PSYCHOLOGICAL FEATURES CHARACTERIZING ORAL HEALTH BEHAVIOR, DIABETES SELF-CARE HEALTH STATUS AMONG IDDM PATIENTS

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Abstract

Associations have been found between diabetes status and periodontal diseases and dental caries. In addition to biological explanations, psychological features can be proposed to affect the relations between oral health and IDDM (=insulin-dependent diabetes mellitus). The aim of this study was to evaluate the psychological features characterizing oral hygiene practices, dental visiting and diabetes self-care. The research population consisted of 149 IDDM patients, and cross-sectional data were collected by a quantitative questionnaire, in clinical examinations and from patient records.

There was a positive correlation between the sum scores for dental self-efficacy and diabetes self-efficacy and, correspondingly, between the dental and diabetes locus of control beliefs. High self-esteem was found to associate with good adherence to some specific health behaviors, such as tooth brushing, exercising and insulin adjustment. When Weiner´s attribution theory was used, there were similarities in the causal thinking in oral and diabetes view. All in all, especially the perception of self-efficacy was found to be a powerful feature characterizing health behavior. There were overlapping relations showing an association of high dental self-efficacy with good diabetes adherence, of high diabetes self-efficacy with frequent dental visiting, and of good metabolic control with high tooth brushing self-efficacy, frequent tooth brushing and low plaque level. On the basis of these results, enhancement of self-efficacy appears important.

These results suggest that there might, indeed, be some common psychological features for both oral health behavior and diabetes self-care. These could partly explain the relations between diabetes status and periodontal diseases and dental caries. The results can be utilized in patient-centered health education by identifying and enhancing the psychological features that characterize health behavior and health status. The results emphasize the need for co-operation between dental and diabetes health care professionals in their daily practice.

Keywords: self-efficacy, locus of control, self-esteem, causal attributions

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Ylivieska, April 2000 Mirka Kneckt

List of original articles

This thesis is based on the following papers, referred to in the text by their Roman numerals:

I Syrjälä A-MH, Kneckt MC & Knuuttila MLE (1999) Dental self-efficacy as a determinant to oral health behaviour, oral hygiene and $HbA1_c$ level among diabetic patients. J Clin Periodontol 26: 616–621.

II Kneckt MC, Syrjälä A-MH, Laukkanen P & Knuuttila MLE (1999) Self-efficacy as a common variable in oral health behavior and diabetes adherence. Eur J Oral Sci 107: 89–96.

III Kneckt MC, Syrjälä A-MH & Knuuttila MLE (1999) Locus of control beliefs predicting oral and diabetes health behavior and health status. Acta Odontol Scand 57: 127–131.

IV Kneckt MC, Keinänen-Kiukaanniemi SM, Knuuttila MLE & Syrjälä A-MH Self-esteem as a characteristic of adherence with diabetes and dental self-care regimens. (accepted for publication in J Clin Periodontol), in press.

V Kneckt MC, Syrjälä A-MH & Knuuttila MLE (2000) Attributions to dental and diabetes health outcomes. J Clin Periodontol 27: 205–211.

Contents

1. Introduction

The incidence of IDDM in Finland is the highest in the world, and in 1996 there were 45 cases per 100,000 persons among children aged under 15 years. According to the forecasts, the IDDM incidence of children of that age in Finland will be approximately 50/100,000 per year in the year 2010. (Tuomilehto *et al*. 1999).

The success of dental and diabetes care is notably dependent on the patient´s own health behavior. Knowledge of the importance of good health behavior is not enough to maintain a good level of self-care (McCaul *et al.* 1987, Bader *et al.* 1990). Psychological features, such as self-efficacy, have been found to associate with adherence to self-care regimens (Littlefield *et al.* 1992, Stewart *et al.* 1997). Poor control and/or complications of diabetes are related to the prevalence and severity of inflammatory periodontal disease (Karjalainen *et al*. 1994, Oliver & Tervonen 1994, Yalda *et al.* 1994) and to dental caries among children and adolescents (Karjalainen *et al.* 1997). There is evidence that periodontal disease is related to metabolic control (Miller *et al*. 1992, Grossi & Genco 1998) and complications (Thorstensson *et al.* 1996) in insulin-dependent diabetes mellitus (IDDM). Periodontal disease has actually been regarded as a complication of diabetes (Löe 1993). Nevertheless, the knowledge about oral diseases among diabetic patients is poor (Löe & Genco 1995).

The goal of diabetes self-care is to maintain good metabolic control, which can be obtained by optimal timing and dosage of insulin injections, a healthy diet, physical exercise and self-monitoring of blood glucose. (The Diabetes Control and Complications Trial Research Group 1993, Suomen Diabetesliitto 1995). For a good oral health status, good oral hygiene and regular dental check-ups are needed. Some similarities can be seen between diabetes self-care and oral hygiene practices. Both require systematic daily self-care. By good self-care the patient is able to attain a better health status, but not even complete adherence to self-care regimens can always guarantee good health. Success requires that both the patient and the health care professionals should be aware of the biological associations between oral diseases and diabetes status. Thus, non-adherence is a matter of concern for both the patient and the health care organization, and all effort has to be done to remove the obstacles to optimal self-care. To promote oral health behavior and diabetes self-care, a psychological approach is needed to achieve a profound view of health behavior and the factors determining it.

Good oral health behavior as well as good diabetes self-care can be considered essential for a good health status. The hypothesis underlining this study was that diabetes self-care and oral health behavior are mutually related. It was proposed that there may be similarities between the psychological features modifying these aspects of health behavior. Therefore, health behavior could be one factor determining the relations between diabetes status and periodontal diseases and dental caries. There are no studies available on the possible common psychological features in diabetes adherence and oral hygiene practices and dental visiting, and the aim of this study was to evaluate this issue. The results will help both dentists and diabetes health care professionals to increase the efficiency of patient-centred health education and to extend their collaboration. Their common goal is to help diabetic patients to reach a good quality of life by enhancing their own responsibility concerning their health status and by giving both medical and emotional support.

2. Definition of terms

- health behavior = a general term to describe self-care and the use of health services
- oral hygiene practices = practices performed by the person him/herself, including tooth brushing and interdental cleaning
- diabetes adherence = the level at which the patient daily follows the diabetes self-care regimens established co-operatively by the patient and health care professionals (Hentinen 1988)
- diabetes self-care = includes the timing and dosage of insulin injections, the diet, physical exercise and self-monitoring of blood glucose
- diabetes status = metabolic control and complications of diabetes mellitus

3. Review of literature

3.1. Diabetes mellitus and oral diseases

3.1.1. Periodontal diseases

Diabetes mellitus is a risk factor for periodontal diseases (Oliver & Tervonen 1994, Yalda *et al.* 1994, Genco 1996). Clinical attachment loss is more common in diabetic children and adolescents than in controls (Firatli 1997), and diabetic men have poorer periodontal status than non-diabetic men (Bridges *et al.* 1996). Further, diabetic patients aged 40-49 have more periodontal pockets ≥ 6 mm and more extensive alveolar bone loss than non-diabetic patients in the same age-group (Thorstensson & Hugoson 1993).

Efforts have been made to find diabetic features which, as risk indicators, would determine the association between diabetes and periodontal diseases. Metabolic control of diabetes is considered to play the major role in determining the level of periodontal disease. Poorly controlled diabetic patients have more gingival inflammation, periodontal pockets and/or attachment loss than well-controlled diabetic patients (Ervasti *et al.* 1984, Tervonen & Knuuttila 1986, Safkan-Seppälä & Ainamo 1992, Seppälä *et al.* 1993, Tervonen & Oliver 1993, Seppälä & Ainamo 1994, Karjalainen & Knuuttila 1996). But there are also studies in which no relation between periodontal disease and metabolic control is found (Bacic *et al.* 1988, Hayden & Buckley 1989, Bridges *et al.* 1996).

A long duration of diabetes is a risk for periodontal diseases (Ainamo & Ainamo 1996, The American Academy of Periodontology 1996), and an association between the duration of diabetes and attachment loss has been found (Firatli *et al.* 1996, Moore *et al.* 1999). Contrary to this, no significant relation between the duration of diabetes and periodontal status has been found by Bridges *et al.* (1996).

Moreover, the presence of diabetic complications relates to periodontal disease. There is more attachment loss among adult IDDM subjects with poor metabolic balance and/or multiple complications, and in these patients probed pocket depth ≥ 4 mm re-occurs faster after periodontal therapy (Tervonen & Karjalainen 1997). Further, periodontal disease

associates with retinopathy (Rosenthal *et al.* 1988, Karjalainen *et al.* 1994), renal disease and cardiovascular complications (Thorstensson *et al.* 1996) as well as neuropathy (Rosenthal 1988, Moore *et al.* 1999).

A two-way relationship between periodontal disease and diabetes mellitus has been postulated by Grossi & Genco (1998). Thus, periodontitis, as a chronic infection, may impair metabolic control and increase the need for insulin and hence have an influence on the systemic level. It can be suggested that if the periodontal infection is eliminated, the metabolic balance of diabetes improves (Miller *et al.* 1992, Grossi *et al.* 1996), but this has not been confirmed by Aldridge *et al.* (1995) and Smith *et al.* (1996). On the whole, knowledge is currently insufficient regarding the ability of periodontal therapy to improve the metabolic control of diabetes (Taylor 1999).

There are several possible mechanisms involved in diabetes that mediate the increased risk for periodontal diseases. A prolonged hyperglycemic condition leads to non-enzymatic formation of advanced glycation end products (AGEs), which affects the structure of many cells and tissue proteins, including collagen, predisposing the person to macro- and microvascular complications. There are reports of decreased collagen synthesis and increased collagen degradation, i.e. increased collagenase activity (Sternberg *et al.* 1985, Reiser 1991). The host response to local infection is inefficient in diabetic patients. Disorders in neutrophil function together with AGE-related activation of inflammatory cells change the profile of cytokines and tissue growth factors. Consequently, the inflammation response and tissue homeostasis are altered. (Schmidt *et al.* 1994, Chappey *et al.* 1997, Vlassara 1997).

On the whole, there are diabetic features that partly determine the association between diabetes and periodontal diseases. The inconsistency in the results may be due to differences in metabolic control, duration of diabetes and age of subjects between different study populations.

3.1.2. Dental caries

Diabetic patients have more fillings (Albrecht *et al.* 1988, Kirk & Kinirons 1991) and more dental caries (Jones *et al.* 1992) than non-diabetic patients. Contrariwise, diabetic patients have been shown to have lower dental caries levels (Albrecht *et al.* 1988, Kirk & Kinirons 1991). Further, no differences have been found in the caries level (Tenovuo *et al.* 1986, Bacic *et al.* 1989, Falk *et al.* 1989, Pohjamo *et al.* 1991) or the root caries level (Tavares *et al.* 1991) between diabetic and non-diabetic patients.

Poor metabolic control appears to associate with dental caries (Pohjamo *et al.* 1988, Twetman *et al.* 1992, Karjalainen *et al.* 1997), but this is not found by Bacic *et al.* (1989). As far as the duration of diabetes is concerned, the incidence of dental caries in children is higher during the first year of diabetes than during the second year (Twetman *et al.* 1992), while no association between the duration of diabetes and dental caries is found by Bacic *et al.* (1989). Further, it has been proposed that if diabetes is diagnosed before the eruption of permanent teeth, the development of dental caries is reduced (Tenovuo *et al.* 1986). This is supported by the finding that there is more caries in the children whose diabetes has been diagnosed after the age of 7 years (Kirk & Kinirons 1991).

Reasons for the elevated dental caries level in some diabetic patients have been sought from alterations in saliva. Lower salivary flow rates in diabetic than non-diabetic patients has been reported (Ben-Aryeh *et al.* 1988, Thorstensson *et al.* 1989a), but there are contradictory results by Belazi *et al.* (1998). Poor control of diabetes relates to a decreased flow of saliva (Harrison & Bowen 1987, Karjalainen *et al.* 1996), while the association between the blood glucose and salivary glucose levels is quite inconsistent (Sharon *et al.* 1985, Reuterving *et al.* 1987, Ben-Aryeh *et al.* 1988, Darwazeh *et al.* 1991, Karjalainen *et al.* 1996). A high glucose level in the oral cavity is proposed as a reason for dental caries, but the results concerning the salivary glucose level are not consistent (Sharon *et al.* 1985, Ben-Aryeh *et al.* 1988, Thorstensson *et al.* 1989b, Darwazeh *et al.* 1991, Belazi *et al.* 1998). Elevated glucose levels in the gingival fluid of diabetic patients (Ficara *et al.* 1975, Friedman *et al.* 1981) and a relation between the levels of blood glucose and gingival fluid glucose have been reported (Ficara *et al.* 1975). Regarding salivary pH and buffer capacity, no differences between diabetic and non-diabetic patients have been found (Tenovuo *et al.* 1986, Thorstensson *et al.* 1989b).

All in all, the results concerning the relation between diabetes and dental caries are contradictory, and there are many possible reasons for that. In many studies, confounding factors, such as the subjects´ age and the duration of diabetes, have been poorly controlled for. There are differences in the way to record caries. Most studies are cross-sectional, while more longitudinal studies are needed.

3.1.3. Candida infections

Diminished salivary flow may be conducive to opportunistic micro-organism, such as *Candida albicans*. Indeed, there are more clinical *Candida* infections in diabetic patients than non-diabetic individuals (Lamey *et al.* 1988, Darwazeh *et al.* 1990). A high blood glucose level has been shown to associate with candidiasis (Hill *et al.* 1989) and a high salivary glucose level with high salivary yeast counts (Karjalainen *et al.* 1996). Diabetic patients colonized with *Candida* have higher salivary glucose levels than non-colonized patients (Darwazeh *et al.* 1991). However, diabetes has not been shown to associate with denture stomatitis (Phelan & Levin 1986), and metabolic control has not been found to have any significance concerning candidiasis (Bartholomew *et al.* 1987) or candidal load (Willis *et al.* 1999).

3.2. Oral health behavior and oral health

Regular oral health behavior has been included in the national instructions for the care of diabetes. The dental care system should ensure that each diabetic patient has adequate knowledge and skills to perform oral hygiene practices, including tooth brushing and interdental cleaning. Information about the use of fluoride and xylitol products should be given. Dentist should determine individual recall times for diabetic patients, ranging from 2-3 months for high-risk patients up to one year for patients with normal oral health. (Suomen Diabetesliitto 1995).

3.2.1. Oral hygiene practices and dental visiting among diabetic patients

Despite the presence or absence of diabetes, oral hygiene practices seem to be similar among adults. Regular tooth brushing on a once- or twice-a-day basis varies from 74% to 94% among diabetic patients compared to 83% to 89% among non-diabetic patients (Thorstensson *et al.* 1989a, Jones *et al.* 1992, Spangler & Konen 1994). Daily dental flossing varies around 34% in both groups (Spangler & Konen 1994). However, there is a difference in the regular use of toothpicks, as 46% of long- and 31% of short-duration diabetic patients use toothpicks regularly, while 30% of non-diabetic subjects do that (Thorstensson *et al.* 1989a). Among IDDM patients, infrequent interdental cleaning is related to poor metabolic control or advanced complications (Karjalainen *et al.* 1994).

Over 70% of diabetic children visit a dentist at least twice a year (Kirk & Kinirons 1991). Regular dental visiting varies from 81% to 61% among insulin-treated patients compared to 45% to 60% among NIDDM patients (Jones *et al.* 1992, Spangler & Konen 1994). Eleven percent of the long- and 17% of the short-duration IDDM patients have not visited a dentist for two years, and they are not so willing to spend time or money on teeth as non-diabetic subjects (Thorstensson *et al.* 1989a). According to a longitudinal study concerning both type 1 and type 2 diabetic patients, diabetic patients fail more dental appointments than non-diabetic subjects (Pohjamo *et al.* 1995). Diabetic patients require more emergency dental care than non-diabetic patients (Thorstensson *et al.* 1989a), and IDDM patients with poor metabolic control or advanced complications visit dentist less regularly than those with good diabetes status (Karjalainen *et al.* 1994). Although the level of oral hygiene practices and the frequency of dental visiting among diabetic patients seems to be moderately good, it is alarming that poor adherence is shown by the patients with poor metabolic balance and complications. Therefore, enhancement of oral health behavior is particularly needed in that group.

The variables affecting the oral health behavior of diabetic patients have been poorly evaluated. IDDM patients with severe family dysfunction brushed, flossed and visited a dentist less regularly than patients with better family function (Spangler & Konen 1994). Among other populations, patients comply better with oral health care regimens when informed and positively reinforced and when there are no barriers to treatment. Lack of information, fear and economics are reasons for non-adherence with oral hygiene regimens. (Wilson 1987). Several other reasons have also been proposed to lead to non-adherence with dental care regimens: low socio-economic status (Tedesco *et al.* 1992), unfavourable health values (Camner *et al.* 1994), stress (Meyer 1989) and poor motivation (Syrjälä *et al.* 1994). Further, dental health attitudes (Freeman & Linden 1995) and health beliefs (Barker 1994) are significant for oral health behavior.

3.2.2. Oral hygiene practices and dental visiting versus oral health

Microbial dental plaque is the major etiologic agent in periodontal diseases (Listgarten 1986, Socransky & Haffajee 1992). Consequently, both prevention and treatment of gingivitis and periodontal diseases should focus on controlling the plaque level. Individual instructions and practices in oral hygiene techniques have turned out to be

effective, and good self-care together with regular dental visiting help to prevent dental diseases (Axelsson & Lindhe 1981, Axelsson *et al.* 1991). It has been noticed that tooth brushing, flossing and annually dental visiting associate with lower plaque, calculus and gingivitis levels, which, in turn, lead to smaller pocket depths and less attachment loss (Lang *et al.* 1995). Though self-care is very important, supragingival plaque control by the individual alone is not enough, and it has been shown not to prevent further periodontal destruction (Westfelt *et al.* 1998). Regular professional care, including subgingival plaque removal, is necessary for the treatment of periodontitis (Greenstein 1992, Corbet & Davies 1993). Unfortunately, compliance with maintenance visits is not very good (Mendoza *et al.* 1991, Wilson *et al.* 1993). Irregular dental attenders, who only use dental services only when they have trouble with their teeth, have more sites with plaque or calculus, more bleeding sites and deeper mean probing depths (Mullally & Linden 1994). Thus, good plaque control and regular maintenance visits are crucial factors in the prevention and treatment of periodontal disease.

Microbial plaque and sugar in the diet are etiological factors for dental caries. The relationship between the frequency of ingestion of sucrose-containing food items and caries has been clearly demonstrated (Gustafsson *et al.* 1954). Among children and adolescents, it has been shown that tooth brushing twice a day with fluoride containing toothpaste is sufficient to prevent dental caries (Arrow 1998, Ashley *et al.* 1999), which is in line with some previous findings in a large population study on Finnish adults. Among them, frequent tooth brushing, regular dental check-ups, and avoidance of sugar in coffee or tea, have separately and all together been demonstrated to relate to fewer caries lesions both on coronal and root surfaces and to a greater number of teeth. All these differences remain steady when age, sex, and the level of education are controlled for. (Vehkalahti & Paunio 1988, 1989, Vehkalahti *et al.* 1991). Long-term clinical trials have shown that intensive professional efforts prevent dental caries in children and adults (Axelsson & Lindhe 1981, Axelsson *et al.* 1991). As far as the frequency of dental attendance is concerned, there is no self-evident rule. Both individually adjusted intervals and dental attendance at least once a year have been recommended as appropriate (Levine 1996). It appears that adolescents´ regular dental attendance is associated with fewer extracted and more sealed teeth (Hawley *et al.* 1997).

3.3. Diabetes self-care

Various terms have been used to describe patients´ own practices concerning diabetes treatment. Adherence to diabetes self-care regimens has been defined as the level to which the patient daily follows the diabetes self-care regimens established co-operatively by the patient and health care professionals (Hentinen 1988). Self-care can be either strict adherence to prescribed regimens or active self-care (de Weerdt *et al.* 1990). Active self-care refers to self-monitoring, dietary adjustments, insulin dosage for daily purposes and regular exercise. The term ´diabetes self-management´ emphasizes the responsibility and role of the patient him/herself in managing the diabetes. The terms ´compliance´ and ´adherence´ should be distinguished, because compliance means only strict observance of

instructions, while adherence refers to more flexible self-care and control of situations. Adherence is a more suitable term than compliance to describe diabetes care (McNabb 1997), and it is therefore used in this study.

3.3.1. Diabetes self-care practices

Diabetic patients adhere best to the most vital self-care practices: insulin injections (Schlenk & Hart 1984, Peveler *et al.* 1993) and glucose testing (Schlenk & Hart 1984, Glasgow *et al.* 1987). It has been shown that 92% of patients never miss an injection of insulin, only 7% of subjects totally ignore the glucose testing, and 70% of all prescribed glucose tests are performed (Glasgow *et al.* 1987). Among Finnish insulin-treated patients, 84% of adults and 72% of adolescents show high compliance with insulin treatment (Hentinen & Kyngäs 1992, Toljamo 1999).

Thirty-five percent of adult insulin-treated patients show good adherence to exercise, but only 23% to diet instructions (Toljamo 1999). Among adolescent diabetic patients, 62% show high compliance with the co-operation with the nursing staff, while only 11% show similar compliance with the diet and 28% with the home monitoring regimens (Hentinen & Kyngäs 1992). The dietary and exercise regimens (Glasgow *et al.* 1987, Glasgow *et al.* 1997, Ruggiero *et al.* 1997) and foot care and physical exercise (Schlenk & Hart 1984) are adhered to most poorly. Sixty-eight percent of diabetic patients report difficulties with the control of smoking, 58% with weight regulation, 54% with exercise and 49% with diet, but only 10% with insulin injections (Hanestad & Albrektsen 1991). Among an adult insulin-treated patient population, 35% find it difficult to quit smoking, while 88% have difficulties concerning the illness and 84% concerning parties. Eighty-eight percent have problems with the diet instructions at least sometimes, and 78% with assessing the influence of exercise on blood glucose. (Toljamo 1999)

In Finland, IDDM patients have been shown to visit their diabetes care unit approximately four times a year (Kangas 1993), which makes it possible to monitor metabolic control and to interfere with the progression of complications. In previous studies, no-show visits have been reported to vary between 4% to 40% of all appointments (Griffin 1998). Infrequent attenders have more complications and poorer metabolic balance than those who keep their appointments. The factors predisposing to non-attendance include the patients´ health beliefs and attitudes, the organization of the clinic, the costs of attendance and the degree of patient participation in consultation. (Griffin 1998).

There are various reasons for poor diabetes self-care. Diabetes self-care is very complex, requires life-long commitment, and requires modification of one´s personal life-style. These aspects have been shown to decrease adherence to self-care regimens. (Becker 1976, Haynes 1976). It has been suggested that self-management behaviors are affected by numerous variables, such as financial resources, emotional support, complexity of regimen, disruption of lifestyle, education in self-management skills, cues to action, perceived barriers, locus of control and motivation. Motivation is determined by, for example, values, life experiences, psychological features and knowledge. Perceived benefits, ability, severity of disease, susceptibility to complications and barriers

modify the motivation of patients. (Wooldridge *et al.* 1992). Lack of knowledge may affect adherence (Coates & Boore 1998), and the amount of knowledge appears to relate to self-care only among patients with sufficient motivation (Pennings-van der Eerden 1990). Concerning adherence to the prescribed diet, knowledge is needed, but social demands and personal preferences have been found to be play a major role, and simplification of the diet regimens has been recommended (Lo 1998). The most frequent barriers to dietary adherence are encountered at home, then come barriers at shopping for food and away from home (Glasgow *et al.* 1997). Poor self-care may be a completely rational decision based on the patient´s belief that good self-care is not necessary for good health (Roberson 1992), or the regimens can be regarded as non-reliable (Thorne 1990). There are many reasons for poor diabetes self-care: stress, a lack of time, being away from home, a lack of a convenient place to exercise, a lack of family support (Glasgow & Eakin 1998), smoking and living alone (Toljamo 1999). Fear of hypoglycemia has been reported as a major reason for poor metabolic control, because the patient prefers to have a slightly too high than low blood glucose (Mollema *et al.* 1998). It can be concluded that diabetes adherence should be viewed from the physical, psychological, social and environmental perspectives. Subjective motivation can be considered important for good diabetes self-care. While psychological features can affect motivation, it is suggested that health behavior models could be useful for analysing health behavior.

The circumstances for maintaining good diabetes self-care are good in Finland, where diabetic patients´ health care is well organized. There are specific diabetes teams and diabetes nurses, and the care of diabetes is the responsibility of special clinics, especially at the onset of the disease (Suomen Diabetesliitto 1995). National instructions have been published concerning the goals and methods of the care of IDDM patients in Finland (Suomen Diabetesliitto 1995). Still, it can be proposed that the patient education would be even more efficient and satisfactory for both diabetic patients and health care professionals if the psychological features characterizing health behavior could be better considered.

3.3.2. Diabetes health behavior and diabetes status

Fairly complex daily self-care is needed to keep the level of blood glucose close to normoglycemia. The insulin regimens should be physiologically based, with multiple daily insulin injections. The individual glycemic responses to food intake and exercise affect insulin dosage. Blood glucose measurements should be made at least three to four times per day by the patient, to determine the adjustments needed in insulin dosage. Differences in insulin absorption, insulin sensitivity, exercise, stress, food absorption, hormonal changes caused by puberty, menstrual cycle and pregnancy as well as illnesses and travelling cause variability in blood glucose levels. (American Diabetes Association 1998a,b). The goals of diabetes nutrition recommendations include the maintenance of near-normal blood glucose levels, achievement of optimal serum lipid levels, provision of an appropriate calorie intake and improvement of overall health (American Diabetes Association 1998c). Diabetic patients should have foot care assessments made regularly. Further, diabetic patients should not smoke (Ilanne-Parikka & Himanen 1999, Rönnemaa

1999), because smoking is a major cardiovascular risk factor (Mühlhauser 1990, Rana & Botha 1990) and may also impair nephropathy (Suomen Diabetesliitto 1995). Regular exercise is a crucial part of diabetes self-care, because exercise may prevent macrovascular diseases by improving cardiovascular fitness and the lipoprotein profile and by reducing blood pressure (American Diabetes Association 1997). To prevent diabetic complications, it is important to keep blood pressure and blood lipids at a normal level (Rönnemaa 1999). Apart from all these self-care practices, systematic monitoring by diabetes health care professionals is crucial for the maintenance of good metabolic control and avoidance of complications.

The Diabetes Control and Complications Trial Research Group (1993) has highlighted the finding that optimal blood glucose control helps to delay and prevent the complications of diabetes. Poor self-care causing poor long-term metabolic control may lead to the development of diabetic complications, which include retinopathy, nephropathy and neuropathy, as microvascular, and atherosclerotic changes as macrovascular complications. Good self-care practices (Hentinen & Kyngäs 1992, Toljamo 1999) and good adherence to the recommendations (Kravitz *et al.* 1993, Daviss *et al.* 1995) have been found to associate with good $HbA1_c$ levels (= glycosylated haemoglobin). The adherence to the dietary and exercise regimens (Burroughs *et al.* 1993), the extent to which the diet is followed, the reported attention to insulin dosage, the number of daily glucose tests (Schafer *et al.* 1983), and practical self-management skills, i.e. self-adjustment of insulin (Day *et al.* 1996), appear to be predictors of metabolic control. Those infrequently attending the monitorings have poorer metabolic control than regular attenders (Jacobson *et al.* 1991). But according to other studies, good self-care does not always guarantee a good metabolic balance (Glasgow 1987, Glasgow 1991, Johnson *et al.* 1992). In addition to regimen adherence, stress, individual metabolic factors and the appropriateness of the regimens should also be considered (Glasgow *et al.* 1987). All in all, the patient´s self-care practices are indeed a very crucial part of maintaining a good diabetes status. They are especially significant because there are good possibilities to enhance them.

3.4. Psychological models used in health studies

There are various psychological features that affect health behavior. It should be realized that psychological and physical well-being are interdependent. It would be important to identify the significant psychological features because it is possible to influence them. This, in turn, would enhance health behavior and health status. In the case of diabetes, for example, psychological features may influence metabolic control either directly via neurohormonal mechanisms or indirectly through motivation and the ability to adhere to self-care practices (Helz & Templeton 1990).

Various theoretical psychological models have been developed, which can be used to analyse health behavior in more detail. The models chosen to be used in this study analyse health behavior from different perspectives. All of them have been previously used to analyse health behavior and health status from the viewpoint of both diabetes and oral health. The chosen models are generally accepted and well-known theoretical

frameworks and widely used in behavioral medical research, and they have thus already been validated previously. The models have been developed for decades, and some of them have mutually similar aspects. Human behavior is very complex, and it might therefore be better understood by combining different explanatory models (Salazar 1991). The psychological models chosen here should be considered as complementary to each other rather than as distinct ones. In the following chapters, the theoretical basis of each of the selected psychological models will be described together with its previous applications concerning diabetes and oral health.

Apart from the chosen psychological models, there are also many other models that have been used in health behavior studies, such as the theory of reasoned action (Ajzen and Fishbein 1980), the theory of planned behavior (Ajzen 1985), the health belief model (Hochbaum 1958, Kegeles 1963, Rosenstock 1966) and the self-regulation model (Leventhal *et al.* 1980). These models are not used in the present study.

3.4.1. Self-efficacy

The theory of self-efficacy was developed within the framework of a social learning theory, in which health is considered to be determined by behavioral, cognitive, physiological and environmental factors (Bandura 1977a). The perception of self-efficacy is crucial for human behavior, for determining the beginning and maintenance of behavior and for its persistence. People avoid activities that they perceive as more than they can cope with, but engage in activities that they believe they can manage. The magnitude, strength and generality of self-efficacy perceptions may vary. In other words, tasks are ordered by difficulty level (magnitude), certainty of the ability to cope may differ (strength), and expectations may be specific to particular activities or generalized to other situations (generality). The performance of activities necessitates not only a high self-efficacy perception, but also appropriate incentives and skills. (Bandura 1977b). Self-efficacy determines the amount of expended effort and persistence when there are obstacles or aversive experiences (Bandura 1982).

Perceptions of self-efficacy develop on the basis of enactive attainments, vicarious experience, verbal persuasion, and physiological states related to emotional arousal. Enactive attainments, which are based on one´s own experiences, are the most important determinant (Bandura 1982). Vicarious experience implies observing others and comparing oneself with other people, while verbal persuasion consist of convincing an individual by assuring him/her that he/she is able to do the behavior in question. Stressful and taxing situations cause emotional arousal, which affects the physiological state. Individuals feel somatic symptoms, which may alter the level of self-efficacy. Finally, information from all these sources is cognitively processed by the individual, and a judgement of the self-efficacy concerning a specific behavior is formed. The perception of self-efficacy develops in the course of life: family and peers are the first important agents for developing self-efficacy, cognitive efficacy is cultivated at school, and the transition from childhood to adulthood is regarded to imply a growth of self-efficacy. Adulthood involves many demands on firm sense of self-efficacy, such as partnerships, relationships, parenthood and career. By middle age, self-perceptions have become

stabilized, but self-efficacy still has to be reappraised in new situations. Especially with advancing age, when the physical capacities, sensory functions and intellectual facility diminish, self-efficacy needs to be reappraised. (Bandura 1981).

According to dental studies, self-efficacy have been found to relate to tooth brushing and flossing (McCaul *et al.* 1985, Tedesco *et al.* 1991). Self-efficacy concerning tooth brushing and flossing have been found to associate with the frequencies of tooth brushing, flossing and dental visiting (Stewart *et al.* 1997), but self-efficacy has not been found to associate with the oral hygiene status (Wolfe *et al.* 1991). Dental health education has been shown to improve dental self-efficacy (Stewart *et al.* 1996, Wolfe *et al.* 1996).

With regard to diabetes, high insulin management self-efficacy has been found to relate to good diabetes self-care practices in insulin usage (Hurley & Shea 1992). There has been an association between high diabetes self-efficacy concerning the major diabetes self-care practices and a good level of adherence to those practices (Littlefield *et al.* 1992). It has similarly been found that self-efficacy is associated with diabetes adherence (Kavanagh *et al.* 1993, Lo 1998) and is able to predict glycosylated haemoglobin levels (Kavanagh *et al.* 1993, Day *et al.* 1996). High diabetes self-efficacy has been related to better perceived health, mental health and social functioning (Aalto *et al.* 1997). The perception of self-efficacy in diabetic patients can be improved by patient empowerment, which, in turn, has a positive effect on the metabolic control of diabetes (Anderson *et al.* 1995). Finally, the perception of self-efficacy is recommended to be used as a framework in diabetes education and intervention programs (Glasgow & Osteen 1992, Johnson 1996, Shortridge-Baggett & van der Bijl 1996, Aalto *et al.* 1997).

3.4.2. Locus of control

The theory of locus of control proposes that a person has an internal locus of control if he/she interprets events as being dependent on his/her own behavior or stable characteristics, and external control when he/she thinks that events are in some way contingent upon luck, fate, chance or the influence of other powerful persons (Rotter 1966). Applying this theory to health settings, those who feel that they have control over their own health and place a high value on health are more likely to pursue health-promoting behaviors than those who feel that their health is contingent upon external factors. It has been proposed that locus of control beliefs may be generalized from specific situations to similar or related ones (Rotter 1966). Thus, it is important to evaluate the relationship between dental and diabetes-related locus of control beliefs.

Relations between locus of control and oral health status have been found. There are relations between good oral health and an internal locus of control (Kent *et al.* 1984), between a higher plaque index and external control (Wolfe *et al.* 1991), and between greater pocket depth and a chance locus of control (Borkowska *et al.* 1998). Locus of control appears to associate with tooth brushing behavior, but these results are not valid in all groups (Regis *et al.* 1994, Macgregor *et al.* 1997). There has been a shift from external to internal locus of control beliefs as a consequence of oral hygiene intervention (Wolfe *et*

al. 1996), whereas Scruggs *et al.* (1989) has not found any such change. Nor have any correlations between locus of control beliefs and compliance with dental appointments been shown (West *et al.* 1993).

The results from diabetes locus of control research are quite contradictory. An association between internal locus of control beliefs and better adherence has been found (Pennings-Van der Eerden 1990, Lo 1998), but internal locus of control has been found to relate to less frequent self-monitoring of blood glucose and more frequent binge eating (Peyrot & Rubin 1994). Further, there have been relations between better diabetes compliance and both internal and powerful others health locus of control (Schlenk & Hart 1984). External locus of control has been shown to associate with more hospitalizations among diabetic boys (Lernmark *et al.* 1996). With regard to metabolic control, internal locus of control has been found to associate with better metabolic control, but no such association has been found among individuals with extreme internality (Reynaert *et al.* 1995). Contrariwise, external locus of control has been shown to associate with better metabolic control of diabetes (Edelstein & Linn 1987). There is a sex difference in locus of control among children with poor metabolic control, with boys having an internal and girls an external locus of control (Hamburg & Inoff 1982). The relation between locus of control and metabolic control has been found to be very weak (Meize-Grochowski 1990) or completely absent (O´Connor *et al.* 1992, Aalto *et al.* 1997). The combination of internal and powerful others locus of control is considered useful: while the patient feels personal responsibility for self-care, there is also a good patient-provider relationship (Schlenk & Hart 1984). Diabetes appears to be best controlled in the patients who believe in both internal factors and in health care professionals´ work, while poorest control is seen among those believing in chance (Toljamo 1999). It has been noticed that men have more internal beliefs than women, women and older patients have more chance beliefs than men and younger patients, and patients with a long duration of diabetes believe less in powerful others than those with short duration of disease (Toljamo & Hentinen 1995).

Reasons for the confusing results have been sought in misuse of the locus of control theory. Condition-specific measures rather than generalized ones should be used (Allison 1991). Further, it is drawn attention to the fact that the value dimension must be taken into consideration when predicting health behavior with locus of control beliefs. It has been proposed that locus of control is only part of a larger construct called perceived control, which also includes the person´s capability of implementing health-promoting behavior. (Wallston 1992). These might be the reasons why locus of control beliefs have not been found to predict well health behavior.

3.4.3. Self-esteem

Self-esteem is defined as a personal, subjective judgement of worthiness, which is expressed in one´s attitudes towards oneself and is conveyed to others. The level of self-esteem is related to the subject´s style of adapting to environmental demands. Coopersmith (1967). An individual with high self-esteem respects himself, considers himself to be at least equal to others, recognizes his own limitations and expects to grow and improve (Rosenberg 1965), whereas an individual with low self-esteem feels helpless

and inadequate (Coopersmith 1967). General self-esteem is considered a relatively stable feature, and self-appraisals are thought to be relatively constant, because people need psychological consistency (Lecky 1945). Self-esteem evidently changes over age (Macgregor *et al.* 1997), while it is lowest around the age of 12-13, and after the age of 14 it continues to improve until early adulthood (Rosenberg 1986). Adolescent males have been shown to have better self-esteem than females of the same age, particularly concerning the quality of physical attractiveness (Rosenberg 1986), and persons in the upper and middle social classes have been found to have higher self-esteem than those in the lower social groups (Macgregor & Balding 1991). There is situational variance in self-evaluations, and self-esteem might be different in different areas (Coopersmith 1967). On the whole, the theory of self-esteem is well-known, and it has been used to analyse many different health behaviors.

In the dental sphere, it is notable that the subjects in dental studies are children or adolescents. It is shown that higher self-esteem associates with frequent tooth brushing, and especially with tooth brushing to make the teeth feel clean (Macgregor & Balding 1991, Regis *et al.* 1994). There is a correlation between recalled advice about tooth brushing and lower self-esteem (Macgregor *et al.* 1997). The results concerning dental visiting are contradictory: low self-esteem has found to associate with both visiting a dentist recently and more than a year ago (Regis *et al.* 1994), and high self-esteem has correlated with more recent dental visits (Macgregor *et al.* 1997). Self-esteem was not reported to associate with compliance with dental appointments by West *et al.* (1993).

Diabetes research has revealed an association between high self-esteem and good diabetes adherence (Jacobson *et al.* 1987, Littlefield *et al.* 1992, Lo 1998), but Kovacs *et al.* (1992) failed to demonstrate any such association, nor has self-esteem been found to be a good predictor of metabolic control (Grossman *et al.* 1987, Daviss *et al.* 1995). No associations have been found between self-esteem and ketoacidosis or severe hypoglycemia in youth (Herskowitz Dumont *et al.* 1995). However, supporting a diabetic patient´s self-esteem may be essential for encouraging psychological well-being, which, in turn, influences metabolic control (Bradley & Gamsu 1994). Low self-esteem has been found to contribute to depression in adults with diabetes (Bailey 1996).

3.4.4. Weiner´s attribution theory of motivation and emotion

According to Weiner´s motivation attribution theory, most people assign causes to their success or failure. Having an explanation for an event gives people a feeling that they are able to control their own lives. A motivational sequence is initiated when a person interprets an outcome as successful or unsuccessful, which leads to feelings of happiness (success) or sadness (failure). If the outcome is unexpected, negative or important, the individual makes one or various causal attributions, to determine the reason why a certain outcome occurred. There are many causal antecedents, including information, rules and biases, to influence the way in which explanations are found. Examples of the causes of outcomes are ability, effort, luck, task, physical characteristics and personality. These attributions can classified on three causal dimensions: internality-externality, stability-

instability and controllability-uncontrollability. These causal dimensions are linked to affective reactions and social emotions. Finally, both affective state and expectancy of future success or failure affect behavior. (Weiner 1985).

Causal thinking is especially likely in situations which are important for the individual and involve the possibility of loss, such as many illnesses, particularly chronic ones (Wong & Weiner 1981). Thus, the attribution approach is suitable for analysing diabetic patients, since various complications of diabetes are health- and even life-threatening. Both periodontal diseases and dental caries, when advanced, lead to a loss of teeth and thus a loss of normal occlusion and ultimately to changes in personal appearance.

In several studies the attribution approach has used to analyse people´s explanations of different illness and health situations. Syrjälä (1994) has analysed dental attributions quantitatively. Success is usually attributed to internal factors and failure to external factors, as shown in the study of Lowery & Jacobsen (1985) on chronic illness outcomes. Furthermore, Brubaker (1988) reports support for the theory by analysing weight outcomes: stability is higher concerning success and lower concerning failure. The attribution approach has further been used as a therapy model to influence various steps in the motivational sequence (Weiner 1988). For example, Hudley & Friday (1996) have used the reduction of attribution bias to alleviate aggression in young people.

4. Aims of the study

4.1. Hypothesis of the study

It is postulated that similar psychological features characterize oral health behavior and diabetes self-care, both of which require daily, systematic self-care. These similarities might give new insight into the relationship between oral health and diabetes status.

4.2. Aims of the study

The purpose was to evaluate the psychological features affecting oral hygiene practices, dental visiting and diabetes self-care among IDDM patients, and to find out if there is some similarity between these psychological features.

- The purpose was to analyse the relationship between dental and diabetes self-efficacy and to explore the usefulness of self-efficacy in determining health behavior and health status. The overlapping relations of dental and diabetes self-efficacy to other aspects of health behavior and health status were analysed.
- The aim was to analyse the relationship between dental and diabetes locus of control beliefs and the usefulness of locus of control beliefs in determining health behavior and health status also by using the value dimension. The overlapping relations of dental and diabetes locus of control to other aspects of health behavior and health status were analysed.
- The purpose was to explore the usefulness of self-esteem in determining oral hygiene practices, dental visiting and diabetes adherence.
- By using Weiner´s motivation attribution theory, the aim was to describe the causes for success and failure in gingivitis, dental caries and diabetes metabolic control, and to analyse the possible similarities between the attributions for dental and diabetes health outcomes.

5. Material and methods

5.1. Study population

The study was a cross-sectional survey of 149 IDDM patients visiting the diabetic clinic of the Oulu Primary Health Care Centre, corresponding clinics of neighbouring communities or the diabetic clinic of the Department of Internal Medicine at the University Hospital in Oulu. The recruiting method was to ask consecutive eligible patients visiting these clinics on the sampling days between August 1995 and December 1996. Written informed consent was obtained from the participants. The protocol had been accepted by the ethical committees of the Medical Faculty at Oulu University and the Oulu Primary Health Care Centre.

The criteria for inclusion in the study were that the subjects were willing to participate, had had IDDM for at least six months and had at least one own tooth. The diagnosis of IDDM was defined as the patient being completely dependent on exogenous insulin. The patients whose diabetes had manifested during pregnancy or a period of alcoholism and the patients who had pancreatitis as well as pregnant women and those incapable of completing the questionnaire were excluded. When the patients were asked to take part, 80% were willing to do so. For a third of the refusers, the long distance to the clinic was the reason for refusing. There was no selection on the basis of diabetes status, because the purpose was to recruit a heterogeneous study population with sufficient variation.

The study population consisted of 62 women and 87 men. The age range was 16 to 72 yr, median 32 yr and mean 34 yr (SD 12). The basic education was categorized as high basic education (n = 49), which means completion of high school studies, and low basic education (n = 100), which comprises primary, secondary or comprehensive school. Professional education was categorized as higher professional education (n = 59), which means a university or college degree, and lower professional education, which comprises other forms of professional education and no professional education (n = 87). The number of subjects with different levels of basic and professional education classified according to sex and age are shown in Table 1.

Table 1. Number of subjects with low levels of basic and professional education classified according to sex and age.

Sex	Age group (n)	Low basic education (n)	Low professional education (n)
Women	16–26 (22)	11	18
	27–39 (25)	12	9
	40–72 (15)	13	7
Men	16–26 (26)	18	22
	27–39 (28)	21	16
	40–72 (33)	25	18

5.2. Questionnaire

The data were collected by means of a self-completed quantitative questionnaire, which was given to the patients when they were asked to take part and returned by them when they came to the clinical oral examination. The dental items were pre-evaluated by 31 non-diabetic subjects, and the whole questionnaire, including both dental and diabetes items, by 21 IDDM patients. These subjects were outside the present study. The analysis was made by means of frequencies, Cronbach´s alpha reliability coefficients and written comments from subjects. The questionnaire was condensed, the reply alternatives were simplified, and on the basis of the open-ended questions, more alternatives were added to Weiner´s motivation attribution scales.

5.2.1. Health behavior

The dental items included the frequencies of tooth brushing, dental visiting and interdental cleaning. These items and the reply alternatives are shown in Appendix 1. These variables were classified as follows: tooth brushing at least twice a day (n = 76) vs. less often (n = 70), dental visiting at least once year (n = 77) vs. less often (n = 65), and interdental cleaning at least once a day (n = 22) vs. less often (n = 125).

The diabetes adherence scale (Appendix 2) covered 6 self-care practices: adjustment of insulin injections to meal times and insulin dosage to exercise, adherence to the dietary and exercise instructions, regular meal times and measurement of blood glucose levels. These self-care practises were obtained and modified from the study of Kuusinen (1994). The Cronbach alpha reliability coefficient (α) for the scale was 0.76. The range of sum scores for the diabetes adherence scale was 11–29, the median being 22. The diabetes adherence sum scores of 6–23 (n = 96) were categorized as low, and those of 24–30 (n = 51) as high. Thus, the patients receiving high scores for diabetes adherence did every self-care practice at least quite well or completely well.

5.2.2. Dental and diabetes self-efficacy scales

The patients´ beliefs about their confidence in complying with the self-care regimens in various situations were analysed by self-efficacy items. The dental self-efficacy items has been designed by A-M Syrjälä, who had modified the items on the self-efficacy scale developed by Lawrance (1986). As shown in Appendix 3, there were separate scales concerning tooth brushing (6 items), dental visiting (7 items) and interdental cleaning (6 items) (Paper I). To obtain a single good and practicable general dental self-efficacy scale, the tooth brushing and dental visiting scales were combined (Paper II). The Cronbach α for the tooth brushing self-efficacy scale was 0.92, and that for both the dental visiting and the interdental cleaning self-efficacy scales 0.95. For the combined dental self-efficacy scale, the Cronbach α was 0.93, while the range of sum scores was 13–52 and the median 40. The dental self-efficacy sum scores of 13–40 (n = 70) were categorized as low, and those of 41–52 (n = 70) as high. The median was taken as the cut-off point, because the items were used for the first time, the sum scores were found to be high, making the distribution skewed, and there was no better cut-off point.

The diabetes self-efficacy items were selected from among those developed by Kuusinen (1994), whose scales were derived from a study by Varonko (1987). The diabetes self-efficacy scale (Appendix 4) included 6 diabetes self-care items, about which enquiry was made in relation to 4 situations (quarrelling, holiday, loneliness and hurry). The final diabetes self-efficacy scale hence included 24 items, and the Cronbach α for that scale was 0.95. The range of sum scores was 38–120 and the median was 82.

The diabetes self-efficacy sum scores of 24–94 (n = 108) were categorized as low, and those of 95–120 (n = 30) as high. Thus, a patients with high scores in diabetes self-efficacy would answer that he/she could do at least 5 of the 6 self-care practices quite well or completely well.

5.2.3. Dental and diabetes locus of control scales and value dimension

The locus of control scales are shown in Appendix 5. The dental locus of control scale, which included 8 items, was modified from the Dental Coping Belief Scale used by Wolfe *et al.* (1991). The diabetes locus of control scale, which included 8 items, was condensed from that used by Kuusinen (1994), who obtained the original scale from the study of Ferraro *et al.* (1987). Higher scores on both scales were regarded as indicating more internal locus of control beliefs. Altogether 147 subjects gave answers to the whole dental locus of control scale and 139 to the whole diabetes locus of control scale. Cronbach´s α for the dental locus of control scale was 0.60, and that for the diabetes locus of control scale was 0.70.

To analyse the value placed by the subjects on good oral health, there were three questions on the importance of regular dental visiting, avoiding dental caries and avoiding gingivitis (Appendix 5). A sum score was calculated for these oral health questions, and the subjects were classified into ones with high or low dental valuation in relation to the median (range 6 – 12, median 10). To analyse the value placed by the subjects on good diabetes metabolic control, there was a question concerning the subject´s evaluation of

the importance of maintaining good metabolic control (Appendix 5). The subjects feeling it to be very important (n = 70) were classified as having a high diabetes valuation, and those feeling it to be important, less important or completely unimportant (n = 57) as having a low diabetes valuation.

5.2.4. Self-esteem scale

The self-esteem scale (Appendix 6) was based on that of Rosenberg (1965), from which two items were excluded on the basis of the pilot study. Cronbach´s alpha reliability coefficient (α) for eight selected items was 0.85. The median was taken as a classification criterion for the self-esteem scale, the sum scores for low self-esteem being 8–27 and those for high self-esteem 28–32. The median was taken as the cut-off point, because the scale in this form was used for the first time, the sum scores were found to be high, making the distribution skewed, and there was no better cut-off point. There were 141 subjects who filled in the whole self-esteem questionnaire.

5.2.5. Dental and diabetes attribution items

The dental and diabetes attribution items (Appendices 7 and 8) were modified both from items used by Lowery & Jacobsen (1985) and on the basis of the open-ended questions included in the pilot study. The attributions were measured with a structured format, and the subjects were allowed to give as many causes as they wanted. The patients had a chance to give their own cause in the open-ended items, but these answers were not analysed in the study because they were too few in number. To assess the dimension of attributions, other studies with the attribution approach were utilized (Lowery & Jacobsen 1985, Weiner 1985, 1988, Brubaker 1988).

The patients´ assessments about their gingivitis and caries outcomes, i.e. if they had had success or failure in avoiding these conditions, were based on the information received by the patient from his/her dentist at the most recent dental visit. Similarly, the patients´ assessment about their diabetes metabolic control was asked. Those assessing their diabetes to be in a very good or moderate good metabolic balance were classified as having been successful, while those assessing it to be in moderate poor or very poor were classified as having failed.

5.3. Health variables

A periodontologist, A-M Syrjälä, made the clinical oral examinations, which included visible plaque as an index of oral hygiene using the criteria of Ainamo and Bay (1975), gingival bleeding after gentle probing as an index of gingival inflammation and decayed surfaces and softened root surfaces as variables of dental caries. Dental caries was determined as a detectably softened floor, undermined enamel or softened wall (WHO

1987). Caries was clinically diagnosed on all tooth surfaces by visual examination and probing without taking X-rays. Decayed surfaces were recorded as the sum of all surfaces of all teeth, and root caries was recorded as the sum of decayed root surfaces of all teeth. The percentages of surfaces with plaque and bleeding after probing were calculated from the mesial, distal, buccal and oral surfaces of all teeth. For statistical analyses, the visible plaque index was dichotomized on the basis of the median value.

The distributions of patients according to the mean glycosylated haemoglobin ($HbA1_c$) level for the previous year were as follows: ≤ 7.5% (n = 36), 7.6–8.5% (n = 30), 8.6–10.0% (n = 36), > 10.0% (n = 22). This classification was done according to the national instructions for the care of IDDM (Suomen Diabetesliitto 1995). In this study, $HbA1_c$ level was dichotomized (≤8.5% and >8.5%) for a statistical analysis. The mean number of $HbA1_c$ assays during the previous year was 3.5 (SD ± 1.3). Descriptive statistics of diabetes and dental status are shown in Table 2.

Table 2. Descriptive statistics of the diabetes and oral health status of the study population.

Variable	Minimun	Median	Maximum	Mean	SD
Duration of IDDM (years)	0.5	15	49	16	10
Mean $HbA1_c$ level (%) for previous year	4.7	8.3	13.8	8.5	1.8
Number of teeth	2	28	32	25	7
Gingival bleeding index (%)	5	23	56	24	11
Visible plaque index (%)	0	53	98	50	23
Number of decayed coronal surfaces	0	1	51	2.9	6.7
Number of decayed root surfaces	0	0	14	0.9	2.1

5.4. Statistical analyses

The validity of the scales when continuous sum scores are used has not been established yet. Instead, the sum scores were used as variables on an ordinal scale, and non-parametric methods were therefore mainly used. Analyses were done on only those subjects who replied to all questions on the scale concerned. As a rule, the level of significance was set at $p < 0.05$, but results at $p < 0.10$ were reported when the tested hypotheses were important. The statistical analyses were performed using SPSS for Windows, version 6.1.3 or 7.5.

Cronbach´s alpha reliability coefficient (α) (Nunnally 1978) was used to evaluate the reliability of the self-efficacy, locus of control and self-esteem scales. *Factor analysis* (Nunnally 1978) was used to evaluate the structural validity of the dental self-efficacy scales. Factor analysis was made with the Maximum Likelihood estimation and oblique rotation.

Mann-Whitney U-test (M-W U-test) was used to analyse the relations of on the scales between dichotomized groups, such as sex, basic and professional education, reported oral health behavior, $HbA1_c$ levels and value dimensions. The associations between the

health variables and the subjects´ own assessments of success or failure concerning gingivitis, caries and metabolic control as well as the relations of age and duration of diabetes to the subjects´ own assessments were analysed by Mann-Whitney U-test.

Spearman´s rank correlation coefficient (r_s) was used to analyse the associations between sum scores on the scales and continuous variables, such as age, duration of diabetes, $HbA1_c$ level and oral health variables. It was also used to analyse the rank correlations between the sum scores on different scales. *Pearson´s correlation coefficient (r)* was used to analyse the correlations between the attributions for dental health and metabolic control whenever the assumption of normality was met. Spearman´s rank correlation coefficient (r_s) and Pearson´s correlation coefficient (r) were tested against the null hypothesis that the correlation coefficient is zero.

Pearson´s χ^2-test was used in bivariate analyses to determine the significances of the interdependencies between these variables, such as diabetes adherence, $HbA1_c$ level, oral health behavior and the subjects´ own assessments of success or failure in relation to the background variables. It was used to test the dependence of diabetes adherence and the level of self-esteem.

Stratified analysis was used when evaluating the effect of background variables on the correlations between the dental and diabetes self-efficacy scales and between the locus of control scales, and when the significance of the value level on the associations between locus of control and health behavior and health variables were analysed.

Logistic regression analysis (Hosmer & Lemeshow 1989) by the enter method was used to test the significances of the discovered relations when taking into account the effect of possible confounding variables. The goodness of fit-test was considered when the analysis was done. The aim of using the logistic regression model was to find concise models with relatively few parameters. Because the variables are psychological in nature and the cut-off points have not yet been established, the odds ratios provide supplementary information.

6. Results

6.1. Self-efficacy (I, II)

6.1.1. Usefulness of determining corresponding health behavior and health variables

Subjects with higher sum scores on the tooth brushing, interdental cleaning and dental visiting self-efficacy scales had a better level of corresponding health behavior ($p < 0.001$). The logistic regression analysis revealed these relations when the effects of sex, age and basic and profesional education were controlled. (I). Further, the sum scores on the combined dental self-efficacy scale related to tooth brushing and dental visiting (II).

Negative correlations emerged between the visible plaque index and the sum scores on tooth brushing self-efficacy ($r_s = –0.21$, $p = 0.012$) and dental visiting self-efficacy ($r_s = –0.24$, $p = 0.004$). These were confirmed by a logistic regression analysis when the effect of sex, age and education were controlled (I). The sum scores on the combined dental self-efficacy scale correlated negatively with the sum of decayed surfaces ($r_s = –0.30$, $p < 0.001$) (II).

The diabetes self-efficacy sum scores correlated with those of the diabetes adherence scale ($r_s = 0.76$, $p < 0.001$). In addition, the patients with low $HbA1_c$ levels had higher sum scores on the diabetes self-efficacy scale than the patients with high $HbA1_c$ levels, which was a nearly statistically significant result ($p = 0.064$). (II).

6.1.2. Overlapping relations: dental and diabetes self-efficacy, health behavior, $HbA1_c$ and visible plaque

The sum scores on the diabetes self-efficacy scale correlated with those on the dental self-efficacy scale ($r_s = 0.41$, $p < 0.001$). The correlations were significant in all groups when the scales were stratified by sex, age, and basic and professional education. (II).

Those having a $HbA1_c$ level ≤ 8.5% had higher tooth brushing self-efficacy sum scores ($p = 0.020$), a higher frequency of tooth brushing ($p = 0.032$) and a lower visible plaque index ($p < 0.001$) than those having a $HbA1_c$ level > 8.5%. The logistic regression models confirmed the significance of these relations when the effects of sex, age and education were controlled. (I). The sum scores on the combined dental self-efficacy scale correlated with the $HbA1_c$ levels ($r_s = –0.32$, $p < 0.001$). The reduced logistic regression model that standardized the effect of diabetes adherence, sex and duration of diabetes revealed that a high combined dental self-efficacy may indicate, though weakly, a low $HbA1_c$ level (II).

The sum scores on the combined dental self-efficacy scale correlated positively with the sum scores on the diabetes adherence scale ($r_s = 0.35$, $p < 0.001$), and logistic regression analysis supported this association. The model showed that, in addition to associating with high diabetes self-efficacy, high dental self-efficacy associated nearly statistically significantly with a good level of adherence (Table 3). (II).

Table 3. The logistic regression model for good diabetes adherence.

Good diabetes adherence	Odds ratio (95% CI)	*P*
Independent variables		
High diabetes self-efficacy	14.3 (4.8–43.0)	< 0.001
High dental self-efficacy	2.20 (0.91–5.3)	0.079
Women	2.23 (0.98–5.5)	0.080
Duration of diabetes in years	1.02 (0.98–1.06)	0.366

Those reporting a high frequency of dental visiting had higher sum scores on the diabetes self-efficacy scale (M-W U-test, $p = 0.024$). However, the final logistic regression model, which controlled the effects of dental self-efficacy, sex and duration of diabetes, revealed no significant relation between dental visiting and diabetes self-efficacy. (II).

6.2. Locus of control (III)

6.2.1. Usefulness of determining health behavior and health variables

A high frequency of dental visiting was associated with higher, i.e. internal, dental locus of control sum scores ($p = 0.040$). Further, those with higher sum scores on dental locus of control were shown to have lower visible plaque indexes, and fewer decayed and root caries surfaces (Table 4).

The sum scores on the diabetes locus of control correlated only weakly with the reported diabetes adherence ($r_s = 0.17$, $p = 0.052$), and non-significantly with the $HbA1_c$ level.

Table 4. Spearman´s rank correlations (r_s) between the dental locus of control scale and the oral health variables (non-stratified and stratified by reported value).

Oral health variables	Dental locus of control			Dental locus of control – high dental valuation			Dental locus of control – low dental valuation		
	r_s	*p*	n	r_s	*p*	n	r_s	*p*	n
Gingival bleeding index	–0.01	(0.890)	147	–0.11	(0.391)	63	0.04	(0.731)	80
Visible plaque index	–0.18	(0.034)	147	–0.23	(0.066)	63	–0.04	(0.722)	80
Number of decayed surfaces	–0.23	(0.006)	146	–0.28	(0.026)	63	–0.14	(0.230)	79
Number of root caries	–0.22	(0.009)	147	–0.37	(0.003)	63	–0.13	(0.258)	80

6.2.2. Overlapping relations: dental and diabetes locus of control, health behavior and health variables

The sum scores on the dental locus of control scale correlated with those on the diabetes locus of control scale (r_s = 0.42, $p < 0.001$). Positive correlations were found in all groups, even when the analysis was made by stratifying according to sex, age, and basic and professional education.

No associations were found when analysing the overlapping effects of the dental locus of control on diabetes adherence and the $HbA1_c$ level and, correspondingly, the effects of the diabetes locus of control on the oral hygiene practices, dental visiting and oral health variables.

6.2.3. Consideration of the valuation dimension

The subjects who reported a high value for dental health had higher sum scores on the dental locus of control (p = 0.008), while those reporting a high value for good metabolic control had higher diabetes locus of control sum scores (p = 0.023).

When the associations between locus of control and behavior and health status were analysed separately among those with a high or a low value, the correlations between the sum scores on dental locus of control and dental caries and root caries were higher among those putting a high value on dental health (Table 4). In the *low* dental valuation group, those visiting a dentist at least once a year had higher dental locus of control sum scores than those who visited a dentist less often (p = 0.043). When the diabetes locus of control scale was stratified by the valuation of good metabolic control, diabetes locus of control did not show any significant correlations with diabetes adherence or the $HbA1_c$ level in either of the stratified groups.

6.3. Self-esteem (IV)

6.3.1. Usefulness of determining oral health behavior

Tooth brushing frequency was the only oral health variable which had at least some association with self-esteem: 61% of those with a high self-esteem had a high frequency of tooth brushing, but only 46% of those with a low self-esteem had it (p = 0.097). Logistic regression analysis confirmed this result by showing the significance of self-esteem in determining the frequency of tooth brushing (Table 5).

Table 5. Logistic regression model for a high frequency of tooth brushing.

High frequency of tooth brushing	Odds ratio (95% CI)	*p*
Independent variables		
High self-esteem	2.33 (1.05-5.2)	0.038
Women	2.62 (1.16-5.9)	0.020
Age	1.02 (0.99-1.05)	0.303
$HbA1_c$ level ≤ 8.5	1.99 (0.92-4.3)	0.080

6.3.2. Usefulness of determining diabetes adherence

High sum scores on the self-esteem scale were related to a good ability to adjust one´s insulin dosage (p = 0.040) and good exercise adherence (p < 0.001), but not to dietary or blood sugar measurement adherence. The emerging associations were tested with logistic regression analysis, which showed that a high level of self-esteem determined good adherence to the adjustment of insulin dosage and exercise (Table 6).

Table 6. Logistic regression models for good adherence to adjustment of insulin dosage and to exercise.

Dependent variable	Odds ratio (95% CI)	*p*
Independent variables		
Good adherence to insulin dosage adjustment		
High self-esteem	2.42 (1.14–5.1)	0.021
Women	2.27 (1.07–4.8)	0.032
Duration of diabetes in years	1.03 (1.00–1.07)	0.076
Good adherence to exercise		
High self-esteem	2.61 (1.29–5.3)	0.008
Women	0.91 (0.45–1.85)	0.803
Duration of diabetes in years	0.97 (0.94–1.01)	0.101

6.4. Weiner´s attribution theory of motivation and emotion (V)

6.4.1. Subject´s assessments of success and failure in relation to corresponding clinical status

The subjects who reported failure with gingivitis had a higher visible plaque index than those reporting success ($p = 0.001$). Further, reported failure with caries was related to more dental caries ($p < 0.001$). Likewise, those reporting failure with diabetes metabolic balance had higher $HbA1_c$ values than those reporting success ($p < 0.001$). These results gave evidence of the validity of subjective assessments of success and failure.

6.4.2. The three most frequent causes of success and failure

Altogether 89% of the subjects gave one or more attributions to a gingivitis outcome, 95% to a caries outcome and 99% to a metabolic balance outcome.

The subject´s own effort and interest were the most frequently given causes of success with avoiding gingivitis. For failure in avoiding gingivitis, lack of effort and mood were the most frequent causes. As far as the three most common causes of success in avoiding caries were concerned, they were all attributed to effort. For failure, the most common cause was task difficulty. Next came laziness, which can be attributed to a lack of effort or mood, and the third most frequent reason also concerned a lack of effort. Regarding success with the diabetes metabolic balance, the subject´s own ability to control diabetes was the most common cause. Then came luck and motivation. In terms of failure with metabolic balance, lack of effort was the most frequent cause, being followed by physiological factors and lack of motivation.

In addition to the causes given for success or failure, it was important to notice the causal dimensions behind them. The presence or absence of effort and interest, were attributed as internal, unstable and controllable. Mood was internal, unstable and uncontrollable. The subject´s own ability could be attributed as internal, stable and controllable, while motivation, or a lack of it, was internal, unstable and controllable. Laziness could be attributed either as a lack of effort or mood. Task difficulty was attributed as external, unstable and uncontrollable by the patient at that moment. Luck as well as physiological factor were external, unstable and uncontrollable.

6.4.3. Commonality between subjective dental and diabetes assessments

There was evidence of similarity between the assessments: of those reporting success in avoiding gingivitis (n = 76), 82% had experienced success with metabolic status, while of those reporting gingivitis (n = 55), 67% reported success with metabolic balance. As a more concrete result, the patients reporting success with gingivitis had lower $HbA1_c$ levels (mean for the previous year) than the patients assessing themselves as having failed

with gingivitis (M-W U-test, $p = 0.024$). In other words, the $HbA1_c$ level for the patients reporting success with gingivitis was 8.1% (SD 1.5), while that for the subjects reporting failure was 9.0% (SD 1.9).

Some similarities were found between the three most frequent causes of dental health and diabetes metabolic balance outcomes. The following correlations concerning the assessments of failure were found: not bothering to do interdental cleaning with non-adherence to diabetes treatment instructions ($r = 0.51$, $p = 0.037$), laziness as the cause of having caries with non-adherence to diabetes treatment instructions ($r = 0.51$, $p = 0.037$) and with poor motivation for diabetes care ($r = 0.42$, $p = 0.096$). But as far as the similarity of causes of success was concerned, no statistically significant correlations were found.

7. Discussion

7.1. Discussion of population and methods

7.1.1. Study population

The main purpose of the study was to analyse the psychological features determining oral health behavior and diabetes self-care. The number of participants was 149, which was considered sufficient to show variation in the study variables and to allow analyses of the associations between variables. The purpose was to collect versatile data by means of a quantitative questionnaire, clinical oral examinations and patient records. The wide scope of the study limited the feasible number of subjects. Volunteer bias can be considered quite small, because as many as eighty per cent of those invited to take part were willing to do so. The weakness of the study population was that the sample was voluntary rather than randomly chosen. Systematic bias was caused by the fact that the patients who completely failed to attend checkups at the diabetes clinics could not even be asked to participate. It is assumed that adherence to self-care regimens is poor among the patients who do not even visit the diabetes clinic. Further, they do not get information from clinical assays, nor new regimens for better self-care.

The purpose was to collect a study population whose diabetes self-care regimens and requirements would have been somehow nearly similar. This was necessary, to allow diabetes adherence to be analysed by the same items. Thus, the study population consisted exclusively of IDDM patients completely dependent on exogenous insulin. Regarding the other diabetes variables, such as metabolic control and complications, there were no exclusion criteria. The distributions of the duration of diabetes and the mean $HbA1_c$ levels are comparable to the general diabetic patient population in the same area (Keinänen-Kiukaanniemi & Jalovaara 1995), and the mean metabolic level was nearly the same as that reported by Valle *et al*. (1999). These similarities support the assumption that the study population represents a typical IDDM patient population. As in previous studies, this study population showed poorest adherence to the diet and exercise compared to the other aspects of diabetes self-care. The percentages of good and poor diabetes self-care are difficult to compare, because different criteria have been used in different studies.

There was some variation concerning the distributions of demographic variables, which is useful because it can be assumed that demographic variables affect the level of health behavior and the psychological features behind it. Each subject was to have had diabetes for at least six months, but it may be questionable if this period is long enough to establish one´s own perceptions and habits concerning diabetes self-care. However, this issue was discussed with the diabetes nurse, and based on her clinical experience, the criterion was acceptable. Nevertheless, this may not be a major problem, because most of the present subjects had had diabetes for a long time (median 15 yr, mean 16 yr, SD 10 yr). With regard to the oral health status, the subjects were to have teeth of their own, and the mean number for teeth was 24.9 (SD 6.8), which means that very reduced dentition was not a problem here. The reported oral hygiene practices and dental visiting were moderate, though poorer than those reported by Thorstensson *et al.* (1989a) and Spangler & Konen (1994).

As regards the associations between health behavior models and age, sex and level of education, it has to be taken into account that the latter variables are usually related to each other. Some associations were found in this study population. But, these demographic variables cannot be considered as real confounding factors concerning the psychological features, because they are related to personal characteristics. On the other hand, these demographic variables can be proposed to be confounding factors when predicting health behavior, because they have been found to associate with the level of behavior. Thus, these variables were controlled as far as possible in the logistic regression analysis when behavior was used as a dependent variable.

When viewing the results of this study, it is necessary to note that Finnish diabetic patients are scheduled for systematic checkups, the instruments and materials for diabetes self-care are available free of charge, and in many municipality diabetic patients are entitled to dental care in primary health care centres. These rights are not affected by social class. Thus, there is good social equality between diabetic patients in Finland, which is supported by the fact there are no differences in mortality between social classes (Koskinen *et al.* 1996).

7.1.2. Psychological models and scales

Psychological models were chosen as a basis for evaluating the possible similarities underlining oral health behavior and diabetes self-care. Health behavior models can give more profound information than analyses of self-reports concerning self-care and adherence. Further, by knowing the significant psychological features, it is possible to influence the health behavior of patients. The chosen health behavior models have been used and developed for a long time, and they have been found to be significant for health behavior.

Apart from an optimal study population, the usefulness of the scales is essential for having reliable results. Many of the used scales are modifications of previously used ones, while some scales were developed for this study. At the time the study was started, there were no comprehensive but concise scales covering both dental health and diabetes available. The dental and diabetes scales had to be comparable with each other. Further,

scales formed elsewhere are not necessarily directly usable in Finland because of cultural differences. Thus, the scales were used for the first time in this form, and their reliability and validity have to be further evaluated in future studies. Because the scales were modifications, it was necessary to do pilot studies with the questionnaire before recruiting the study population. No test-retest analysis was done on the scales, but there has also been criticism concerning the use of the test-retest method (Nunnally 1978). The self-esteem, dental locus of control and diabetes motivation attribution items were translated from English to Finnish, but no back and forth translations made by a language consultant were performed because the items were modified. After all, the other used items, including the diabetes self-efficacy, diabetes locus of control and dental attribution items, were already in Finnish or had been formulated directly in Finnish.

The reliability of the scales is essential for the credibility of the results. The alpha reliability coefficients for all self-efficacy scales were >0.90, while that for the dental locus of control scale was 0.60, that for the diabetes locus of control scale 0.70, that for the diabetes adherence scale 0.76 and that for the self-esteem scale 0.85. On the whole, the alpha reliability coefficients were very high, especially regarding the diabetes and combined self-efficacy scales, which may be partly due to the fact that the scales included relatively many items. However, a decision was made not to omit any items because the scales were aimed to be comprehensive enough. The optimal alpha range is between 0.70 and 0.80, and many of the coefficients of the scales used here are close to these values. Nevertheless, the high alphas rather confirm the internal consistency and homogeneity of the scales than weaken their usefulness. Regarding Weiner´s motivation attribution theory, it was not technically possible to use alpha reliability coefficients, because of its different structure. There were no previous scales, and the dental items were therefore formulated on the basis of the previous diabetes items. The theory was included in the study because the purpose was to evaluate its usefulness for health behavior research.

Good validity of the scales is another significant factor in obtaining reliable results. The locus of control, self-esteem and diabetes adherence scales were modified from previous scales, and it can thus be assumed that their content validity has been evaluated previously. Content validity was checked as far as possible by making sure that the items represented the corresponding model adequately, but the content validity of the dental self-efficacy items would have improved if they had been in the conditional mood. As far as the dental self-efficacy scales were concerned, factor analysis was used to confirm structural validity. In this study, reported health behavior was chosen as a criterion for evaluating the validity of the psychological scales. Significant associations between the dental self-efficacy scales and the corresponding reported oral health behavior supported the criterion-related validity of the self-efficacy items. Concerning the validity of Weiner´s motivation attribution items, it was shown that the subjective assessments related quite well to the health status. According to Kerlinger (1986), the difficulty of criterion-related validation is the choice of criteria. The relation between theory and health behavior or health status is one, but not the most optimal way, to evaluate validity, because these relations are not always even postulated by the theory. However, the results concerning the self-efficacy scales and the diabetes adherence scale can be proposed to confirm the validity because the relation between self-efficacy and health behavior has been shown in other studies.

The scales were used both as continuous and as dichotomized. Dichotomization was used because one purpose was to obtain more concrete information about the differences between the subjects with poor and good levels of the used variables. Dichotomization was suggested by the journals in which the articles were published. To minimize the information bias caused by dichotomization of the scales, the cut-off points for the scales were chosen on the basis of the distributions and rationality of the answers. These cut-off points were checked by analysing the same relations after a modification of the cut-off point by a few scores. When the median was used as the cut-off point, some information may have been lost, which may be a weakness of this method.

7.1.3. Self-reporting and clinical examinations

There may be doubts about the credibility of self-reported answers to health behavior items. It has been proposed that self-assessments may be very truthful in some items, while being inaccurate in others. The inaccuracy may be due to forgetting or negligence, or some patients may give excessively positive answers to avoid guilt and anxiety. (Kuusinen 1994). Furthermore, the current oral hygiene practice items only inquire about frequencies, while the quality of behavior cannot be measured. The level of knowledge may lead to an over- or underestimation of one´s own health behavior. The problem is that the answers may reflect the patients´ ideal perception of self-care. This can be seen in the skewness of distributions. The patients were treated by various health care professionals, which means that the differences in the self-care regimens, motivation and knowledge given to patients may affect the results. But social desirability may not be a major problem here, because the subjects were not personal patients of the investigators. There were instructions at the beginning of the questionnaire to advise the participants to reply without consideration of what was right or wrong.

Concerning different diabetes self-care practices, it is reasonable to explore them separately because there might be some inconsistency in the adherence to various self-care practices (Johnson 1992, Richmond 1993). Likewise, the level of self-care change between different situations and people may give different impressions about good self-care. On the whole, adherence to self-care is considered quite a difficult variable to analyse, because there is no commonly accepted way to measure it (Kyngäs 1995, Furlong 1996, McNabb 1997). It is useful to explore adherence to diabetes self-care regimens simultaneously with metabolic control levels (Haynes *et al.* 1998), because they are complementary.

The oral clinical examination was made and metabolic control was determined from patient records. The dental indexes and the measures used were based on generally accepted recordings and were considered suitable and sufficient for the present purposes. $HbA1_c$ as an indicator of metabolic level is widely accepted, and the classification was done according to the national instructions (Suomen Diabetesliitto 1995). However, the significance of the diabetic patient´s host response has to be taken into account when assessing the results concerning health status. Thus, the objective view of health status alone is not an ideal reference. It is not even relevant to expect very high correlations

between health status and psychological theories, and the correlations detected here, though small, are interesting.

7.2. Discussion of the results

7.2.1. Self-efficacy

This was the first time when the relationships between dental and diabetes self-efficacy and between self-efficacy in one field and health behavior and health status in another were analysed. Both forms of self-efficacy were clearly related to corresponding behaviors and to health status. Further, a correlation between the dental and diabetes self-efficacies was found, which supports the observation of Bandura (1977) that the perception of self-efficacy may be generalized to other situations. Besides, there were some significant overlapping relations; high dental self-efficacy associated with good diabetes adherence and high diabetes self-efficacy with more frequent dental visiting. Further, a poor metabolic control level associated with low tooth brushing self-efficacy, low frequency of tooth brushing and a high plaque level. These overlapping relations are significant findings, and enhancement of capability in relation to oral health behavior could thus enhance that concerning diabetes self-care, and vice versa. On the whole, when the self-efficacy model was used, some psychological similarity was found in oral health behavior and diabetes self-care. On the basis of the results, it may be proposed that the perception of self-efficacy is not necessarily totally health behavior-specific, but the sense of ability to cope with various health behavior practices might be a common feature. Lawrance & McLeroy (1986) have concluded that the extent to which self-efficacy can be generalized between different health problems is an important outcome of health education.

Previously, dental self-efficacy has been found to relate to oral hygiene practices and dental visiting (McCaul *et al.* 1985, Tedesco *et al.* 1994, Stewart *et al.* 1997) and, correspondingly, diabetes self-efficacy to diabetes self-care (Hurley & Shea 1992, Littlefield *et al.* 1992, Kavanagh *et al.* 1993). The results of the present study are accordant with these findings concerning health behavior and, furthermore, the relation found here between diabetes self-efficacy and metabolic balance is parallel to that reported by Kavanagh *et al.* (1993) and Day *et al.* (1996). With regard to the oral health status, however, a relation between dental self-efficacy and dental caries was found. While parallel to the finding by Wolfe *et al.* (1991), in the present study findings were not related to plaque. On the whole, according to the previous studies and the results of this study, the perception of self-efficacy seems to be an effective theoretical basis characterizing health behavior and health status.

Health care professionals should be able to take the usefulness of self-efficacy into account and to improve their patients´ self-efficacy. Perceptions of self-efficacy can be used to explain behavioral changes, to predict effects of interventions, and to improve health behavior. Concerning health behavior, self-efficacy determines whether a given behavior is initiated, how much effort is expended and how long the behavior is sustained against obstacles. The determinants of self-efficacy should be kept in mind, including

enactive attainments, vicarious experience, verbal persuasion and physiological states related to emotional arousal. Health care professionals can give support and positive feedback and set good examples, which can motivate the patient to better self-care, and thus to obtain improved oral health and better metabolic control. Success in these things promotes self-efficacy. All in all, the perception of self-efficacy may, indeed, be a common psychological feature determining oral and diabetes self-care.

7.2.2. Locus of control

The result that the dental and diabetes locus of control beliefs correlated clearly with each other supports the proposal of Rotter (1966) that locus of control beliefs originating in one area may be generalized to other related forms of behavior. Further, the results gave evidence that internal dental locus of control was related to frequent dental visiting and a better oral health status, especially with a lower number of caries, but an internal diabetes locus of control related only very weakly to diabetes adherence, and there was no relation between the diabetes locus of control and metabolic balance. On the basis of this study, there is no evidence that locus of control beliefs would be a psychological connections between oral health and diabetes.

The theory of locus of control has been used for a long time in behavioral studies, but the results have been quite confusing. There have been reported relations between locus of control and tooth brushing behavior (Regis *et al.* 1994, Macgregor *et al.* 1997), oral health status (Kent *et al.* 1984, Wolfe *et al.* 1991, Borkowska *et al.* 1998), diabetes self-care (Peyrot & Rubin 1994) and metabolic control (Meize-Grochowski 1990, Reynaert *et al.* 1995). On the other hand, O´Connor *et al.* (1992) and Aalto *et al.* (1997) failed to find any associations between locus of control and diabetes self-care and metabolic control.

It has been proposed that the reason for the confusing results obtained by applying the locus of control theory might be misuse of the theory by excluding the value dimension. In this study, it was noticed that there were associations between the reported high values attributed to care and a corresponding internal locus of control, but consideration of the value dimension did not improve the ability of the locus of control to predict health behavior. But the correlations between dental locus of control and oral health variables were stronger among those reporting high value for dental care than among those reporting low dental value.

On the whole, the theory of locus of control cannot be considered a particularly useful theory when analysing health behavior. There might be usefulness for the dental approach, although the results there gave only partial support. The relation between dental caries and dental locus of control may be connected to the relation between the frequency of dental visiting and dental locus of control. On the basis of this study, it is proposed that locus of control beliefs do not play a directly decisive role in everyday practice, but it is still assumed to be significant that a subject has personal control over his/her own health. However, a person has to believe in being able to cope in practice, in other words she/he needs high self-efficacy. In this study population, the subjects had internal locus of control beliefs and moderately good levels of oral hygiene practices, dental visiting and diabetes adherence. It is assumed that locus of control beliefs, especially external beliefs,

might be more significant if the subjects had a really poor level of self-care. Thus, the further studies concerning the theory of locus of control should focus on those patients. Further, knowledge affecting the answers might be one significant bias concerning the locus of control, and it is questionable if the scale used here is powerful enough to reveal the subjects´ real locus of control.

7.2.3. Self-esteem

The interest in self-esteem lies rather in its significance for psychological well-being and personal motivation than in its usefulness for predicting behavior (Rosenberg 1986). In this study, high self-esteem related with a high frequency of tooth brushing as well as with good adherence to the exercise recommendations and an ability to adjust insulin dosage. Thus, self-esteem seems to be a psychological feature which influences some specific practices both in dental and diabetes care. Good adherence to regular tooth brushing and exercising regimens are health behaviors whose long-term advantages are typically not seen until after persistent and regular practising. Non-adherence will most likely cause only minor disorders in the short term. Rosenberg (1965) thought self-esteem to be a fairly stable trait, and it could hence be important precisely for the practices requiring long-term self-care. Furthermore, self-esteem was related to an ability to adjust insulin doses, which requires particular problem-solving skills, self-assurance and practical experience.

There have found associations between high self-esteem and good diabetes adherence by Jacobson *et al.* (1987) and Littlefield *et al.* (1992), but there are also contradictory results (Kovacs *et al.* 1992). The results of the present study are accordant with those of Regis *et al.* (1994) and Macgregor *et al.* (1997), who found self-esteem to be related to tooth brushing. Regis *et al.* (1994) showed an association with dental visiting. The present study revealed no relation between self-esteem and metabolic control, which is accordant with Grossman *et al.* (1987) and Daviss *et al.* (1995).

It should be noted that if a person thinks that an activity can give a sense of self-worth, in other words, promote his/her self-esteem, he/she usually tries to develop the self-efficacy needed for that action. Coopersmith (1967) pointed out that the level of self-esteem is related to the way of adaptation to environmental demands, and that high self-esteem gives self-confidence in one´s own ability to cope in difficult situations, which may lead to better self-care. And further, success in self-care strengthens self-esteem. This effectiveness of self-esteem should be recognized by health care professionals, because they can promote their patients´ self-esteem during checkups. For this purpose, health care professionals should respect individuals and their privacy, be non-judgemental, recognize the patients´ life circumstances, and empower the patients to manage with diabetes and to solve their problems effectively (Bradley & Gamsu 1994).

7.2.4. Weiner´s attribution theory of motivation and emotion

The results showed that there is commonality in causal thinking, because there was similarity between the attributions for success and failure concerning oral health and diabetes status, and correlations between the attributions were found. The practical evidence about commonality was that the subjects who reported success with gingivitis had better metabolic balance. The similarities can be proposed to be due to the similar characteristics of the illnesses, because persistent, regular self-care is needed for them all, and a possibility of loss is involved in them. In other words, patients willing to take part in the study might have somehow similar attribution processes.

In the present study, effort, interest and ability were the most common causes of success, while lack of effort and, in the case of caries, the task difficulty were the most common causes of failure. Thus, the results are in accordance with Weiner´s (1985) studies. In the present study, failure was often attributed to internal causes, though the theory assumes external causes to be most common for failure, and success was usually attributed to internal causes, similar to those reported by Girodo *et al.* (1981) and Betancourt & Weiner (1982).

It should be kept in mind that the causal dimensions are more important for the practical interpretation than the causes in themselves, because the dimensions are related to the expectation of success and affective reactions. Thus, if present failure is attributed as an unstable and success as a stable cause, these are assumed to lead to future success. On the whole, it would be useful to know more about the patient´s causal thinking, especially in cases of failure. This would help to predict future success or failure, to predict the patient´s reactions to different situations, and to plan appropriate health education, in which myths and misattributions are resolved. Health care professionals should know that, according to Weiner (1988), it is possible to influence the perception of outcome, to change the chosen causes and to change the patient´s behavior.

8. Conclusions and practical implications

The results suggest that there are, indeed, some common psychological features for oral hygiene practices, dental visiting and diabetes self-care. Psychological features might be considered to have a role for understanding the relation between oral diseases and diabetes status.

- Because of the overlapping relations between the self-efficacy scales and the behavior and health status in an other field, it is concluded that enhancement of the patient´s capability in relation to oral health behavior could enhance his/her capability concerning diabetes self-care, and vice versa.
- It is concluded that locus of control is not useful for finding similarities between oral hygiene practices, dental visiting and diabetes self-care. The ability of locus of control to determine health behavior or health status is not convincing, and the significance of the locus of control theory is hence proposed to be quite small.
- Self-esteem seems to be a psychological feature which influences some specific practices both in dental and diabetes care, namely tooth brushing and exercising, which require persistence, and insulin adjustment, which, in turn, requires problem-solving skills, self-assurance and practical experience. Thus, psychological similarity was found when the self-esteem theory was used.
- Concerning Weiner´s attribution theory, it is concluded that there is commonality in causal thinking. There were relations between the attributions for success and failure concerning oral health and diabetes status, and there was similarity between the dimensions of these attributions.

On the basis of the results, the perception of self-efficacy is a significant practical feature characterizing daily behavior, and its enhancement might be important. It can be proposed that locus of control does not play a directly decisive role, but internal locus of control is needed to make the person believe that he/she can affect his/her own health. The significance of self-esteem is that high self-esteem is important for good motivation and self-confidence. It is noteworthy that it is possible to affect all these psychological features.

There are various ways in which dental and diabetes health care professionals are able to promote the psychological features analysed in this study. Health education should be based on identifying and enhancing the psychological features affecting the patient´s

health behavior and health status, to obtain better and more stable results both in oral health and diabetes status. Based on the questionnaire used in this study, it will be possible to condense a usable formula for analysing oral health behavior, diabetes self-care and the psychological features characterizing them. The findings of the present study should be applied to further intervention studies.

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10. Appendices

APPENDIX 1

ORAL HEALTH BEHAVIOR ITEMS

How often do you brush your teeth?

1. more than twice a day
2. twice a day
3. once a day
4. 2-3 times a week
5. less frequently

How often do you clean your interdental surfaces (by dental floss, tooth pick or interdental brush)?

1. once a day or more
2. 2-3 times a week
3. once a week
4. less frequently
5. never

How often do you visit a dentist?

1. more than once a year
2. annually
3. biennially
4. triennially
5. less frequently
6. never

APPENDIX 2

DIABETES ADHERENCE ITEMS

Assess how well you usually comply with your diabetes self-care advice.

- Adjusting insulin injections to meal times.
- Adjusting insulin dosage to exercise.
- Dietary instructions.
- Regular meal times.
- Exercise instructions.
- Measuring blood sugar levels.

One of five answers could be selected: not at all (1 point), poorly (2 points), moderately (3 points), quite well (4 points), completely (5 points).

APPENDIX 3

DENTAL SELF-EFFICACY ITEMS

Brushing and interdental cleaning self-efficacy items:

How sure you are that you brush your teeth / clean your interdental surfaces in following situations?

- When you are tired in the evening.
- When you are not going to go to the dentist in the near future.
- When you are on vacation.
- When you have a lot of work.
- When you have a headache or you are ill.
- When you have problems with diabetes metabolic balance.

Dental visiting self-efficacy items:

How sure you are that you visit dentist as often as you have been advised?

- When the dentist does not call you regularly.
- When you have no symptoms in your teeth.
- When you have money problems.
- When you are busy.
- When you are not able to arrange an appointment with a familiar dentist.
- When you have earlier unpleasant experiences.
- When you are frightened for painful operations.

One of four answers could be selected: completely confident not to (1 point), fairly confident not to (2 points), fairly confident (3 points), completely confident (4 points).

APPENDIX 4

DIABETES SELF-EFFICACY ITEMS *

How well could you comply with following instructions? †

- Adjusting insulin injections to meal times.
- Adjusting insulin dosage to exercise.
- Dietary directions.
- Regular meal times.
- Exercise directions.
- Measuring blood sugar levels.

* Diabetes self-efficacy items were asked in relation to four situations: quarrelling, holidays, loneliness and hurry.

† One of five answers could be selected: not at all (1 point), poorly (2 points), moderately well (3 points), quite well (4 points), completely (5 points).

APPENDIX 5

DENTAL AND DIABETES LOCUS OF CONTROL ITEMS AND VALUE ITEMS

Dental locus of control items:

Read the following statements and choose the alternative* which best describes your thoughts.

- I believe that only the dentist can prevent cavities.
- I believe that by flossing my teeth I can prevent gingivitis.
- I believe that if both of my parents have bad teeth, brushing and flossing will not help my teeth.
- I believe that by brushing and flossing my teeth I am less susceptible to tooth decay.
- I believe that I am responsible for preventing the loss of my teeth.
- I believe that tooth loss is a normal part of growing old.
- I believe that by brushing my teeth I can prevent gingivitis.
- The health of my teeth is a matter of good luck.

Diabetes locus of control items:

Assess the following statements and choose the alternative* which best describes your beliefs.

- My diabetes remains under control best if I meet other diabetics regularly.
- If my diabetes is going to go out of control, it will do so no matter what I do.
- If I take good care of myself, my diabetes will stay under control.
- If I am able to avoid complications, it will be because others (doctors, nurses, family, friends) have been taking good care of me.
- Avoiding complications is largely a matter of good fortune.
- I will probably develop complications no matter what I do.
- I have so many worries in my life that my diabetes will not stay under control.
- If my diabetes goes out of control, it is usually by accident.

* There were four choices of answer: I agree completely, I agree partly, I disagree partly, I disagree completely. The answers were coded from 1 to 4 points, and a higher score was taken to indicate more internal answer.

DENTAL VALUATION ITEMS:

- How important is regular dental visiting for you?
- How important is avoiding dental caries for you?
- How important is avoiding gingivitis for you?

The four reply alternatives were: very important (4 points), important (3 points), less important (2 points) or completely unimportant (1 point).

DIABETES VALUATION ITEM:

- How important is the maintaining of good metabolic control for you?

The four reply alternatives were: very important (4 points), important (3 points), less important (2 points) or completely unimportant (1 points).

APPENDIX 6

MODIFIED ROSENBERG´S SELF-ESTEEM ITEMS

Read the statements and choose the best alternative* for you.

- I feel that I am a person of value, at least on an equal plane with others.
- I certainly feel useless at times.
- I am able to do things as well as most other people.
- I feel I do not have much to be proud of.
- I have a positive attitude toward myself.
- All in all, I am inclined to feel that I am a failure.
- At times I think I am no good at all.
- I feel that I have a number of good qualities.

*There were four choices of answers: strongly agree, partly agree, partly disagree, strongly disagree. The answers were coded from 1 to 4 points, a higher score indicating higher self-esteem.

APPENDIX 7

WEINER´S MOTIVATION ATTRIBUTIONS AND DIMENSIONS CONCERNING DENTAL OUTCOMES

When you were last time at the dentist, how were your teeth and gums?

If you had no gingivitis in your gums, choose the reasons for it.	**Attribution**	**Loc***	**Stab***	**Contr***
Cause				
In spite of tiredness I clean my teeth in the evenings.	Effort	i	us	c
I am interested in the health of my gums.	Emotion (interest)	i	us	c
I have tried to clean interdental surfaces using floss, toothpicks or interdental brush.	Effort	i	us	c
I am able to clean my teeth properly.	Ability	i	s	c
I have a good diabetes metabolic balance.	Physiological factor	e	us	uc
I really concentrate on cleaning my teeth in the evenings.	Effort	i	us	c
It is easy to clean my interdental surfaces.	Task difficulty	e	us	uc
My dentist have tried to treat my gingivitis.	Doctor input	e	us	uc
If you had gingivitis in your gums, choose the reasons for it.	**Attribution**	**Loc***	**Stab***	**Contr***
Cause				
I have not bothered to clean my interdental surfaces.	Effort	i	us	c
I have been lazy.	Effort/Emotion (mood)	i	us	c /uc
I am not capable of concentrating on cleaning my teeth in the evenings.	Effort	i	us	c
It is hard to clean my interdental surfaces.	Task difficulty	e	us	uc
I have a poor diabetes metabolic balance.	Physiological factor	e	us	uc
I am so tired in the evenings that I am not capable of cleaning my teeth.	Effort	i	us	c
I can´t clean my teeth properly.	Ability	i	s	c
I do not care about the health of my gums.	Emotion (interest)	i	us	c
My dentist have not tried to care my gingivitis.	Doctor input	e	us	uc
If you had no caries in teeth, choose the reasons for it.	**Attribution**	**Loc***	**Stab***	**Contr***
Cause				
I have tried to clean my teeth with care.	Effort	i	us	c
I have tried to use xylitol products.	Effort	i	us	c
I have tried to avoid eating sweets and other sugary snacks.	Effort	i	us	c
I am interested in the health of my teeth.	Emotion (interest)	i	us	c
In my opinion the teeth are easy to care for.	Task difficulty	e	us	uc
I have had the luck to inherit good teeth from my family.	Luck	e	s	uc
I have managed to choose a good dentist.	Luck	e	us	uc
If you had caries in your teeth, choose the reasons for it.	**Attribution**	**Loc***	**Stab***	**Contr***
Cause				
I have old fillings in my teeth.	Task difficulty	e	us	uc
I have been lazy.	Effort/Emotion (mood)	i	us	c /uc
I have not tried to clean my teeth with care.	Effort	i	us	c
I have not tried to avoid eating sweets and other sugary snacks.	Effort	i	us	c
I have not tried to use xylitol products.	Effort	i	us	c
I have inherited poor teeth from my family.	Luck	e	s	uc
I do not care about the health of my teeth.	Emotion (interest)	i	us	c
I have not managed to choose a good dentist.	Luck	e	us	uc
In my opinion the teeth are difficult to care for.	Task difficulty	e	us	uc

*Locus: i=internal, e=external; Stability: s=stable, us=unstable; Controllability: c=controllable, c=uncontrollable.

APPENDIX 8

WEINER´S MOTIVATION ATTRIBUTIONS AND DIMENSIONS CONCERNING DIABETES OUTCOME

What is your diabetes metabolic balance like, very good to moderate good or moderate poor to very poor?

If your diabetes is in very good or moderate good metabolic balance, choose the reasons for it.I

Cause	Attribution	Loc*	Stab*	Contr*
I have learned to control my diabetes.	Ability	i	s	c
I have received good advice.	Luck	e	us	uc
I have good motivation for diabetes care.	Emotion (motivation)	i	us	c
I have acquired information.	Effort	i	us	c
I follow my instructions for treatment conscientiously.	Effort	i	us	c
My diabetes is easy to keep in good metabolic balance.	Physiological factor	e	us	uc
My body system responds well to the care.	Physiological factor	e	us	uc
Other people help me.	Luck	e	us	uc
I have been in good spirits / in a cheerful mood / a good frame of mind.	Emotion (mood)	i	us	uc
I have had good luck.	Luck	e	us	uc

If your diabetes is in moderate poor or very poor metabolic balance, choose the reasons for it.

Cause	Attribution	Loc*	Stab*	Contr*
I do not follow my instructions for treatment.	Effort (interest)	i	us	c
My diabetes is difficult to keep in a good metabolic balance.	Physiological factor	i	us	uc
I have poor motivation for diabetes care.	Emotion (motivation)	i	us	c
My life situation is nowadays such that I am not capable of concentrating on it.	Social factors	e	us	uc
I have not learned to control my diabetes.	Ability	i	s	c
I have felt low / been in a low spirits.	Emotion (mood)	i	us	uc
My body system does not respond well to the care.	Physiological factor	e	us	uc
I have not received good advices.	Luck	e	us	uc
I have not acquired information.	Effort	i	us	c
I have had bad luck.	Luck	e	us	uc
I do not get help from other people.	Luck	e	us	uc
I have a eating disorder (anorexia nervosa, bulimia etc.).	Psychological factor	e	us	uc

* Locus: i=internal, e=external; Stability: s=stable, us=unstable; Controllability: c=controllable, c=uncontrollable.

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