to be a promising approach to diabetes self-management. *Study III:* The participation rate in the study was 41% and attrition was 24%. Of those patients who actually participated in the intervention, 13% withdrew. From the regression models no predictors or associations were found with regard to improvement in HbA<sub>1c</sub>. The programme proved to be feasible in terms of design and methods. However, no clear pattern was found regarding predictors of or associations with improved metabolic control. *Study IV:* Impairment of insulin absorption from lipohypertrophic injection sites was also found with analogue insulins. It is suggested that patients should be advised to refrain from injecting insulin aspart into lipohypertrophic subcutaneous tissue.

Key words: diabetes mellitus type 1, diabetes-related distress, psychometrics, behaviour modification, cognitive behaviour therapy, behavioural medicine, glycaemic control, predictor, lipohypertrophy, insulin absorption, injection technique

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- IV. Johansson U-B, **Amsberg S**, Hannerz L, Wredling R, Adamson U, Arnqvist H.J, Lins P-E. Impaired absorption of insulin aspart from lipohypertrophic injection sites. Diabetes Care; 2005, 28, 2025-2027  
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## LIST OF ABBREVIATIONS

AT	Applied Relaxation
ATR	Applied Tension Release
AUC	Area Under Curve
CBT	Cognitive Behaviour Therapy
CGMS	Continuous Glucose Monitoring System
C-max	The maximum plasma concentration of a drug
CSII	Continuous Subcutaneous Insulin Infusion
DCCT	The Diabetes Control and Complications Trial
DES	Diabetes Empowerment Scale
DLOC	Diabetes Locus of Control scale
DSCI	Diabetes Self-Care Inventory
EDIC	The Epidemiology of Diabetes Interventions and Complications study
HAD	Hospital Anxiety and Depression scale
HbA <sub>1c</sub>	Glycosylated haemoglobin
HFS	Hypoglycaemic Fear Survey
HRQoL	Health-Related Quality of Life
ISBM	International Society of Behavioral Medicine
NDR	Swedish National Diabetes Register
PAID	Problem Areas in Diabetes scale
PSS	Perceived Stress Scale
RCT	Randomised Controlled Trial
SDSCA	Summary of Self-Care Activities
SMBG	Self-monitoring of blood glucose
SOC	Sense of Coherence questionnaire
Swe-PAID-20	Swedish version of the Problem Areas in Diabetes scale
T-max	The time after administration of a drug when the maximum plasma concentration is reached
W-BQ12	Well-being Questionnaire
WHO	World Health Organization

# 1 INTRODUCTION

Diabetes is a chronic disease that requires a lifelong therapeutic self-care regimen to maintain control over blood glucose. A major task for diabetes care providers is to support patients in performing necessary self-care behaviours. In order to do this we need to develop strategies, such as recommending effective self-care regimens and instructing patients on their use, as well as promoting behavioural changes when needed. In clinical practice, however, many patients have problems in adhering to the treatment, which contributes to long-term poor glycaemic control [1]. Those patients face an increased risk of diabetic complications [2] and impaired quality of life [3].

Most patients with diabetes report a satisfactory level of quality of life [3], and it would be a simplification to say that poorly controlled diabetes is always a result of an underlying psychological problem, since there may be many reasons why diabetes outcomes are sub-optimal [4]. Yet, the disease has been described as the most psychologically and behaviourally demanding of chronic diseases [5], and there is consensus that psychological factors may play a key role in causing incomplete diabetes self-management [6-8].

Poor adherence to the treatment and poor glycaemic control have been shown to be associated with diabetes-related distress, not involving general distress [9], which indicates an occurrence of diabetes-specific stressors. Self-care behaviours can have a negative effect on the diabetes treatment if they are not carried out correctly, as in the case of an unsuitable insulin injection technique. One example of this is the problem of lipohypertrophy, which is associated with erratic insulin absorption and poor glycaemic control [10-12].

In summary, the current thesis reports on some aspects in the field of health promotion, defined as ‘the process of enabling people to increase control over, and to improve, their health’ [13]. The topics deal with behaviour-oriented support to poorly controlled type 1 diabetes patients, evaluation of an instrument measuring diabetes-related distress, and a closer look at insulin absorption in lipohypertrophic injection sites. The relevance of nursing research in these areas is motivated by the common and final concern of diabetes self-management among patients.

## 2 BACKGROUND

### 2.1 TYPE 1 DIABETES

Type 1 diabetes is a chronic metabolic disease with an absolute requirement of insulin replacement therapy. The disease is associated with a risk of life-threatening severe hypo- and hyperglycaemia, as well as long-term complications. Over time, diabetes can damage the eyes, kidneys, nerves, blood vessels and heart, resulting in various consequences, e.g. retinopathy, neuropathy, heart disease and stroke. Combined with reduced blood flow, neuropathy in the feet increases the risk of foot ulcers and limb amputation. Globally, diabetes affects approximately 171 million people (2.2%), the number is also steadily rising and is expected to increase to about 366 million (4.4%) in 2030. This alarming situation is described as a ‘diabetes epidemic’ [14]. According to quality of care data from the Swedish National Diabetes Register (NDR) [15], diabetes prevalence in Sweden is about 3%, with a variation of 2-4,5% dependent on area. Approximately 10% of those who are reported to the NDR represent type 1 diabetes patients. In Sweden, the mean annual incidence rate of type 1 diabetes is about 13/100000, with a higher incidence among men (16 vs. 9 /100000) [16].

#### 2.1.1 Treatment goals

The overall aim of diabetes treatment is to prevent acute and long-term complications and to maintain a good quality of life [17]. Both aspects will be discussed in more detail below.

##### 2.1.1.1 Metabolic control

HbA<sub>1c</sub> has been used as a marker of long-term glycaemic control in diabetes patients for more than two decades [18]. The HbA<sub>1c</sub> blood test, also called glycosylated haemoglobin, estimates how well plasma glucose has been controlled during the previous six to eight weeks.

Usually, Swedish hospitals use the DCA 2000 <sup>TM</sup> for analysis of HbA<sub>1c</sub>, which has proved to have good accuracy [19]. A normal HbA<sub>1c</sub> is 3.6-5.0%. Among diabetes patients an HbA<sub>1c</sub> of about 6.5% is considered good. *Poorly controlled diabetes* is defined as HbA<sub>1c</sub> > 7.5% [17].

As a landmark report, the Diabetes Control and Complications Trial (DCCT) [20] has shown that improving blood glucose control in type 1 diabetes markedly reduces complications of the eyes, kidneys, and nerves. It has been suggested that features of glucose control, other than those that are reflected by HbA<sub>1c</sub>, may be added to modify the risk of complications, e.g. specific patterns of glucose variation, in particular postprandial hyperglycaemia [2]. However, recent evidence from the DCCT group and the Epidemiology of Diabetes Interventions and Complications (EDIC) study [21] indicates HbA<sub>1c</sub> as the major determinant of microvascular complications.

As a result of the DCCT, guidelines have been drafted by the Swedish National Board of Health and Welfare [17] regarding diabetes and its treatment. In Table 1 the aims regarding metabolic control are presented, according to guidelines from year 1999.

Table 1. Aims for glycaemic control according to guidelines from year 1999 [17]

	Good control	Intermediate control	Poor control
B-glucose before meal, mmol/l	4.4-6.1	6.2-7.8	>7.8
B-glucose after meal, mmol/l	5.5-8.0	8.1-10.0	>10.0
HbA <sub>1c</sub> (%)	<6.5	6.5-7.5	>7.5

Achieving the goals of metabolic control is not an easy task for everyone with diabetes. In fact, according to the NDR only 32% of type 1 diabetes patients actually achieve an HbA<sub>1c</sub> of below 6.5%. Thus, a majority are above the targeted level, and as many as approximately 35% are in poor glycaemic control [15].

There is an exponential relation between HbA<sub>1c</sub> and the risk of long-term complications [2, 20]. Therefore, when HbA<sub>1c</sub> increases from 7% to 8%, the risk increase is even higher than in a case where HbA<sub>1c</sub> increases from 6% to 7%. By lowering HbA<sub>1c</sub> by 10% from e.g. 7% to 6.3%, the risk of developing complications of the eyes is suggested to be reduced by almost 50% [2]. There has been speculation regarding the clinical importance of even small improvements, such as reducing HbA<sub>1c</sub> from 7% to 6.6% and it is believed that the greatest benefits are achieved in those who lower HbA<sub>1c</sub> from the highest levels [22]. Notably, there seems to be no threshold of HbA<sub>1c</sub> for prevention against long-term complications [23].

It is suggested that metabolic control must be achieved by a minimum of hypoglycaemias and with preserved well-being. Since glycaemic control is only one of many possible personal goals, it is stressed that the aim of metabolic control should be set with respect to each individual's life situation [17].

#### 2.1.1.2 *Quality of life*

For patients with diabetes, treatment can have a significant impact on many aspects of quality of life. Work, interpersonal relationships, social functioning, and physical and emotional well-being can be substantially influenced by diabetes and its treatment [24]. Quality of life refers to the degree of excellence people consider their lives to contain. People around the world judge excellence using similar criteria, such as performing daily activities, energy or discomfort, positive or negative feelings, personal control, interpersonal relations, pleasant activities, personal and intellectual growth, and material possessions [25, 26]. Research has shown that people with diabetes have a worse quality of life than people with no chronic illness, indicating complications are the most disease-specific determinant of quality of life. On the other hand, most people with diabetes have a better quality of life than most people with other chronic diseases [3].

Unfortunately, the concept of health-related quality of life (HRQoL) seems to have become ambiguous over the years and there are an overwhelming number of different instruments designed to assess the various aspects of this dimension. Nevertheless, there is little agreement about how to assess quality of life and the concept of disease-

specific HRQoL has become, if possible, even more confused. Polonsky [27] suggests a conceptual framework of overall HRQoL, disease specific HRQoL covering three broad areas of physical, psychological and social functioning. This thesis will deal with some aspects of quality of life, further discussed in Papers I-III.

### **2.1.2 Hypoglycaemia**

Hypoglycaemia is the most common adverse event associated with insulin treatment in type 1 diabetes. It can occur suddenly and is characterised by unpleasant physical and psychological symptoms such as shaking, sweating, drowsiness, nausea, poor coordination, mental confusion, negative mood, and unconsciousness [28]. The condition can lead to dangerous conditions, e.g. coma, permanent brain damage and death. It can also negatively affect social and occupational life in embarrassing ways [29, 30]. The DCCT [31] found that strict glycaemic control resulted in a threefold increase in the number of hypoglycaemic events in type 1 diabetes. Thus, patients approaching near normo-glycaemia balance the risk of hypoglycaemia against the risk of long-term complications of hyperglycaemia. During daily life, diabetes patients must recognise impending and fully developed hypoglycaemic episodes in order to take appropriate actions. In many people with insulin-treated diabetes their perception of symptoms becomes altered or diminish over time, and they may develop an impaired awareness of hypoglycaemia, which in itself is associated with an increased risk of severe hypoglycaemia defined as an event requiring external assistance for recovery [32]. Psychological factors clearly play a crucial role in determining an individual's likelihood of developing severe hypoglycaemia. Low mood, emotional coping and socioeconomic status have been linked to risk of severe hypoglycaemia and so too have other more straightforward behavioural factors such as an individual's propensity to carry a supply of carbohydrates for emergency use and the determination to achieve normoglycaemia [33].

### **2.1.3 Diabetes self-management**

The four major components of diabetes self-management are: medication/insulin injection, diet, exercise, self-monitoring of blood glucose (SMBG) [34] and, above all, balancing these self-care activities. Every action taken by the patient may affect blood glucose.

Self-care in diabetes is crucial to keep diabetes under control, and Anderson et al [35] propose that as much as 98% of the self-care is usually provided by the ill persons or their families. However, a problem that is hard to face, is that adherence to self-care does not always lead to good metabolic control, whereas neglect of self-care is likely to lead to poor metabolic control [36]. One self-care activity that was of interest in this thesis was insulin injection technique.

#### *2.1.3.1 Injection technique*

The procedure of insulin injection is a commonplace feature of diabetes self-management and requires an appropriate technique to optimise outcome [37]. It is remarkable that research in this area of self-management seems to be limited, and there

is a lack of solid evidence [38, 39]. However, to provide some basis for discussion of this issue, primary aspects with regard to current standards are given below [39-42].

- Insulin should be injected subcutaneously in the abdomen in an area round the belly button, in the external front of the thigh or in the external part of the buttock.
- Injection sites should be rotated in order to prevent lipohypertrophy.
- A new needle should be used for each injection, except for those being treated with continuous subcutaneous insulin infusion (CSII), where a new needle and injection site are recommended every other third day.
- Needle size is recommended to be 5-8 mm, but should be chosen with respect to the amount of subcutaneous fat [38].
- A two-finger pinch-up technique is recommended with an angle of 45° [40] or 90° [41] to inject the insulin.
- The skin fold should continue to be held, the needle has been withdrawn from the skin, which should be after 10 seconds duration in order to avoid leakage.

#### **2.1.4 Lipohypertrophy**

Lipodystrophy at the sites of repeated insulin injections is a well-known complication of insulin therapy. A lipodystrophic reaction can evolve either as a hypertrophic or an atrophic skin lesion, for which two distinct mechanisms of origin have been suggested. Insulin-associated lipoatrophy is regarded as resulting from a local immune reaction against impurities of the insulin preparation, while lipohypertrophy is assumed to be a consequence of a local trophic action of insulin [43, 44]. Prevalence rates of lipohypertrophy vary between 20 and 50 % in type 1 diabetes patients [10, 11, 45], while lipoatrophy is quite rare.

It is generally held that absorption of insulin from lipohypertrophic sites is erratic. A recent study using continuous glucose monitoring has documented a significant correlation between the mean of daily differences of blood glucose and severity of injection site lipohypertrophy [46], and long-term poor glycaemic control has been associated with insulin-induced lipohypertrophy [47]. Absorption of isophane and regular insulins has previously been studied in this respect, and it was concluded from these investigations that impairments of insulin absorption from lipohypertrophic sites, thus documented, were of sufficient magnitude to be of clinical importance [48, 49]. Insulin analogues are currently being used by a majority of type 1 diabetes patients and the question then arises as to whether lipohypertrophy also alters the absorption rate of such rapidly absorbed insulins from the injection site. Using a specific immunoassay for the determination of insulin aspart in plasma the absorption of a single subcutaneous dose of this insulin analogue from hypertrophic and non-hypertrophic subcutaneous fat was studied in Paper IV.

#### **2.1.5 Barriers to good glycaemic control**

The barriers to achieving optimal glycaemic control may be numerous and may vary from an individual perspective. This thesis does not provide a complete review of the barriers involved but a summary of associated factors according to recent literature is given in Table 2.

Table 2. Factors associated with poor glycaemic control

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Genetic factors [4]
Lower economic status [4]
Lack of motivation [4, 8]
Emotional distress [4, 8]
Diabetes-related distress [9, 50, 51]
Depression [4, 8]
External locus of control [8]*
Eating disorders [4, 8]
Delayed intellectual and emotional development [8]
Impulsive or avoidant coping styles [8]
Number of life events [8]
Phobic symptoms of blood and injury [52]
Fear of hypoglycaemia [28]
Low mood [53]
Alcohol excess [53]
Inadequate blood glucose monitoring [53]
Poor exercise/sedentary lifestyle [53]
Refusal to take tablets/insulin, or under-dosing [53]

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\*The individual's belief that his/her behaviour is guided by fate, luck or external circumstances [54].

The above summary includes the review of DeVries et al [4] reporting on the determinants and correlates of long-standing poor glycaemic control in adult type 1 diabetes; the review of Fisher et al [8] covering both type 1 and type 2 diabetes patients; and a recent study with the aim of predicting future improvement in glycaemic control [53]. Moreover, when conducting a literature search on the topic, studies on phobic symptoms [52] and fear of hypoglycaemia [28] have been found, which deserve special attention. It comes as no surprise that there is a close association between fear of hypoglycaemia and perceived risk of future severe hypoglycaemia [29]. In many instances this is appropriate, in that fear is often high in individuals who have impaired awareness of hypoglycaemia and/or have experienced multiple episodes in the past [55]. However, in other people, fear of hypoglycaemia may be high, while absolute risk is low – such individuals often display high levels of trait anxiety or have had a previous traumatic experience of hypoglycaemia [33].

Among all barriers described, diabetes-related distress [9] was a primary focus of this thesis and served partly as guidance in the design of the intervention study.

### 2.1.6 Diabetes-related distress

Depression is common in both type 1 and type 2 diabetes and has been associated with impairment in metabolic control and poor adherence to self-care regimens [56]. Among type 1 diabetes patients, it has been shown that depression is up to four times more prevalent as compared with the general population [57], indicating a possibility of diabetes-specific stressors. As a result, attention has recently been paid to diabetes-related distress as a measure of psychosocial adjustment specific to diabetes [9]. Repeated research has been conducted to describe the problem areas involved such as

diabetes-related emotional problems, treatment-related problems, food-related problems and problems related to social support [50]. Others have described the construct in terms of distress in relation to life with diabetes, and distress in relation to the management of diabetes [51]. Approximately one third of the patients have proved to be suffering from more severe diabetes-related distress [51], using criteria as given by Hermanns et al [58]. Diabetes-related distress has been shown to be positively correlated with glycaemic control, and with greater distress associated with poorer glycaemic control [9].

### **2.1.7 Facilitators of good glycaemic control**

Factors associated with good or improved glycaemic control include those of internal locus of control; coping that is task-oriented, problem-focused, or rational; support from friends; positive orientation and making use of past experience when managing the disease [8]. According to the study of Singh and Press [53], baseline characteristics that predicted future improvements in glycaemic control were seen in cases with a recent diagnosis of diabetes; in subjects with inadequate treatment with diet, oral glucose-lowering agents or insulin; in subjects with exacerbation of co-existent medical problems, with recent stressful life events and missed clinic appointments.

## **2.2 ORGANISATION OF DIABETES CARE IN SWEDEN**

In Sweden, the national guidelines of diabetes follow the St. Vincent declaration [59]. In practice, diabetes care is organised at two levels: hospital outpatient clinics and departments of medicine, usually treating people with type 1 diabetes; and primary care, usually treating people with type 2 diabetes. Type 1 diabetes patients usually see the physician, as well as the diabetes specialist nurse once a year. These appointments are separated so that each patient sees one of the healthcare providers every six months. Additional support is provided when necessary.

### **2.2.1 Diabetes care teams**

Due to the complexity of managing diabetes, it is necessary for most diabetes patients to regularly depend on others for support in optimising the management of their diabetes. One important source of support is that within the healthcare setting.

In order to attain a holistic view, diabetes patients need access to diabetes care teams, representing different specialities. It is suggested that medical, psychological, social and pedagogic perspectives should be integrated in a well-structured team, thus involving physicians, diabetes specialist nurses, nutritionists, podiatrists, welfare officers, and psychologists.

### **2.2.2 Patient education**

Diabetes self-management education is the cornerstone for care of all patients with diabetes. Because diabetes and its treatment is so complex, patient education is well-integrated in today's clinical practice guidelines for treating patients with diabetes [17, 60]. It is critical that patients understand the condition and how to treat it. The complexity has also been acknowledged to the extent that 'education' has been defined as follows: '.... a planned learning experience using a combination of methods, such as

teaching, counselling, and behaviour modification techniques which influence patients' knowledge and health and illness behaviour' [61]. Education is fundamental to lifestyle change and prevention of ill health, and aims to increase knowledge, build skills and develop attitudes that lead to improvements in metabolic control and quality of life in order to reduce or prevent complications [62].

All members of the diabetes care team play a role in education, although nurses and especially diabetes specialist nurses have been utilised most often as key persons in the delivery of formal diabetes self-management education [63, 64]. Topics of educational focus are: facts of the disease, SMBG, nutrition, exercise, medication/insulin treatment, prevention and treatment of hypoglycaemia, recommendations for actions to take during illness, aspects of smoking, traffic, alcohol, social and psychological aspects, sexuality, stress and anxiety, and long-term complications [17, 60].

## **2.3 KEY FINDINGS FROM PSYCHO-EDUCATIONAL RESEARCH**

### **2.3.1 Efficacy of interventions**

To date, the impact of patient education, as well as psycho-educational interventions on various health outcomes, has been described as low or moderate and most often not sustained [65-67]. Although patient education is considered a fundamental aspect of diabetes care, knowledge and behaviour have proved to be poorly correlated, meaning that knowledge alone does not always produce behaviour change [68, 69]. Notably, a recent meta-analysis found evidence for the effectiveness of psychological treatments in improving glycaemic control in children and adolescents, but not in adults with type 1 diabetes [70].

### **2.3.2 Strategies in promoting health and behaviour change**

Awareness of the limitations of traditional, compliance and knowledge-based education is becoming more widespread, and it is suggested that health professionals should be more behaviour-oriented in order to improve health outcomes among patients [69, 71]. Multifaceted interventions are the most effective, including education, and both behavioural and psychosocial elements. Additionally, the interventions should target lifestyle change and factors such as self-efficacy and empowerment [69, 72]. It is also conceivable that 'one size does not fit all'. People with diabetes differ in their clinical profiles, cultural backgrounds, and psychosocial needs. Furthermore, in many cases diabetes self-management is rarely the patient's primary life concern. Therefore, a more holistic patient-centred approach is suggested [73, 74].

In the past decade, there has been a growing interest in the role of cognitive and motivational factors as determinants of self-management behaviours. As a result, a plethora of social, cognitive and behavioural models have been generated [6]. The models do not only describe determinants of people's self-management behaviour, they also give hints or ideas of what strategies should be in focus in order to support individuals in their behaviour-change efforts. Some of the most common models in this area are the so-called 'Health Belief Model' [75], 'Stages of Change Model' [76] and the 'Empowerment Model' [72], the latter being described as a philosophical foundation for behaviour change [6]. In terms of optimising glycaemic control, a theoretical basis for

psycho-educational interventions is suggested, but so far no particular theory appears to be superior to others [67]. Therefore, instead of providing a detailed description of them all, common fruitful elements and strategies are given below.

#### *2.3.2.1 Common elements in promoting behaviour change*

In reviewing the research concerning behaviour change interventions, Peyrot and Rubin [6] propose a concrete support process that is based on existing behaviour-change models. It is a step-by-step patient-centred approach, including five major steps (the 5C intervention).

1. Constructing a problem definition
2. Collaborative goal setting
3. Collaborative problem solving
4. Contract for change
5. Continuing support

##### *Constructing a problem definition*

All successful models begin by defining the current problem and the desired change in behaviour. This first step involves getting a clear picture of what the problem is according to the patient, who is regarded as the specialist in living with diabetes. The therapist/clinician's role is to act as a facilitator for the patient's self-examination, helping to define the problem as clearly as possible. This strategy is more likely to be supportive than just recommending different self-care behaviours in general.

##### *Collaborative goal setting*

Research suggests that setting specific goals promotes greater behaviour change than setting vaguer or no goals. In addition, the goals should be measurable, action-oriented, realistic but challenging, for example 'Cycling to and from work 3 times a week', instead of 'Doing some more exercise'. Moreover, it is preferable to take the patients ability and perceived self-efficacy into account [77].

##### *Collaborative problem solving*

This step involves identification of barriers to behaviour change, commonly including cognitions (e.g. beliefs that treatments are not effective), emotions (e.g. lack of self-efficacy), social networks (e.g. lack of support), resources (e.g. lack of time or money), and/or physical environment (e.g. lack of facilities). The therapist/clinician should ask how these aspects represent barriers, to get as clear a description as possible in order to develop necessary promotive strategies.

Collaborative problem solving leads to formulating activities to achieve the goal. Instead of telling the patient what to do, the therapist/clinician supports the patient in deciding how to achieve the desired behaviour change by asking questions. The patient has to formulate and consider conceivable alternatives. One therapeutic strategy is to build on previous successes in behaviour change, if there are any. In this way, the patient's self-efficacy – confidence in his/her ability to perform health behaviours – increases his/her chance of reaching the desired goals.

### *Contract for change*

During this step a so called ‘plan for action’ or ‘a behavioural contract’ is written and agreed upon. This plan comprises time point for the start of behaviour change and current planned actions. The patient receives a copy of the contract, which acts as a reminder. It is of great importance for the patient, as well as the therapist/clinician, to understand the circumstances (environmental, social, financial, and attitudinal) that act as barriers or facilitators in making behavioural changes. Therefore, written records of track outcomes or self-monitoring of behaviours [77] is an important component in the patients own work between appointments.

### *Continuing support*

Since almost everyone lapses in behaviour-change activities, it is suggested that relapse prevention is made part of the process of behaviour change. Peyrot and Rubin [6] state that the most important issue is preparing patients for how to handle lapses by identifying coping resources.

### *Developing knowledge*

To be able to change behaviour, the patient obviously needs an understanding of what to do and how to do it, e.g. how to interpret blood glucose values, which not always is an easy task. Associations have been found between poor glycaemic control and cognitive dysfunction. Dunbar et al [77] emphasise the importance of focusing on behaviour-oriented information and the correct way of giving it, rather than focusing on the reasons for the change. Language should be simple.

### *Motivators, inhibitors/facilitators, intentions and triggers*

Additionally, based on the different models for behaviour change, Peyrot and Rubin [6] suggest that four categories of factors should be the target when promoting behaviour change in diabetes: motivators, inhibitors/facilitators, intentions, and triggers.

*Motivators* are factors that predispose someone to action, e.g. ‘I wish to get pregnant and live a long healthy life with my partner. This motivates me to engage in sensible self-care’. *Inhibitors* are barriers to action, e.g. ‘I can’t follow a healthy diet because I haven’t got enough skills in cooking, as well as the fact that I live alone, which makes meal-planning and cooking boring’. *Facilitators* are resources for action, e.g. ‘My sister gives me a call every other day to ask how things are going with my plan to give up smoking’. *Intentions* are proximal causes of behaviour change, i.e. What is the particular goal for behaviour change and is the individual ready to change? *Triggers* are the events that make a person shift from a predisposed state to the action state, e.g. ‘The doctor told me that I would be able to go scuba-diving if my blood-glucose levels were in good control. This was the determining factor for taking better care of my diabetes’.

## **2.3.3 Lack of solid evidence**

Reviews to date indicate a lack of solid evidence regarding the efficacy of psycho-educational support, particularly for those adult type 1 diabetes patients who are in poor control [4, 65, 69, 70].

Overall, the literature on psycho-educational research is difficult to interpret. Firstly, literature reviews do not always make a clear distinction between educational

intervention and psychological interventions [78]. Secondly, there tend to be methodological deficiencies such as low participation rates, small, unrepresentative samples, lack of randomised controlled trials, and lack of follow-up and long-term evaluation [65, 79-81]. 'Effect size' and 'effectiveness' is often described in a time frame of no longer than six months, which might be problematic in view of the possibility that there might be a delay before improved adherence is reflected in better glycaemic control [80]. In addition, attention is drawn to the lack of theoretical approach to the interventions, supposing that theory-based interventions are the most effective [82]. Finally, it is also claimed that there are no clear descriptions of the components of the interventions, and a lack of diabetes-specific measures for evaluation [83].

## **2.4 CONCEPTUAL FRAMEWORK**

### **2.4.1 Health and health promotion**

In 1948 the World Health Organization (WHO) defined health from a new perspective, stating that health was defined not only by the absence of disease and infirmity, but also by the presence of physical, mental and social well-being [84]. In line with the WHO's definition, health promotion emanates positive factors that enable health (also called the salutogenic perspective), which is different from disease prevention, based on negative factors that cause disease (also called the pathological approach) [85]. Health promotion as defined by the WHO is 'the process of enabling people to increase control over, and to improve, their health' [13]. Health promotion is usually described in terms of actions/conditions that can be cured, eased, helped or promoted. Common concepts in this context are health, the holistic view, empowerment and coping [86]. Thus, aspects of health and health promotion are relevant in diabetes care and research, in the sense of preventing/stopping the progress of long-term complications and enhancing well-being among patients. Nursing strategies in this area may involve all those actions and strategies that emphasise and encourage lifestyle choices and self-care [87], as well as caring for the psychosocial needs of patients.

### **2.4.2 Behavioural medicine**

In the past, individuals suffering from different chronic conditions would see a physician and maybe a nurse. In the late 1960s, however, psychologists working with physicians began using behaviour modification techniques to treat medical problems such as chronic pain, addictive disorders and sleep disorders. This launched the discipline that came to be known as behavioural medicine, a broad interdisciplinary field concerned with the link between health, illness and behaviour [88]. The International Society of Behavioral Medicine (ISBM) [89] is one such multidisciplinary organisation of clinicians, educators and scientists, dedicated to promoting the study of the interactions of behaviour with biology and the environment, and the application of that knowledge to improve the health and well-being of individuals, families, communities and populations.

### **2.4.3 The CBT model as a theoretical framework for intervention**

Interventions based on Cognitive Behaviour Therapy (CBT) have previously been successfully applied in behaviour change in different areas [90-94].

Papers II and III in this thesis are based on the theoretical framework of CBT, which is the systematic application of principles from learning theory [95], cognition theory [96] and social psychology [97]. Thus, CBT is a synthesis of those theories, suggesting the following assumptions according to the literature [98-101].

#### 2.4.3.1 *The interaction of the individual and the environment*

The individual is regarded as a person who constantly interacts with his/her internal and external environment. Thus, the individual's behaviour (actions), cognitions (thoughts, beliefs, perceptions), feelings, and physiology are integrated, as illustrated in Figure 1. All these aspects will most likely affect the way the patient manages his/her diabetes. For example, if all the patient's energy is focused on keeping his/her disease secret from friends and colleagues, this will probably affect his/her self-management when those persons are around. In the worst case, he/she will avoid necessary self-care behaviours such as testing blood glucose and injecting insulin, since such activities would identify the person as having diabetes, a thought that would be most frightening. Hence, by using this model it is possible to identify triggers and sustainers of problems, that violate optimal self-management behaviours. The approach involves finding out what thoughts and feelings are going on, what are the physiological reactions and what is the effect, i.e. how does the patient behave?

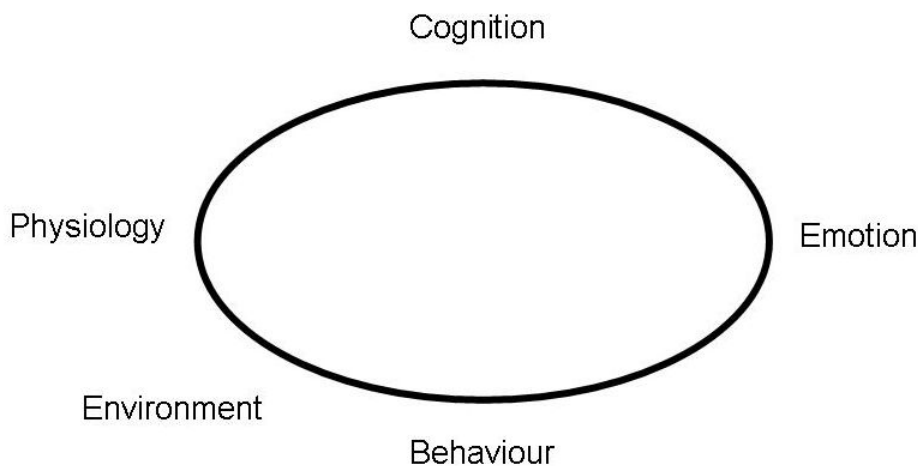


Fig. 1. The interaction of the individual and the environment

#### 2.4.3.2 *Behaviour as learnt by its consequences*

The term 'operant conditioning' was initially used by Skinner [102] as referred to the observation that behaviour could be modified by its consequences. Hence, people are more likely to engage in a specific behaviour if they expect positive outcomes. The behaviour is reinforced, with positive outcomes, leading the person to repeat the behaviour. Cycling to work could be a behaviour that leads to positive outcomes in the way it makes a person feel healthy and fresh, as well as leading to positive effects in lowering blood glucose. The same behaviour may also involve negative consequences, e.g. wet clothes if rain, and steep hills that make the person feel exhausted, with the risk of hypoglycaemia as a consequence. Thus, in the same manner the behaviour will

decrease if the consequences are negative. Consequences that are in the near future usually have a more powerful determinate effect than those that are far off. Hence, living a life here and now 'like anyone else' without paying much attention to diabetes-related demands may involve a feeling of freedom and pleasure. Future and possible threats of complications are far off and may not have such an impact on the person's behaviour. This operant learning theory suggests that behaviour is to a large extent influenced by external, environmental factors, as well as by psychological factors [103].

#### *2.4.3.3 Behaviour as learnt by its associations*

The principles of respondent or classical conditioning grew out of the work of Ivan Pavlov [104] and are based on the fact that certain stimuli automatically elicit certain responses apart from a prior learning or conditioning experience. These 'automatic' stimulus response relationships are called unconditioned reflexes, which involve e.g. 'food ->salivation', 'light to eye ->pupil constriction', 'high temperature -> sweating, flushing' etc. These behaviours do not need to be learnt, since they are automatic responses to stimuli. Thus when giving a bowl of food to a hungry dog, the dog will salivate automatically, without learning to do so. Continuing the experiment as Pavlov did, by including a ringing bell as an additional stimulus just before serving the food, will result in the previous neural stimulus being conditioned by associating it with food. The next time the bells ring, the dog will associate it with food before the food is served. Hence, behaviour can be learnt by respondent conditioning. Classical conditioning may also involve emotions, which can be respondentally conditioned, e.g. phobic fears among patients as described above [52]. Thus, a frightening experience of severe hypoglycaemia may lead to future fear of hypoglycaemia and avoidance behaviour as respondentally conditioned.

#### *2.4.3.4 Cognitions as cause of the behaviour*

If behaviour is action – i.e. what one does – then cognitions are one's mental processes, through which one thinks about and ascribes meaning to oneself, others and events, and from which one develops beliefs, attitudes and expectations. Beck [96] introduced the term 'automatic thoughts' to describe reflexive, negative thoughts, which come to mind and create an emotional effect, e.g. anxiety, which in turn affects a physiological response, 'fight or flight', the reaction of sympatheticus. The behavioural response may imply avoiding anxiety-provoking situations. Negative automatic thoughts often contain some sort of cognitive distortion, e.g. 'mind-reading', 'magnifying', 'over-generalisation', and 'all-or-nothing thinking'.

The 'ABC' model, originally developed by Albert Ellis [105], has been adapted for more general CBT use and may be helpful in understanding the role of cognitions. In this framework, 'A' represents an event or experience, 'B' represents the beliefs about 'A', and 'C' represents the emotions and behaviours that follow from those beliefs. For a person with diabetes this could be exemplified as described below:

##### **A. Activating event:**

In a few minutes you are about to lead a meeting at the division at your work.

#### B. Beliefs about A:

Suddenly you have this terrifying thought: What if I get an insulin reaction during the meeting? Then I will lose control and make a fool of myself in front of the others.

Maybe they will find out that I'm a 'diabetic' and lose confidence in me...

#### C. Consequence

Emotions: Low, sad and anxious.

Behaviours: To be on the safe side, I eat a large snack and some fast-acting sugar to keep the blood sugar levels higher during the meeting. I have prepared a bowl of fruit and sweets, available for everyone (including myself) during the session.

According to Ellis, core beliefs fall into three categories: 1) demands on oneself, e.g. 'It's my own fault that I can't manage my diabetes'; 2) demands on others, e.g. 'My doctor is worthless. He doesn't understand me. That's why things go wrong'; and 3) demands on the world, e.g. 'My life must always be enjoyable, or else it's not worth living'.

The beliefs involved in this process are described as irrational (unhelpful), since they help produce unhealthy feelings and behaviours. On the other hand, beliefs that encourage the individual to create healthy emotional and behavioural consequences are called rational or self-helping, which is a possible direction to work towards, according to the CBT model. The theory holds that each behaviour of the individual has a function that can be understood and treated when dysfunctional. The specific techniques involved in general CBT will be further described in the Methods section.

### **3 AIMS**

The general aims of this thesis were to evaluate a behavioural medicine intervention among poorly controlled adult type 1 diabetes patients and to gain a deeper knowledge in an area of diabetes self-management.

#### **3.1 SPECIFIC AIMS**

The specific aims were:

- To evaluate the psychometric properties of the Swedish version of the Problem Areas in Diabetes (Swe-PAID-20) scale in type 1 diabetes patients (I).
- To examine the impact of a behavioural medicine intervention on HbA<sub>1c</sub>, self-care behaviours and psychological factors in poorly controlled adult type 1 diabetes patients (II).
- To describe experience from a behavioural medicine intervention among poorly controlled adult type 1 diabetes patients, in terms of feasibility, predictors of and associations with improved glycaemic control (III).
- To investigate whether the absorption of a single subcutaneous dose of insulin aspart is impaired when administered to lipohypertrophic tissue in patients with type 1 diabetes (IV).

## 4 METHODS

### 4.1 STUDY DESIGN AND SAMPLE

Quantitative designs were used for the studies as displayed in Table 3, dependent on the nature of the inquiries.

Table 3. Overview of design and data collection methods used in the studies

Paper	Study design and sample	Data collection method
I	Methodological research design. Scale development. 324 patients and 10 diabetes specialist nurses	Questionnaires: Swe-PAID-20 and HFS
II	Randomised controlled prospective trial. 72 patients	HbA <sub>1c</sub> and questionnaires: SDSCA, Swe-PAID-20, HFS, W-BQ, PSS and HAD
III	Descriptive, prospective design. 94 patients	HbA <sub>1c</sub> , questionnaires: SDSCA, Swe-PAID-20, W-BQ, PSS, HAD, DLOC, DES and SOC
IV	Randomised crossover trial. 9 patients	Blood samples for free insulin and blood glucose

The sample in Paper I was derived from three university hospitals in Stockholm, while Paper IV represents the Diabetes Day Care Unit at Danderyd Hospital, and the samples in Papers II-III represent the Diabetes Day Care Units of Danderyd Hospital and the Stockholm South General Hospital. The structure and organisation of the two hospitals were similar and mean values of HbA<sub>1c</sub> for the patients representing each hospital were identical, measuring 7.1%. The patients included in the studies were adults, aged 18-65 years.

#### 4.1.1 Procedure

Data were collected during the years 2006 (Paper I), 2005-2006 (Papers II-III) and 2002-2004 (Paper IV) respectively. The patients in study I were systematically selected (every fourth patient) from the local diabetes registry at the Department of Medicine at Danderyd Hospital. No limits regarding metabolic control were criteria for inclusion. Equivalence concerning sample sizes of HbA<sub>1c</sub> levels was achieved by dividing the sample into HbA<sub>1c</sub> level < 7.5% and HbA<sub>1c</sub> level > 7.5% in order to avoid differences that might occur because of metabolic control. Inclusion proceeded until the desired sample size of a least 200 patients was achieved, in order to perform factor analysis [106]. The patients taking part in studies II-III comprised a sample primarily selected on the basis of poorly controlled diabetes with an HbA<sub>1c</sub> > 7.5%. Initially the intention was to recruit patients with diabetes duration of no longer than four years. However, this inclusion criterion had to be modified, to recruit the power-calculated sample size of at least 32 patients in the intervention and control group respectively. Even so, recruiting had to be extended to involve an additional hospital in the city. Figure 2 shows the progress of subjects through the randomised controlled trial. The subjects for study IV were consecutively identified as having visible, palpable and massive lipohypertrophy at clinical visits. The patients served as their own controls when

analysing insulin absorption. The sample size of the study was based on an interim analysis.

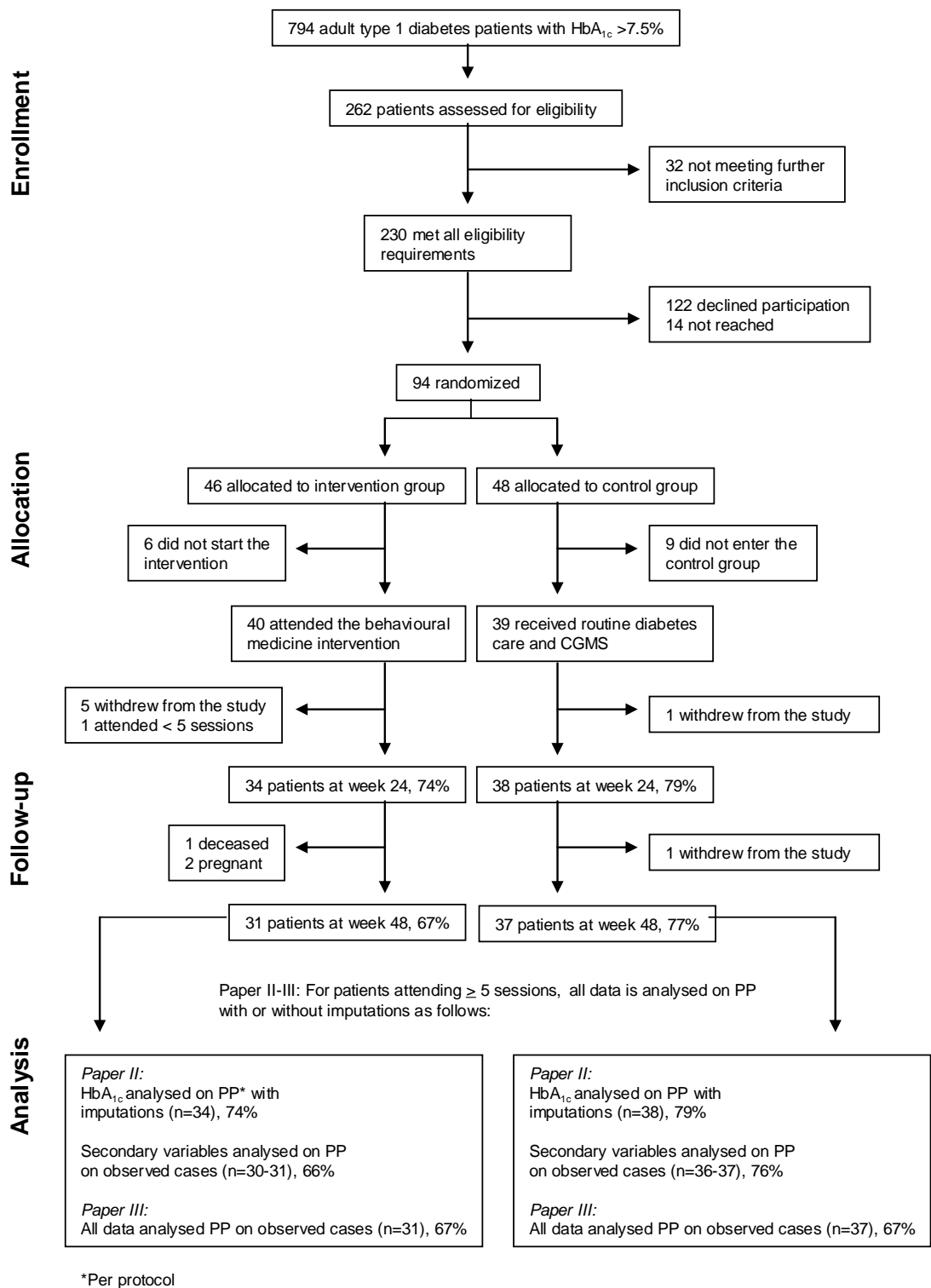


Fig. 2. Flow of participants through the study

## 4.2 SCALE DEVELOPMENT

(PAPER I)

After linguistic adaptation using the forward-backward translation method [107, 108], the 20-item PAID scale was developed and evaluated as illustrated in Figure 3.

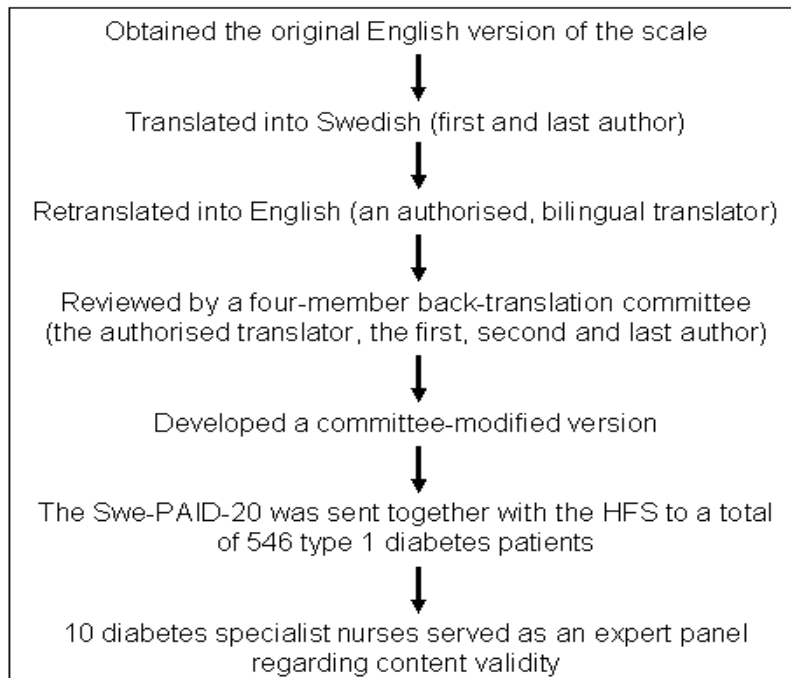


Fig. 3. Flow chart for the development and evaluation of the Swe-PAID-20

The item ‘Feeling unsatisfied with your diabetes specialist nurse’ was added to the scale due to the fact that the current Swedish healthcare system is based on both diabetes physicians and diabetes specialist nurses participating in diabetes care teams. Furthermore, the scale was intended to be used as an outcome variable in the contemporary behavioural medicine intervention of this thesis, which was originally designed to involve only recently diagnosed type 1 diabetes patients. To keep the same total sum of the PAID, one of the original items, ‘Coping with complications of diabetes’, was replaced by the new item. The deleted item was judged to be the least relevant in this group of recently diagnosed patients, who had probably not yet had developed complications of diabetes.

## 4.3 THE BEHAVIOURAL MEDICINE INTERVENTION

(PAPER II)

The behavioural medicine intervention was designed by the current research group and was based on principles of CBT, according to experience from similar intervention strategies in cardiac patients [91] in mid-Sweden, as well as inspiration from a Dutch study using the CBT approach on poorly controlled type 1 diabetes patients [109]. The programme was entitled ‘StyrKRAFT i Ditt Liv<sup>®</sup>’, meaning ‘Power to Choose your Direction’. This positive wording was intended to symbolise our aim to build up

strength, skills and motivation of participants, so that they could choose sound and healthy directions in their lives with diabetes.

A structured manual, incorporating all the sessions, was developed. This consisted of a basic intervention programme (week 0-8), where the main purpose was to map the patients' own behaviours, and teach them different tools that were suitable for working towards behaviour change as well as a structured maintenance programme (week 9-48), where the main focus was on maintaining the behaviour changes achieved and on minimising future risk of relapse.

#### **4.3.1 Outline of each session**

Each session was divided into several parts, the overall aim being to give the participants an opportunity to gain knowledge in a specific area, to learn a skill, to share experiences, and to review and receive homework.

- First, there was a brief period of relaxation [110], followed by an introduction to the theme of the session. Homework assignments were reviewed and all participants were asked about how they experienced their homework. Patients were reinforced if they had completed homework and hindrances were discussed with those who had not completed homework. The course leaders aimed at creating a 'no-fault', helping atmosphere during the session.
- After this there was a short 'lecture' period to provide knowledge in a specific area of living with diabetes. Table 4 provides a summary of the content of the eight sessions. The themes were developed by the diabetes specialist nurse and the psychologist together. Inspiration was derived from clinical experiences of diabetes patients, previous research in the area [72, 109], and non-fiction literature [111, 112] on the topic.
- The third part of the session concerned problem solving, and here a case study relevant to the given topic of the session was used. The case study was read by each participant and then discussed in the group.
- The fourth part of the session was skills training. New skills or 'tools' were presented, as shown in Table 4. The techniques provided served as basis for mapping own behaviours and/or developing coping strategies to live with diabetes.
- Finally, the session was rounded off with homework assignments and a summary of the session.

Table 4. Themes and tools in the behavioural medicine intervention

Session	Theme	Tool
1 (G)	How does diabetes affect my life?	Logbook for self-care activities and feelings of stress. The model of interaction. Applied Tension Release (long version)
2 (G)	Stress and diabetes. CGMS	Logbook. CGMS. Maladaptive thoughts – how to identify them. Problem solving
3 (G)	Stress and diabetes, continuation. Feedback on CGMS	Logbook. Maladaptive thoughts – how to handle them. Applied Tension Release (short version)
4 (G)	Diabetic complications and the future	Logbook. Coping with worries/anxiety. Exposure
5 (G)	Family and friends	Logbook. Applied Tension Release (quick version). Assertiveness training
6 (G)	Values in life? Finding a balance. Putting it into practice	Worksheet: Values and goals in life
7 (I)	Goal setting and plan	Individual plan
8 (G)	Maintaining behaviour modification. How to handle relapses	Individual plan

G = Group session

I = Individual session

### 4.3.2 The CBT approach

The course leaders aimed at using a helping approach that emphasised [100]:

- a structured, goal-oriented approach
- active participation of the patient in problem solving
- focus on ‘here and now’
- individualised behaviour-change programme
- assessment of the patients’ behaviours and their controlling conditions in measurable terms
- use of empirically and scientifically tested techniques to increase desired behaviours and to decrease undesired behaviours
- a short-term, time-limited period of support
- cooperation between therapist and patient in order to set up goals and to determine effects

The intervention was led by a diabetes specialist nurse (first author of Paper II) and a psychologist (second author) trained in CBT. The roles of the course leaders are presented in Table 5.

Table 5. The roles of the diabetes specialist nurse and the psychologist

<i>Activity</i>	<i>Diabetes specialist nurse</i>	<i>Psychologist, CBT</i>
Baseline assessment (clinical data, current problem areas in diabetes, expectations)	X	
CGMS instructions and individual feedback at baseline	X	
Feedback on repeated CGMS in group	X	X
Introducing the themes of sessions, leader of the brief relaxation period	X	
Leader of the 'lecture' part and skills training		X
Follow-up and feedback on homework assignments	X	X
Goal setting and planning together with the patient	X	X
Follow-up during the maintenance phase	X	X

In addition, the two psychologists in the research team acted as supervisors to the diabetes specialist nurse, with regard to the behaviour-oriented approach. A manual was developed in order to ensure good consistency between patients and groups.

### 4.3.3 Tools for behaviour change

Tools used in the programme were those commonly used in CBT [113-115], which are further described below.

#### 4.3.3.1 Self-assessment

During the eight-week basic intervention programme, the patients were provided with a log book for self-assessment. The patients were instructed to maintain a daily log regarding blood sugar levels, insulin doses, and episodes of hypoglycaemia, exercise and meals. The patients were also instructed to log to what degree they perceived stress in terms of being irritated/upset, worried, low/sad, weary, rushed and/or dejected. This detailed mapping aimed at providing a clear picture of the patient's behaviour in order to identify problem areas that needed to be dealt with better.

#### 4.3.3.2 Problem solving

According to the systematic review of Hill-Briggs [116], a total of 50% of interventions using problem solving techniques have shown improvements in HbA<sub>1c</sub> among adult diabetes patients. In the current study we introduced a case study during each session, to highlight the theme of the session. On the basis of Goldfried and Davison [117] a six-step problem solving method was practised and focused on, thus developing the coping skills of the patients. The six steps included:

1. *Problem definition*: What is the problem? Try to give as clear a description as possible.
2. *Generation of alternatives*: Brainstorm possible solutions without valuation.
3. *Examination of alternatives*: Consider the pros and cons of the alternatives.
4. *Decision making*: On the basis on the considerations, select the alternative that seems most likely to provide the optimal solution.
5. *Planning*: Make a plan for how to carry out the selected alternatives.
6. *Evaluation*: When the plan has been put into effect, consider whether it solved the problem. What worked and what did not?

#### 4.3.3.3 *Identifying and dealing with negative thoughts*

The ABC model [105] was introduced as a helpful tool to understand the role of cognitions. The patients were trained to explore their automatic thoughts and discover how these thoughts affected their mood and behaviour. In the next step, the patients were asked to challenge their beliefs and try to find more undistorted or self-helping cognitions. The primary focus in this intervention was still on 'behaviour' rather than on 'thoughts'.

#### 4.3.3.4 *Exposure*

The participants were asked to identify fears or anxieties in their lives with diabetes, e.g. fear of diabetes-related complications [9, 118], fear of hypoglycaemia [5], fear of self-injection and SMBG [119], possibly resulting in negative consequences of diabetes self-management. In addition to knowledge-seeking as far as the actual fear was concerned, exposure was outlined as a possible strategy for confronting fearful situations in order to decrease fear [120].

#### 4.3.3.5 *Assertiveness training*

Assertiveness training is a behavioural procedure in which the patient is trained to state his or her opinions and rights without being rude to others [100]. Having diabetes usually involves interpersonal situations when family, friends or others care about and/or criticise patients' diabetes behaviours. These persons, often and jokingly called 'the Diabetes Police', may be right in their disapproval of the patient's choice of food, skipping medication etc. Nevertheless, the patient has the right make his/her own decisions regarding self-care. Assertiveness training can help to reduce the anxiety associated with deficient performances in interpersonal situations [100]. In the current intervention programme, attention was focused on the theme as a coping mechanism. Three types of communications were introduced and role-played: *passive* conversation, *aggressive* conversation and *assertive* communication with a recommendation for the latter to be practiced. Group members took part in observing the communication styles of the course leaders and were encouraged to try other alternative ways of communicating in order to state their own options and rights.

#### 4.3.3.6 *Relaxation*

Another coping technique that was introduced to the patients was Applied Tension Release (ATR) [110], which is a further developed, optimised and advanced version of the earlier Applied Relaxation (AR) technique developed by Öst et al [121]. The ATR

technique aimed at achieving: 1) a quick relaxation or tension-release skill as a portable coping tool, useful in different stressful situations in everyday life, and 2) a longer (5-20 minutes) deep, resting and recovering or reviving relaxation skill, applicable in situations when time and place make it suitable. The main focus of the method is on learning to identify tensions and then being able to reduce them also in everyday active life.

The patients were provided with a specially designed CD with recorded instructions. The CDs were used early in the training phase in order to optimise training, but were later faded out in order to promote self-instruction techniques.

#### *4.3.3.7 Goal setting*

The use of goal setting techniques has been described as a valuable tool for improving self-management skills among diabetes patients [122]. During the seventh individual session, held by either the diabetes specialist nurse or the psychologist, each participant designed a plan for his or her behaviour-change activities. Goal setting was discussed and formulated, taking into account aspects such as: 1) Why is the desired change important to me?; 2) When reaching the goal, my behaviour will be as follows.... (Define the desired outcome); 3) What are the possible barriers to reaching the goals?; 4) What resources are available?; 5) Which strategies can I use to tackle the barriers? Goals were established stepwise in a written plan of action and were planned to be followed up regularly according to the given schedule.

#### *4.3.3.8 Biofeedback – CGMS*

Biofeedback therapy belongs to the category of pedagogic and behavioural strategies that have been used for a long time [123]. In the current study, a Continuous Glucose Monitoring System (CGMS<sup>®</sup> System Gold<sup>™</sup>, Medtronic Minimed, Northridge, CA, USA) served as biofeedback in the process of monitoring the patients blood glucose and his/her self-management behaviours. A 'sensor', which is a small sterile disposable glucose-sensing device, is inserted subcutaneously in the abdomen. Every five minutes for a period of up to three days, the sensor averages interstitial fluid glucose levels, which then are stored in the connected monitor that can be clipped into a belt. The patients were instructed to do four daily calibrations of the monitor using a standard blood glucose meter. They were also instructed to enter insulin injections, meal information, exercise, episodes of hypoglycaemia and other important events into both a logbook and into the monitor. Careful instructions and training formed part of the baseline appointment with the nurse. After three days, the monitor was taken back to the diabetes specialist nurse and data was downloaded to a computer and printed out, thus providing graphic representation of what had been going on during the monitored period. Personal feedback was given by the diabetes specialist nurse. The main purpose of this feedback was not to educate the patient, but rather to help him/her reflect on the current glucose profile with regard to daily self-care behaviours, e.g. meals, insulin doses, exercise and events of hypoglycaemia. Data suggest that CGMS are currently less accurate, using point-to-point comparisons, than home glucose meters [124], but provide values over 24 hours. The CGMS is shown in Figure 4 and Figure 5 illustrates an example of a 3-day glucose profile.

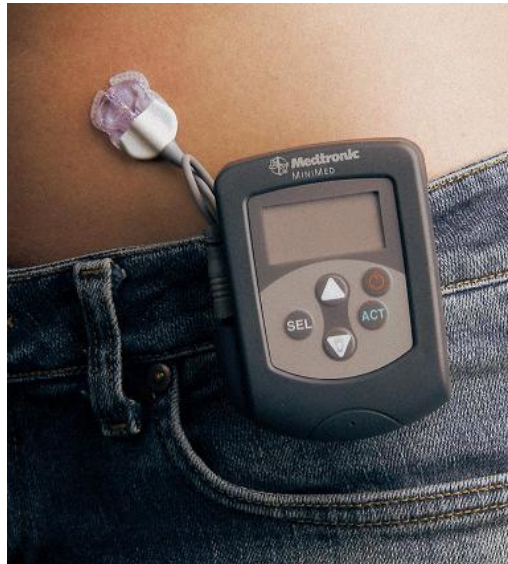


Fig. 4. Continuous Glucose Monitoring System (CGMS<sup>®</sup>), Medtronic MiniMed (Northridge, CA)

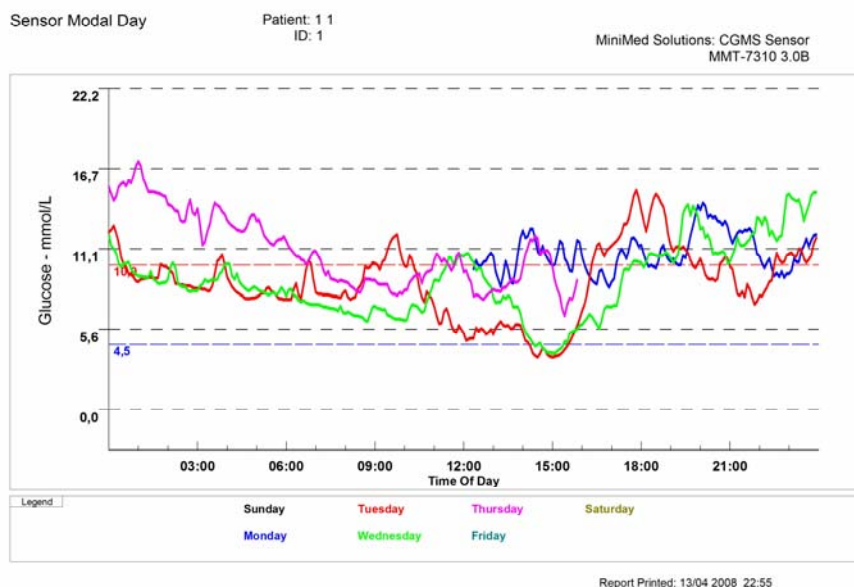


Fig. 5. An example of a 3-day glucose profile provided by the CGMS

#### 4.3.3.9 Homework and feedback

Homework assignments are a recognised central feature of CBT, enabling patients to practice newly learnt skills in everyday life outside of therapy. Completion of extra-session homework is hypothesised to be a critical mechanism for skill consolidation [125]. A meta-analysis [126] has reported on the efficacy of homework assignments in cognitive and behavioural therapy. Nevertheless, there is a lack of evidence regarding the relative effectiveness of different types of homework assignments for different clinical problems.

In the current intervention study, homework assignments regarding all the above topics were delivered to the participants and it was recommended that these assignments were completed in order to practise the new skills introduced in the sessions. Each participant carried a file delivered at baseline assessment. All worksheets and homework assignments were gradually added to this file after every session.

Feedback on homework assignments was delivered not only verbally but also in written form. For those patients who had not done their homework assignments, a separate time for reflection was given in the current session so that homework could actually be done. During these sessions, the fact that some patients avoided talking about self-care led us to actively ask about it at each session by addressing the question to each participant. Self-care was in focus during all of the sessions.

#### **4.4 MEASUREMENTS**

HbA<sub>1c</sub> was the primary variable in evaluating this study. As recommended in the literature [127], patient-reported outcome measures in this thesis were both generic and diabetes-specific. Generic instruments are useful for comparison across populations, of different disorders; severities of disease etc. On the other hand, disease-specific instruments can include more detailed aspects of patients' concerns, and are also known to be more sensitive for assessing changes within patients [108]. The internal consistency of the instruments in studies II-III was tested by Cronbach's alpha [128] and is shown in Table 6. Various authors have made different recommendations on acceptable levels of reliability. Usually, coefficients of 0.80 are highly desirable [106, 108], while levels of 0.60-0.80 are considered as acceptable [108, 129, 130].

Table 6. Internal consistency of measurements

<i>Scale</i>		<i>Cronbach's alpha</i>
SDSCA	General diet	.86
	Specific diet	.44
	Exercise	.80
PAID		.93
HFS	Worry/Fear	.92
	Avoidance	.70
	Total	.90
W-BQ	Negative	.81
	Energy	.86
	Positive	.77
	Total	.91
PSS		.90
HAD	Anxiety	.89
	Depression	.87
	Total	.92
DLOC	Internal	.77
DES		.91
SOC		.91

#### 4.4.1 HbA<sub>1c</sub>

HbA<sub>1c</sub> was analysed with filter paper technique (HbA<sub>1c</sub> via post) at Karolinska University Laboratory, using an immunological assay developed by Roche [131]. The method enables capillary blood-sampling at home. The patients collect two drops of capillary blood on a small piece of filter paper inserted into a card for patient identification. The card is then placed in a small plastic bag, which is sealed and sent by post to the laboratory for analysis. The coefficient of variation (CV) of this method is 2.8% in the normal range of HbA<sub>1c</sub> (<5.2%) and 2.4% at an HbA<sub>1c</sub> level of 10%.

#### 4.4.2 The Summary of Self-Care Activities (SDSCA)

Frequency of self-care behaviours over the past week was assessed with the revised version of the Summary of Self-Care Activities (SDSCA) [132] measure, including a range of activities, such as SMBG, following a healthy diet, and adhering to insulin treatment. With respect to our study sample of type 1 diabetes patients, three additional items were used regarding hypoglycaemia from the Diabetes Self-Care Inventory (DSCI) [109]. Each self-care component in both measures is assessed separately, with higher scores indicating higher levels of self-care. No total score is given for the SDSCA. Items were worded as, for example: 'On how many of the last seven days did you participate in at least 30 minutes of physical activity? (Total minutes of continuous activity, including walking)?'

#### **4.4.3 The Problem Areas in Diabetes (Swe-PAID-20) scale**

Diabetes-related emotional distress was assessed using the Swedish version of the Problem Areas in Diabetes (Swe-PAID-20) scale [133]. The original version of the scale was developed by Polonsky et al [9]. The questionnaire captures the patient perspective on current emotional burden of diabetes and its treatment. A typical item is: 'Which of the following diabetes issues are currently a problem for you? – Feeling constantly concerned about food and eating?' On a 5-point Likert scale, patients rate the degree to which each item is currently a problem for them, from 0 'not a problem' to 4 'a serious problem'. The scale produces a total score ranging from 0 to 100, where a higher score indicates greater emotional distress. A cut-off score of  $\geq 40$  has been suggested to determine whether more severe diabetes-specific emotional problems are present [58]. The scale has been widely used and translated into many languages [50, 51, 134, 135]. Polonsky [9] and Welch [118] have found support for a one-factor solution of the scale, whilst other authors have found solutions giving subscales, as previously mentioned [50, 135, 136].

#### **4.4.4 The Hypoglycemic Fear Survey (HFS)**

The degree of fear as well as avoidance of hypoglycaemia was assessed with the Hypoglycemic Fear Survey (HFS) [137]. The scale consists of 23 items rated on a 5-point Likert scale where 0 = 'never', 1 = 'rarely', 2 = 'sometimes', 3 = 'often' and 4 = 'always', resulting in a total sum score ranging from 0-92, with a higher score being indicative of a greater fear of hypoglycaemia. Patients are asked to circle the number that best describes how often they worry about each item because of low blood sugar, e.g. 'I worry about having a reaction while alone' and 'I worry about making a mistake or having an accident'. The questionnaire consists of two subscales: the Behaviour/Avoidance subscale and the Worry subscale. The Behaviour/Avoidance subscale includes 10 items relating to self-management behaviours aimed at avoiding hypoglycaemia and its consequences. The Worry subscale includes 13 items recounting different aspects of hypoglycaemia that are anxiety-provoking, e.g. 'To avoid low blood sugar I eat large snacks at bedtime'.

#### **4.4.5 The Well-being Questionnaire (W-BQ12)**

Well-being was measured in four dimensions using the Well-Being Questionnaire (W-BQ12) [138], originally developed in Japan [139, 140]. The instrument comprises three four-item subscales: 'negative well-being' (questions 1-4), with all four items negatively worded; 'energy' (questions 5-8), which consists of two positively and two negatively worded items; and 'positive well-being' (questions 9-12) with four positively worded items. An overall scale 'general well-being', is based on the three subscales, giving a total score of 0 to 36. The total score for each subscale is 0 to 12. Examples of typical items are worded: 'I feel downhearted and blue' (negative well-being), 'I feel energetic, active and vigorous' (energy), and 'I have been happy, satisfied or pleased with my personal life' (positive well-being).

#### **4.4.6 Perceived Stress Scale (PSS)**

Mental stress was assessed with the Swedish version of the Perceived Stress Scale (PSS) [141], which comprises 14 items measuring the degree to which life situations

are appraised as stressful. On a 5-point Likert scale, respondents rate the degree of perceived stress from 0 'never' to 5 'very often' for these different situations. A typical item was 'In the last month, how often have you felt that things were going your way?'

#### **4.4.7 The Hospital Anxiety and Depression (HAD) scale**

Anxiety and depression were assessed with the Swedish Hospital Anxiety and Depression Scale (HAD) scale [142], which consists of 14 items measuring level of anxiety and depression in two separate subscales. Each item is answered on a 4-point Likert scale, ranging from 0-3. Cut-off scores for classification of 'possible cases' for anxiety and depression disorders are scores 8-10 respectively, and for 'probable cases' scores 11-21. Items are worded, for example as: 'I get sort of frightened feeling that something awful is about to happen' and 'I can sit at ease and feel relaxed'.

#### **4.4.8 The Diabetes Locus of Control (DLOC) scale**

Internal locus of control was assessed by the Diabetes Locus of Control (DLOC) scale originally developed by Ferraro et al [143]. In the current study we use the Swedish version, developed and psychometrically evaluated by Stenström et al [144]. The DLOC consists of 18 items comprising three six-item subscales: 1) 'Internal locus of control' (IHLC subscale), which assesses the degree to which an individual believes that his/her health (diabetes control) is dependent on his/her own behaviour; 2) 'Powerful others' (PHLC subscale), which assesses the individual's belief that his/her diabetes control is determined by others, e.g. physicians, family members etc.; and 3) 'Chance' (CHLC subscale), which assesses the extent to which the individual considers diabetes control to be a result of chance factors such as fate or luck. On the 6-point Likert scale, patients rate the extent to which they 1= 'strongly disagree' to 6= 'strongly agree', where a higher score indicates a stronger control orientation. Scores are summed up in each subscale with a possible score of 6-36. No total sum of the entire scale is given. Examples of items in the IHLC subscale, as used in this paper, are: 'If I take care of myself, I can minimise diabetic complications', 'If my diabetes gets out of control, it is my own behaviour which determines how soon I get back in control again'.

#### **4.4.9 The Diabetes Empowerment Scale (DES)**

Diabetes-related psychosocial self-efficacy was assessed with the 28-item Diabetes Empowerment Scale, originally developed by Anderson et al [72]. The scale covers items such as: 'In general, I believe that I know what part(s) of taking care of my diabetes that I am dissatisfied with', 'In general, I believe that I know what part(s) of taking care of my diabetes that I am ready to change'. On a five-point Likert scale patients rate the degree to which they agree from 5 = 'Strongly agree' to 1= 'Strongly disagree'. The numerical values of a set of items in each subscale are added and the total is divided by the number of items in the subscale, giving a total score of 1-5 point for each subscale. An overall score for the DES is achieved by adding all the items and dividing them by 28. In this thesis we report on the total scores of the measurement. The three subscales are categorised as: 1) Managing the psychosocial aspects of diabetes; 2) Assessing dissatisfaction and readiness to change, and 3) Setting and achieving diabetes goals. The DES has proved to be a valid and reliable measure of

diabetes-related self-efficacy [72]. The scale has been linguistically adapted into Swedish by the current research team, using the forward-backward translation method [108], but has not yet been psychometrical evaluated in this form. Another contemporary Swedish version of the scale which has recently been tested [145] has found support for its psychometric validity and reliability. The two Swedish versions of the scale are, however, not identical in either their wording or length.

#### **4.4.10 The Sence of coherence (SOC) questionnaire**

The 29-item Sense of Coherence (SOC) questionnaire was developed by Antonovsky to measure overall capacity to cope with stressful life situations [85]. The shorter form, used in this study, includes 13 items, which have been psychometrically evaluated in the Swedish version [146]. A 7-point Likert scale was used with responses ranging from 1= 'very often' to 7= 'very seldom or never'. Scores range from 13 (lowest sense of coherence) to 91 (highest sense of coherence). A typical item was: 'Do you have the feeling that you are in an unfamiliar situation and do not know what to do?'

### **4.5 INSULIN ABSORPTION**

Nine type 1 diabetes patients performed absorption tests in random order separated by a minimum of seven days in either hypertrophic or non-hypertrophic fat tissue. Blood samples for free insulin and blood glucose determinations were taken before the insulin injection and thereafter at repeated intervals up to 330 minutes. A test dose of 10 U of insulin aspart was given before a standardised breakfast each time. Plasma-free insulin was measured after polyethylene glycol precipitation using a two-site enzyme immunoassay containing two monoclonal antibodies [135]. Blood glucose was analysed with the HemoCue method.

A questionnaire was developed with regard to insulin injection technique and opinions on current lipohypertrophy. The questionnaire was answered by the patients when they entered the study.

### **4.6 ETHICAL CONSIDERATIONS**

The studies included in this thesis were conducted in accordance with the Declaration of Helsinki [147] The studies were approved by the Ethics Committee of Karolinska Hospital, Stockholm, Sweden, (Dnr 2005/1401-31/2, Dnr 03-396 and Dnr 01-254).

### **4.7 STATISTICAL ANALYSES**

The statistical analyses were performed using the Stat View software (version 5.0.1; SAS Institute, Cary, NC), (Paper I) and the SPSS 14.0 (SPSS Inc., Chicago, IL, USA (Papers II-IV). An overview of statistical tests used in the thesis is presented in Table 7.

Table 7. Analyses used in the four papers (I-IV) included in the thesis

Purpose	Analysis	I	II	III	IV
Descriptive statistics	Frequency, mean, SD, range	X	X	X	X
To test the difference in proportions in two or more independent groups	Chi-square-test	X		X	
To test the difference between the means of two independent groups (parametric data)	Student's <i>t</i> -test	X	X		
To test differences in ranks of scores of two independent variables	Mann-Whitney <i>U</i> -test			X	
To test differences between two paired groups	Wilcoxon's signed rank test				X
To test the total amount of insulin absorbed	Area under curve (AUC)				X
To test internal consistency or homogeneity of a measure composed of several subparts	Chronbach's Alpha coefficient	X	X	X	
To test the relationship between two variables	Spearman's rank order correlation	X			
To test the correlations of several variables with one another	Inter-correlations matrix	X			
To test whether items on a scale are tapping the same construct and are sufficiently discriminating	Item analysis	X			
To determine the underlying dimensionality of a set of variables	Exploratory factor analysis	X			
To test the degree to which an instrument is content valid, based on average ratings of a panel of experts	Content validity ratio (CVR)	X			
To test mean differences among groups on a dependent variable, while controlling for one or more covariates	ANCOVA		X		
To test the significance of differences between the means of two or more groups on two or more dependent variables, considered simultaneously	MANCOVA		X		

Statistical significance was assigned for *P* values < 0.05.

#### 4.7.1 PAPER I

Missing data on the PAID scale were corrected using the method prescribed by Polit and Beck [106]. For the missing items the most typical responses based on the mean were computed.

## 4.7.2 PAPERS II-III

For patients attending at least 5 sessions of the basic behavioural medicine programme, data were analysed per-protocol with or without imputations as described in Figure 2. With respect to the primary variable, HbA<sub>1c</sub>, analyses were performed on imputed data in order to include all patients who had received the offered treatment. Thus, data were imputed for three patients in the intervention group, i.e. for the two women who became pregnant and for the patient who died. In the control, group data were imputed for the patient who chose to withdraw at the end of the study, and for the patient who was diagnosed with cancer. Remaining data in Papers II-III were analysed on observed cases, i.e. without imputations.

### 4.7.2.1 *Missing data*

Missing data of HbA<sub>1c</sub> was defined as: 1) those tests that were not received at the time point of measurement or 2) tests that were delayed more than two weeks, but less than two months, i.e. the time point for the next measure. In these cases, missing data have been replaced by the computed mean of the previous and next value.

Missing data on the questionnaires have been adjusted according to current data management guidelines as e.g. for the W-BQ [148], SDSCA [132] and HAD [149]. In the absence of written guidelines, the research group agreed on specific index calculations, which were confirmed by a statistician. The mean of each subscale was calculated if missing data accounted for less than 50% on the current subscale, otherwise the value was treated as actually missing.

### 4.7.2.2 *Baseline HbA<sub>1c</sub>*

The baseline value of the primary variable was the computed mean of the two HbA<sub>1c</sub>s before intervention and the value measured when entering the study. This solution was preferred in order to achieve a more stable baseline value to control for possible study effects, that usually occur when patients participate in a trial [150]. In contrast, another solution of the computed mean was chosen with regard to the descriptive part of Paper III. Since 16% did not turn up for baseline assessment, no actual baseline value was available for these subjects. Therefore, instead of computing the mean of three HbA<sub>1c</sub>s, the mean of the two HbA<sub>1c</sub>s before intervention was the basis for these analyses.

## 4.7.3 PAPER III

Attrition rate, defined as a total loss of subjects in an instrument [151], was calculated by dividing the number of subjects who dropped out of the study due to various reasons, representing the ‘overall’ attrition rate of subjects in the intervention and the control group. Calculations of attrition from the actual intervention programme (intervention group) were also performed by dividing those who dropped out of the intervention programme by the numbers of subjects who attended the intervention group.

## 5 RESULTS AND DISCUSSION

### 5.1 PSYCHOMETRIC PROPERTIES OF THE SWE-PAID-20 (PAPER I)

#### 5.1.1 Response rate and missing data

The response rate to the questionnaire was 60%, which appears to be low. It is reasonable to assume that the response rate is dependent on the way the questionnaires were distributed, suggesting that questionnaires given by healthcare providers at regular appointments generate higher response rates than those that are sent by post. This was the case in the study of Sigurdardottir et al [51], generating a response rate of 90% when clinic nurses handed out questionnaires to the patients at regular appointments, compared with the low response rate of 49% when questionnaires were sent by post, as in the study of Snoek et al [50]. On the other hand, the percentage of missing values was low for all Swe-PAID items and ranged from 0.3 to 1.2.

#### 5.1.2 The psychometric properties

The final Swedish version of the Problem Areas in Diabetes scale is presented in the appendix. In the factor analysis a three-factor solution was found to be reasonable with the sub-dimensions of diabetes-related emotional problems (15 items), treatment-related problems (2 items) and support-related problems (3 items). Cronbach's alpha coefficient for the total score was 0.94 and varied between 0.61 and 0.94 in the three subscales, with the lowest alpha in the sub-dimension of support-related problems.

With regard to the convergent validity, a positive correlation was found between the Swe-PAID-20 and the HFS ( $r = 0.45$ ,  $P = 0.001$ ) and HbA<sub>1c</sub> ( $r = 0.25$ ,  $P = 0.001$ ) respectively. Thus the convergent validity was confirmed.

Using an expert panel of diabetes specialist nurses, all but one item: 'Feeling unsatisfied with your diabetes specialist nurse', were judged to be quite relevant or very relevant. As a whole, the scale was regarded as relevant by the expert panellists.

#### 5.1.3 The most serious problem areas among patients

As previously reported by others [9, 50, 118], our patients reported 'worry about the future and the possibility of serious complications' as the most serious problem, followed by 'feelings of guilt when you get off track with your diabetes management'. Both of these problem areas are within the dimension of diabetes-related emotional problems and certainly require emotional and coping-oriented approaches to be handled.

#### 5.1.4 Methodological considerations

The response rate of 60% may possibly denote the disadvantage of non-response in connection with postal questionnaires, which in turn may introduce bias [152]. There are however different views on what constitutes an adequate response rate [153], and concerns about non-response may be exaggerated. For example, Krosnick [154] argues

that it is feasible for lower response rates to lead to a more representative sample than those with a higher response rate, taking into account the subjects' willingness to participate as compared with those who have been 'aggressively pursued'. Similarly Keeter and Miller's analysis [155], comparing a rigorous recruitment approach (61% response) and a standard approach (36% response), demonstrated comparable results from both studies. Implementing a repeat mailing strategy, as suggested by Nakash et al [152], one written reminder was sent to those patients who did not return the questionnaire within two weeks.

This study is limited by the deletion of an original item in order to give space to another item of potential interest. Because of our modification of the instrument there is a lack of information regarding how patients coped with diabetes complications, which might also restrict comparisons with previous studies using the PAID. It is still interesting to find the underlying motives of the original author when developing a new scale that measures the same concept and does not include the current item in the new version, a scale entitled the Diabetes Distress Scale (DDS) [156]. Anecdotal reports suggested that patients were confused about the exact meaning of some of the items in the PAID. With the only reference of Polonsky et al [156] and being unaware of further modification details, one could speculate on the possibility of deleting the item of 'coping with complications' based on patients and healthcare professionals' advice.

When proceeding with the cross-cultural adaptation of self-report instruments, it is recommended to use health professionals as a part of the expert panel [157]. Using patients for this purpose might also have been a conceivable solution [156]. According to previous experience from small test-samples, it was difficult to receive adequate answers from the patients by questionnaires, indicating that patients who reported certain problems as 'serious', also reported the current item to be 'a very relevant question to ask' diabetes patients in general. In the same manner, patients who reported items as 'not a problem', also reported the current item to be an item 'not relevant at all' to diabetes patients in general. This assumed misunderstanding or difficulty in looking at the question from a more general view, made us decide not to involve the patients in this analysis. The problem could possibly have been eliminated if the study design had included focus groups with patients for evaluation, allowing clarifying discussions from both sides [127].

## **5.2 EFFECTS OF A BEHAVIOURAL MEDICINE INTERVENTION (PAPERS II-III)**

### **5.2.1 Effects of the intervention**

As a result of following the behavioural medicine intervention, outcomes regarding metabolic control, self-care behaviours and psychological factors improved. Significant differences between the intervention group and the control group were observed at week 48 in HbA<sub>1c</sub> ( $P<0.05$ ), well-being ( $P<0.01$ ), diabetes-related distress ( $P<0.01$ ), frequency of blood glucose testing ( $P<0.05$ ), fear of hypoglycaemia ( $P<0.05$ ), perceived stress ( $P<0.05$ ) and depression ( $P<0.05$ ), all of which improved more in the intervention group than in the control group. The greatest difference in HbA<sub>1c</sub> between the groups was observed at week 24, as demonstrated in Table 8.

Table 8. HbA<sub>1c</sub> levels (%) at weeks 8-48

Time point (week)	Intervention (n= 34)	Control (n=38)	Difference (95% CI)	<i>P</i> -value
8	7.61	8.23	-0.62 (-0.91 to -0.32)	<0.001***
16	7.49	8.34	-0.85 (-1.26 to -0.45)	<0.001***
24	7.47	8.42	-0.95 (-1.37 to -0.54)	<0.001***
32	7.70	8.39	-0.69 (-1.12 to -0.27)	0.002**
40	7.84	8.36	-0.52 (-0.92 to -0.11)	0.014*
48	7.70	8.12	-0.42 (-0.79 to -0.05)	0.027*

Data are adjusted means

\* <0.05; \*\* <0.01; \*\*\* <0.001

To our knowledge, previous behaviour-oriented interventions for this targeted group of patients have not provided such convincing and long-lasting data as those generated here. In a randomised controlled trial (RCT), van der Ven et al [158] showed promising results of their CBT approach in self-efficacy, diabetes-related distress and depressive symptoms among poorly controlled adult type 1 diabetes patients. However, no improvements were found regarding glycaemic control after 3 months. A further review of recent literature on the topic, showed that the only RCT, except ours, that covers a time frame of one year, is the study of Karlsen et al [159], which shows promising results in achieving more acceptable HbA<sub>1c</sub>. Notably, the target group in that study was not restricted to those with poor glycaemic control, nor to type 1 diabetes patients exclusively. In that sense, our study is unique for the time being, with respect to the targeted group of adult poorly controlled type 1 diabetes patients in such a relative long-term evaluation.

When considering possible contributing factors to the result it seems meaningful to speculate upon the possible importance of the components added to the present intervention. Our intervention programme included formats that were both group-oriented and individually oriented, which allowed the advantages of group processes to be combined with elements of necessary individualisation. This combination might have facilitated motivational aspects of the programme. Moreover, concrete, everyday-life behaviours, and especially self-care behaviours, were central and explicit targets in the programme, both in the themes and behavioural tools introduced during the sessions, through the use of the ‘biofeedback’ methodology with CGMS, and through the weekly and systematic follow-up of homework assignments, which included actual self-care behaviours. In addition, the rather intensive and long-term maintenance programme might also have been of value in order to help maintain the behaviour changes achieved, as well as to tackle actual or potential relapses. These components that were added are in line with requests for previous research in the area, suggesting e.g. a greater focus on behavioural components [159], more individually tailored programmes and long-term follow-up [158].

Apart from conceivable key elements above, it is reasonable to assume that more frequent SMBG is important, but this was not proved by the results of Paper III. SMBG

has previously been shown to be the sole modifiable predictor of HbA<sub>1c</sub> [160], which is also supported by the predictive analyses of Singh and Press [53], suggesting that those patients with inadequate SMBG were associated with continuing poor glycaemic control [53].

With reference to the conceptual framework of Rubin et al [6], it seems that the CBT approach is indeed in accordance with the strategies recommended. Moreover, as Winkley et al [70] did not find evidence for psychological interventions to improve HbA<sub>1c</sub>, it is reasonable to assume that our behavioural medicine approach was more effective, since all aspects of diabetes treatment, including SMBG and insulin dosing, and not only psychological or medical factors were considered [161].

### **5.2.2 Participation rate**

The participation rate in the intervention study was 41% and attrition was 24%. A recent literature review [162] reported attrition rates that included death as a reason, averaging 17-18%, indicating a higher degree of attrition in our study. In the study of Kane et al [162], however, the interventions were dominantly categorised as drug/supplement experiments (60.2%), whereas the category of counselling/education was present a lower rate (6.8%). One can speculate upon the possibility that behaviour-oriented or educational interventions are assumed to be more demanding among participants than interventions offering drug therapies, thus a higher attrition rate would be expected in the former. A somewhat positive result, however, was that the attrition rate proved to be lower (13%) in those patients who were actually attending the behavioural medicine intervention.

### **5.2.3 Predictors of and associations with improved glycaemic control**

In the analysis of change up to week 24, the baseline value of HbA<sub>1c</sub> fell out as a significant factor in both the intervention group ( $P<0.001$ ) as well as the control group ( $P=0.018$ ). However, in the intervention group, a higher baseline value indicated a more prominent decrease, whereas in the control group a lower baseline value indicated a decrease. In the analysis of prognostic factors for the change in HbA<sub>1c</sub> levels up to week 48, however, we found no predictors of or associations with improvement in HbA<sub>1c</sub> at week 48. Whether or not it might be possible to identify other predictors, as yet unknown, is a subject for speculation. An alternative idea is that this behavioural medicine intervention is applicable to a broad range of patients and not only to those with specific patient characteristics, except those given in our inclusion criteria.

### **5.2.4 Targeted behaviour-change activities**

Goal setting among participants mainly covered areas such as self-care (65%) and beliefs and feelings (18%). The major focus for behaviour-change activities was on diet (21%), SMBG (19%), exercise (10%) and job situation (10%).

### **5.2.5 Missing data**

The mean frequency of missing data regarding HbA<sub>1c</sub> was 3.3% for the study sample, with a slightly higher proportion of missing values in the control group compared with

the intervention group. The proportion of missing values for the questionnaires averaged <1%.

## **5.2.6 Methodological considerations**

### *5.2.6.1 Design and report*

As performed in this intervention study, the RCT is considered the gold standard method for the assessment of efficacy of new treatment modalities [163]. By using this, we minimise some of the classic threats to internal validity, e.g. maturation, history, testing, statistical regression and selection bias [151]. Additional guidelines for behavioural medicine research have also been applied [164], so that altogether detailed descriptions of randomisation and flow of participants have been offered, as well as descriptions of the intervention, e.g. content, provider, format, setting etc. This may facilitate replication as well as future reviews and analyses to be performed in order to compare similar intervention research. Nevertheless, different threats to the validity of results apply to most behavioural studies whether or not researchers use RCTs [162].

A qualitative approach to the behavioural medicine intervention would also have been interesting and valuable in gaining rich and deep information from the participants' subjective perspectives [165], but the thesis was planned to involve only quantitative research. However, in Paper III we have tried to get more details concerning who we reach with this kind of intervention and who 'succeeds'.

### *5.2.6.2 Generalisability*

Participation in the study was of course strictly voluntary and over half (53%) of those who fulfilled the inclusion criteria did not participate. Unfortunately, those in poorest control are not likely to participate in clinical trials [4]. However, this was not the case in our study, with no significant differences in HbA<sub>1c</sub> between participants and non-participants. With regard to the attrition rate (24%), in fact only 31% of the possible candidates have been investigated. Altogether this has a negative effect on the external validity of the results for this group. Our sample has to be considered selective, and results may not be generalised to other populations. For the time being, we can only apply the results to patients who meet the inclusion criteria. Thus, we do not know what possible effects the programme would generate on patients with a less favourable psychological profile, as in the study of van der Ven et al [158]. Nor do we know the possible effect on targeted groups in adolescence or in minority groups etc.

### *5.2.6.3 Analysis*

An important methodological and practical question is how to treat subjects in the data analyses that are differently affected by the intervention. It seems reasonable to include in the analyses only those patients who were actually affected by the intervention. After all, only those subjects can be considered a 'real' test of the hypothesis. On the other hand, when patients withdraw from a study, both statistical conclusion validity and internal validity will be comprised [166]. Thus per-protocol analysis is problematic, because the sample will no longer be representative of the entire group, indicating the possibility of bias towards finding positive treatment effects. In study II we neither used a true per-protocol or true intent-to-treat analysis, rather combinations of them both,

taking into account the criteria for a minimum participation rate (60%) for patients to be included in the analyses. On the other hand, some subjects who participated 'long enough', until 24 weeks, but later became pregnant (n=2), dropped out (n=2) or died (n=1), were included in a 'maximum likelihood' analysis and could thus be regarded as intentions-to-treat. The intention was to keep as many candidates as possible in the analyses. This study was primarily designed in order to make a first evaluation of the methods used. Given the promising results, replication with the more conservative approach of analyses with an intention-to-treat procedure [106] would be of great value.

#### 5.2.6.4 *Measurements*

##### *HbA<sub>1c</sub>*

One can speculate upon the choice of selecting the study sample on the basis of HbA<sub>1c</sub>, suggesting other possible criteria such as diabetes-related distress, negative well-being or perceived problems in adhering to the treatment. Except for the advantage of a true measurable variable such as HbA<sub>1c</sub>, the relevance of choosing this variable is supported by the vital importance of glycaemic control for health among diabetes patients. Secondary variables acted as supportive factors to the primary variable, and are also considered important in the evaluation of this research. It is reassuring to note that after completing the behavioural medicine intervention, the patients showed only improved or preserved scores in all psychological and self-care variables.

##### *Patient-reported outcome measures*

Measurements used in this study were tested with respect to Cronbach's alpha. With the exception of one dimension of the SDSCA<sub>Specific diet</sub>, all measures showed alpha levels between 0.70-0.93. It is therefore unlikely that these instruments would have failed to identifying findings of any importance. With regard to SDSCA, the sub-dimension 'Specific diet' showed alpha coefficients as low as 0.44. In line with results of Toobert et al [132], the reliability of this subscale must be questioned. The subscale was used when evaluating the efficacy of the programme together with the other subscales of SDSCA. In paper III the scale is removed from the analyses in order to include only those of acceptable internal consistency. The Swedish version of the DES used in this study has not yet been psychometrically evaluated, which is a limitation.

#### 5.2.6.5 *Cost-effectiveness*

The cost-effectiveness of this intervention has not been evaluated, which might be considered a limitation of the study.

### **5.3 INSULIN ABSORPTION (PAPER IV)**

Lipohypertrophy is a problem for many patients with type 1 diabetes and has remained so with the use of novel insulin analogues. Unfortunately many patients favour injection in such sites, since it causes a minimum of discomfort. However, the consequences thereof have not been clarified with respect to such insulins. In our study we found that the fasting plasma free insulin concentration was  $26 \pm 10$  pmol/l before insulin injection in lipohypertrophic tissue and  $24 \pm 8$  pmol/l before insulin injection

in normal tissue ( $P = 0.674$ ) and that a higher C-max of plasma insulin was observed after injection in normal tissue ( $226 \pm 32$  pmol/l) than in lipohypertrophic tissue ( $169 \pm 33$  pmol/l,  $P = 0.015$ ), with significantly higher insulin levels recorded between 40 and 90 minutes. Notably, there was no significant difference in T-max ( $P = 0.102$ ). We consider these differences to be clinically relevant and it is therefore recommended not to inject analogue insulins into lipohypertrophic sites either.

### **5.3.1 Additional findings of this thesis**

The self-reported questionnaire regarding insulin injection produced the following findings from the nine patients taking part in the study:

The size of the injection needle was 6 mm (n=1), 8 mm (n=5), 12.0 mm (n=2) and 12.7 mm (n=1). Two of the patients reported two different sizes of needles.

The frequency of changing the needle was: at every injection (n=1), once per day (n=2), and an average of 10.5 times/week (n=1), an average of 1.5 times per week (n=1), once per week (n=1), 'when changing insulin pen' (n=1). Patients treated with continuous subcutaneous insulin infusion reported change of insulin set every day (n=1) and every third day (n=1).

Seven patients reported that they rotated injection sites, while two reported they did not.

Lipohypertrophy was seen as a cosmetic problem (n=3), a physiological problem (n=3), or non-existent (n=2). One patient did not answer the question.

The sample size above is far too small to draw any solid conclusions. It only gives a picture of those patients participating in the study.

### **5.3.2 Methodological considerations**

This study may be limited by the small sample size and by the fact only male patients were included as participants. However, an interim analysis was made and this lent support to the small sample size. In addition, two women were asked to participate but chose not to do so. Therefore, further research would be valuable to ascertain the clinical meaning of those findings. In this study we investigated the pharmacokinetics of insulin aspart; we did not study the blood glucose lowering effect *per se*, so the clinical importance of our findings can only be speculated upon in view of previous knowledge in this field.

## **5.4 CLINICAL CONSIDERATIONS AND FUTURE PERSPECTIVES**

In the current thesis, health promotion has been highlighted in different areas of diabetes care. The studies were not restricted to only include poorly controlled type 1 diabetes patients; however, this was the concern in Papers II and III.

Firstly, regarding the Swe-PAID-20, the scale proved to be a valid and reliable measure of diabetes-related distress among type 1 diabetes patients. Thus, the scale may be of value among healthcare providers in order to support patients in their behavioural

change efforts [118]. The Swe-PAID-20 can be used to identify patients who experience diabetes-related distress, which in turn can generate attention to the care of those identified. The scale may also serve as a basis for discussions regarding possible problem areas for patients. Health promotion in the area will include health professionals' awareness of common diabetes-related problems and targeted attention to those who experience diabetes-related distress.

Secondly, study IV has provided updated evidence regarding a crucial part of diabetes self-management concerning lipohypertrophies. The clinical implication of this is that patients should be educated on the true importance of avoiding injection insulin aspart in lipohypertrophic injections sites. In line with the behaviour-oriented approach, it is also important to discuss with patients the barriers to applying a recommended injection technique, and to conduct problem solving exercises regarding these possible barriers.

Finally, with regard to the intervention study, there is a need for ethical reflections upon the goals of communication with patients. Is the goal to achieve a desired change in patient behaviour set from the professionals' perspective? Or is it to facilitate informed choice by the patients to do whatever he or she values? I would say that both these aspects should be taken into account when caring for diabetes patients. It is of course my obligation to educate patients concerning what is to be gained by keeping blood sugar levels as close to normal as possible or at an acceptable level, depending on the individual. Nevertheless, the patient has the right to make decisions regarding his or her own life and self-care, which should be accepted but not regarded as the final decision. Continuous contacts with patients, if accepted by the patient, facilitate reflections on life and self-care behaviours in a respectful but exposing way. Maybe, when the 'time is right', which should not be a passive approach on the part of the healthcare provider, but rather an active one, the patient will try to make a change according to his own will and self-efficacy. Thus, goals in diabetes care should be regarded as stepwise and in line with the patient's perspective of life with diabetes.

Reaching the goals of metabolic control is no easy task, neither for the patient, nor for the healthcare provider. It is reasonable to believe that this challenge requires as much change from the healthcare providers as from the patients for behaviour changes to be successful [167-170]. As indicated above, the immediate consequences of behaviour are often much more salient to patients than the possibility of vague future health problems, such as the risk of complications. This may especially be the case if the patient has first-hand experience of the immediate negative consequence of an acute episode of hypoglycaemia [28]. Thus, focusing on possible barriers instead of the threat of complications may be a fruitful means of communication. Healthcare providers need to apply empirically supported techniques in their practice. These techniques involve more than just educating the patient in self-management, but also reflecting upon such factors as current self-care behaviours and values in life. Consequently, this raises an interesting question: Do healthcare professionals master these skills and to what degree are psychologists and/or welfare officers involved in patient care? Unfortunately, recent research suggests that these approaches and skills are limited in diabetes care [1, 171, 172]. There is some evidence that diabetes specialist nurses who have been trained in more holistic patient-centred methods accept this approach but have difficulties in practising it, at least for a longer period of time [168, 169].

Another important aspect of achieving improved metabolic control is the fact that there are patients for whom attempts to reach strict control are not appropriate. These are the patients with advanced complications, especially retinopathy, who risk acceleration in severity of pre-proliferative or early proliferative retinopathy. Other contra-indications are extremes of age, ischaemic heart disease and limited life expectancy (e.g. serious coexisting disease). Furthermore, caution is required in the case of long duration of insulin-treated diabetes because of counter-regulatory deficiencies, previous history of severe hypoglycaemia, established impaired awareness of hypoglycaemia, history of epilepsy and patients that are unwilling to do SMBG [33]. Health promotion among these patients must indeed find a balance between the gains and the risks involved.

As a result of working on this thesis, my strong belief is that diabetes care would benefit from cooperation with psychologists trained in CBT, in order to support behaviour-change activities as well as dealing with general and diabetes-specific problem areas. The psychologist could also act as a tutor to other health care professionals in diabetes care. Additionally, I find it necessary to provide a more substantial education and training of diabetes specialist nurses who are the key persons in delivering patient education. To understand the patient's self-care behaviours, we need to take into account various psychological and social factors [173], which are apparently often missed. Since the CBT approach has proved to be a fruitful concept, one suggestion for the additional education and training of diabetes specialist nurses could comprise a basic course of learning theory, cognition theory, social psychology, and on top of all this: applied behavioural analysis. Until appropriate training becomes available and is implemented in diabetes care - something which does not happen overnight - a useful alternative is to recruit psychologists trained in the current approach, to support diabetes care teams.

A recent meta-analysis performed in type 1 diabetes children and adolescents concerning the use of the first generation CGMS technique, used in this thesis, failed to demonstrate the superiority of CGMS over SMBG in improving long-term glycaemic control [174]. So far there is a lack of information concerning this issue in adults. It is notable, however, and quite promising, that a new technique has been developed for continuous glucose monitoring, providing real-time glucose assessments. Thus Deiss and coworkers [175] have recently demonstrated that continuous use of this glucose sensor (Guardian RT) exerts a prominent effect on elevated HbA<sub>1c</sub> values in both children and adults with type 1 diabetes. In view of the fact that most of the patients participating in our RCT favoured the use of CGMS, even though it was the first generation, this is noteworthy in a future perspective. A wider use of such techniques requires financial support and specific new skills among health care professionals and patients, and thus represents a current challenge to the 'diabetes community'.

Most scientific papers conclude that there is a need for more scientific evaluations of similar intervention studies, and I agree. But at the same time, and with so much research pointing in the same direction, the challenge now must be to translate these interventions more widely into practice, at least in small areas to be evaluated as a true clinical experiment, involving e.g. nurses trained in these techniques. Hence, the next

interesting step would be to further the educational efforts of diabetes care teams involving CBT, followed by meticulously conducted RCTs.

For the time being, Peyrot and Rubins' [6] step-by-step approach, as shown in Table 9, may be useful when trying a behaviour-oriented approach among diabetes patients.

Table 9. Behavioural/psychological interventions: a step-by-step approach. The table is taken from the article of Peyrot and Rubin [6].

Intervention	Sample question
<i>Problem-focused interventions</i>	
1. Start with the patient's problem	"What's the hardest thing about managing your diabetes?"
2. Specify the problem	"Can you give me an example?"
3. Negotiate an appropriate goal	"What is your goal for changing your self-care behaviour?" "Is that realistic?"
4. Identify barriers to goal attainment	"What could keep you from reaching your goal?" "Why would that keep you from reaching your goal?"
5. Formulate strategies to achieve the goal	"How can you overcome that barrier to reaching your goal?" "How have you successfully dealt with that before; would that work now?"
6. Contract for change	"What are your criteria for defining success?" "How will you reward yourself for success?"
7. Track outcomes	"How will you keep track of your efforts?"
8. Provide ongoing support	"What will you do if you slip in your efforts to reach your goal: what can I do to help?"
<i>Emotion-focused interventions</i>	
9. Identify diabetes distress	"Do you feel overwhelmed by diabetes?"
10. Alleviate diabetes distress	"What are you saying to yourself when you deal successfully/unsuccessfully with a diabetes-related challenge?"
11. Identify depression	"In the past two weeks have you felt depressed or lost interest or pleasure in things?"
12. Treat disorder or refer to treatment	"Would you like to talk to someone who could help you resolve these problems?"

I intend to end this section with the following vignettes in order to sow some seeds for further reflections on how to best meet patients who have difficulties in managing their diabetes and who are in poor glycaemic control:

‘I try to keep my insulin doses as low as possible, because I don’t want to get fat!’

‘It’s impossible to do exercise. I always get a reaction (insulin). No matter what I do. Even walking is a risk!’

‘My blood sugar has a life of its own! I can’t control it. It doesn’t matter what I do. That’s why I give up in the end.’

‘I often miss my lunch dose (insulin) at work. It’s because I don’t want to let my colleagues find out I’m a diabetic... As a matter of fact, to be on the safe side I keep my blood sugar levels higher when I’m working.’

‘If I lived according to the recommendations, life would be boring and not worth living.’

‘I’m aware of the possibility of future complications, but the threat is much too far away, so it doesn’t motivate me to take care of my diabetes now. Actually, I’m quite pleased with my life and I feel well.’

## 6 CONCLUSIONS

To briefly summarise, the main findings in this thesis are as follows:

- The Swedish version of the Problem Areas in Diabetes (Swe-PAID-20) scale seems to be a reliable and valid outcome for measuring diabetes-related emotional distress in type 1 diabetes patients.
- The behavioural medicine intervention proved to be a promising approach in improving outcome in poorly controlled adult type 1 diabetes patients. Significant differences were found between the intervention and control group, regarding HbA<sub>1c</sub>, self-care behaviours and psychological factors, which suggests that this approach is worthy of further evaluation in clinical research and practice.
- The behavioural medicine intervention proved to be feasible in terms of design and methods used. However, no clear pattern was found regarding predictors of or associations with improved metabolic control as the response to the intervention.
- Impairment of insulin absorption from lipohypertrophic injection sites also takes place with analogue insulins. It is suggested that diabetes patients should be advised to refrain from injection insulin aspart into lipohypertrophic subcutaneous tissue.

## POPULÄRVETENSKAPLIG SAMMANFATTNING

Kan ett stödprogram grundat på kognitiv beteendeterapi (KBT) förbättra blodsockerkontroll, egenvård och psykosociala faktorer hos vuxna personer med typ 1 diabetes? Om så är fallet, kan man förutspå vilka personer som når framgång i att förbättra sin blodsockerkontroll? Det var de övergripande frågorna för denna avhandling som även undersöker aspekter av ett egenvårdsområde som injektionsteknik, där studien syftade till att undersöka huruvida insulinabsorptionen i fettvävsskada är försämrad vid injicering av snabbverkande insulin aspart.

Många människor med diabetes har svårigheter att leva efter de rekommendationer som ges för att få bra blodsockerkontroll och god hälsa. För höga blodsockernivåer kan skada känsliga organ som njurar, nerver och näthinna. Detta är kunskap som förmedlas vid Sveriges alla diabeteskliniker idag. Patientundervisning ges för att lära ut hur man bäst sköter egenvården kring diabetes. Trots allt kan det vara svårt att följa givna rekommendationer och mycket tyder på att kunskap och beteende inte alltid följs åt. Därför rekommenderas ett mer beteendecinriktat förhållningssätt från sjukvårdspersonal som tar hänsyn till hela individen och fokuserar mer på psykologiska aspekter som upplevelse av hinder att leva med sjukdomen, tankar kring sjukdom och egenvård m m.

Två av studierna i denna avhandling utvärderar effekten av ett sådant beteendecinriktat stödprogram som bygger på KBT. Patienter lottades slumpmässigt till att ingå i en grupp som fick stödprogrammet (interventionsgrupp) alternativt till att fortsätta med sedvanlig diabetesvård (kontrollgrupp). Stödet gavs dels i grupp, dels individuellt och syftade till att förbättra egenvård och blodsockerkontroll. Under en period av två månader fick patienterna kartlägga sina egenvårdsbeteenden och lära sig olika verktyg, lämpade för beteendeförändring. Stödprogrammet omfattade även ett strukturerat vidmakthållandeprogram med fokus att vidmakthålla genomförda beteendeförändringar och att hantera bakslag. Studien pågick under ett år. Signifikanta skillnader mellan interventions- och kontrollgrupp observerades vid studiens slut avseende blodsockerkontroll, välbefinnande, frekvens av blodsockermätning, rädsla för hypoglykemi (lågt blodsocker), upplevd stress och depression, där alla aspekter förbättrades mer i interventionsgruppen jämfört med kontrollgruppen. Det beteendecinriktade stödprogrammet tycks erbjuda ett lovande förhållningssätt till vuxna personer med svårkontrollerad typ 1 diabetes. Vid fördjupade analyser kunde vi dock inte finna specifika karaktäristika hos de individer som nådde framgång i att förbättra sin blodsockerkontroll. Detta skulle kunna tyda på att programmet lämpar sig för ett brett spektrum av individer. En alternativ förklaring är att det finns andra faktorer än de vi har undersökt, som avgör vem som når framgång i att förbättra sin blodsockerkontroll. Fortsatt forskning krävs för att finna svar på den frågan.

Som ett led i att utvärdera stödprogrammet, översattes ett av de frågeformulär som patienterna besvarade, 'the Problem Areas in Diabetes scale' (problemområden inom diabetes). Formuläret kommer ursprungligen från USA och mäter diabetesrelaterad stress. Då översättning av frågeformulär bl a kan kräva kulturell anpassning utfördes särskild statistik för kvalitetsgranskning av instrumentet. Bl a syftade testerna till att undersöka om frågeformuläret verkligen mäter det som avses att mätas samt att det

mäts på ett tillförlitligt sätt. Frågeformuläret visade sig ha god kvalitet avseende dessa aspekter.

Slutligen, utfördes insulinabsorptionstest på nio patienter med fettvävsskada med snabbverkande insulin aspart. Analyser visade att absorptionen blir försämrade då insulinet injiceras i denna vävnad, varför patienter skall rådas att undvika injektion i en fettvävsskada.

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## APPENDIX

# The Swedish version of the Problem Areas in Diabetes Scale (Swe-PAID-20)

## SWE-PAID-20

### PROBLEMOMRÅDEN VID DIABETES

INSTRUKTIONER: Vilka av följande diabetesfrågor är för närvarande ett bekymmer för Dig? Sätt en ring runt det svar som bäst stämmer överens för Dig. Var vänlig och ge ett svar per fråga.

		Inte ett problem	Mindre problem	Måttligt problem	Ganska allvarligt problem	Allvarligt problem
1.	Att Du inte har klara och konkreta mål för Din diabetes?	0	1	2	3	4
2.	Att Du känner Dig nedslagen av Din behandlingsplan avseende diabetes?	0	1	2	3	4
3.	Att Du känner Dig rädd när Du tänker på att leva med diabetes?	0	1	2	3	4
4.	Att Du känner Dig störd i obekväma sociala situationer som beror på Din diabetes (t ex människor som talar om för Dig vad Du ska äta)?	0	1	2	3	4
5.	Att Du upplever känsla av förlust beträffande mat och måltider?	0	1	2	3	4
6.	Att Du känner dig nedstämd när Du tänker på att leva med diabetes?	0	1	2	3	4
7.	Att Du inte vet om Ditt humör eller Dina känslor beror på Din diabetes?	0	1	2	3	4
8.	Att Du känner Dig tyngd av Din diabetes?	0	1	2	3	4
9.	Att Du oroar Dig för lågt blodsocker?	0	1	2	3	4
10.	Att Du känner Dig arg när Du tänker på att leva med diabetes?	0	1	2	3	4
11.	Att Du ständigt känner Dig bekymrad över mat och ätande?	0	1	2	3	4
12.	Att Du oroar Dig över framtiden och risken för allvarliga komplikationer?	0	1	2	3	4
13.	Att Du känner skuld eller oro när Din diabetesbehandling spårar ur?	0	1	2	3	4
14.	Att inte "acceptera" Din diabetes?	0	1	2	3	4
15.	Att Du känner Dig missnöjd med Din diabetesläkare?	0	1	2	3	4
16.	Att Du känner att Din diabetes tar allt för mycket av mental och fysisk energi varje dag?	0	1	2	3	4
17.	Att Du känner Dig ensam med Din diabetes?	0	1	2	3	4
18.	Att Du känner att Dina vänner och Din familj inte stödjer Dig i Dina ansträngningar att sköta Din diabetes?	0	1	2	3	4
19.	Att Du känner Dig "utbränd" av att ständigt sköta Din diabetes?	0	1	2	3	4
20.	Att Du känner Dig missnöjd med Din diabetessjuksköterska?	0	1	2	3	4

In the Swedish version of the PAID scale one item ("Hantera diabeteskomplikationer" i.e "Coping with complications of diabetes") is deleted from the original scale developed by Polonsky et al., 1995. A new item of interest ("Att du känner dig missnöjd över din diabetessjuksköterska" i.e "Feeling unsatisfied with your diabetes specialist nurse") is added to the Swedish version.

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