Acceptance and Commitment Therapy Group Intervention Effectiveness on Glycemic Control, Psychological Flexibility and Psychological Well-Being of Adolescents with Type 1 Diabetes

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HONKANEN IDA, LEHIKOINEN ANNI: Ryhmämuotoisen hyväksymis- ja omistautumisterapian vaikuttavuus tyypin 1 diabetesta sairastavien nuorten hoitotasapainoon, psykologiseen joustavuuteen ja psykologiseen hyvinvointiin

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TIIVISTELMÄ

Tämän Pro gradu -tutkielman tarkoituksena oli kartoittaa ryhmämuotoisen hyväksymis- ja omistautumisterapian (HOT) vaikuttavuutta hoitotasapainoon, psykologiseen joustavuuteen ja psykologiseen hyvinvointiin tyypin 1 diabetesta sairastavilla nuorilla, joiden hoitotasapaino on heikko. Tutkimuksen tarkoituksena oli myös selvittää hoitotasapainon, psykologisen joustavuuden ja psykologisen hyvinvoinnin välisiä yhteyksiä 1 tyypin diabetesta sairastavilla nuorilla. Lisäksi tutkielmassa tarkasteltiin kahden intervention osallistujan yksilöllisiä polkuja, joista toinen hyötyi interventiosta hoitotasapainon osalta ja toinen ei. Tutkimus toteutettiin alku- ja loppumittausten avulla. Tutkimuksen kohderyhmänä olivat Keski-Suomen keskussairaalan lastentautien poliklinikalla hoitosuhteessa olleet 12–16-vuotiaat nuoret, joiden tyypin 1 diabeteksen hoitotasapaino oli yli hoitosuosituksen. Osallistujat jaettiin satunnaisesti koe- ja kontrolliryhmään. Koeryhmän (n=12) tavanomaiseen hoitoon lisättiin 5 1,5 h mittaista ryhmätapaamista, jotka koostuivat keskustelusta ja HOT-harjoitteista. Kontrolliryhmä (n=13) sai tavanomaista hoitoa. Kaikki 25 osallistujaa täyttivät Lasten ja nuorten tietoisuustaito -kyselyn (CAMM), lasten ja nuorten Diabeteksen hyväksymis- ja toimintakykymittarin (DAAS) sekä mielialakyselyn (RBDI) ennen ja jälkeen intervention. Hoitotasapainon mittarina käytettiin pitkäaikaisverensokeri-tasapainon arvoa (HbA1c), joka mitattiin osana tavanomaista hoitoa. Tutkimuksessa havaittiin, että HOT ryhmäinterventio vaikutti merkitsevästi nuorten diabeteksen hyväksyntään ja kykyyn toimia sairauden kanssa. Tutkimus myös osoitti, että psykologisen joustavuuden taidot olivat yhteydessä parempaan hoitotasapainoon sekä parempaan psykologiseen hyvinvointiin. Ahdistusoireiden puolestaan havaittiin olevan yhteydessä huonompaan hoitotasapainoon. Lisäksi diabetekseen liittyvä psykologinen joustavuus ja kyky toimia sairauden kanssa oli yhteydessä vähäisempään masentuneisuuteen. Yksilöllisten polkujen tarkastelu interventioryhmässä puolestaan osoitti, että osallistuja, jonka hoitotasapaino oli parantunut, kehittyi eniten myös psykologisen joustavuuden taidoissa. Tulosten perusteella psykologisen joustavuuden taidot ovat keskeisiä hoitotasapainon ja psykologisen hyvinvoinnin kannalta. Ahdistusoireisiin ja niiden hoitoon suositellaan kiinnitettävän erityistä huomiota diabetesta sairastavilla nuorilla. HOT-ryhmäinterventiota voidaan suosittaa käytettäväksi nuorilla diabeetikoilla sairauden hyväksynnän ja siihen liittyvän toimintakyvyn lisäämisessä sekä mahdollisesti myös masentuneisuuden vähentämisessä.

Avainsanat: hyväksymis- ja omistautumisterapia, tyypin 1 diabetes, nuoret, ryhmäinterventio, hoitotasapaino, HbA1c, psykologinen joustavuus, psykologinen hyvinvointi

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HONKANEN IDA, LEHIKOINEN ANNI: Acceptance and Commitment Therapy Group Intervention Effectiveness on Glycemic Control, Psychological Flexibility and Psychological Well-Being of Adolescents with Type 1 Diabetes

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ABSTRACT

This Master's Thesis investigated the effectiveness of Acceptance and Commitment Therapy (ACT) based group-intervention on glycemic control, psychological flexibility and psychological well-being of adolescents with type 1 diabetes whose glycemic control was above the recommendations. It also examined the connections between glycemic control, psychological flexibility, and psychological well-being. Finally, we explored the individual paths of two participants from which the other seemed to benefit from the intervention and the other seemed not to benefit from the intervention. The study was conducted by a pretest-posttest design with a control group. 12-16-year-old adolescents with type 1 diabetes whose blood glucose was above recommendations and who were treated at the pediatric outpatient clinic of Central Finland Health District were invited to participate the study. Enrolled individuals were randomly assigned to intervention and control group. The ACT group (n=12) took part in 5 1,5 hour lasting sessions that were composed of discussion and exercises, while the control group (n=13) received the treatment as usual. Participants (n=25) completed Children and Adolescents Mindfulness Measure (CAMM), Diabetes Acceptance and Action Scale for Children and Adolescents (DAAS) and Revised Beck Depression Inventory (RBDI) questionnaire before and after the intervention. Blood glucose (HbA1c) levels were gathered from the medical records. This study found that ACT based short intervention significantly increased diabetes-related psychological flexibility and ability to manage one's diabetes. We also found that psychological flexibility skills were correlated with better glycemic control and well-being, while anxiety symptoms were correlated with inferior glycemic control. Further, diabetes-related psychological flexibility was connected to fewer depression symptoms. On the question of individual paths, this study found that the most remarkable difference between the participants was, that the psychological flexibility of benefited participant improved significantly more than the non-benefited participant. Although the current study is based on a small sample of participants, the findings persuasively suggest, that psychological flexibility skills are pivotal for glycemic control and psychological well-being. Anxiety symptoms and their treatment are recommended to be given special attention in the treatment of type 1 adolescents. Taken together, these findings support the idea of using acceptance and commitment therapy-based interventions as a part of type 1 diabetic adolescents' treatment. This type of treatment could be beneficial to increase the acceptance of the disease, improve functional ability and potentially decrease depression symptoms in this population.

Keywords: Acceptance and commitment therapy, type 1 diabetes, adolescence, group intervention**,** glycemic control, HbA1c, psychological flexibility, psychological well-being

CONTENTS

1 INTRODUCTION

Rapid change in diabetes prevalence, i.e changes on the percentage of population affected by diabetes at a particular time point, has been characterized as one of the largest health emergencies in the 21st century (Merriam-Webster, 2018); International Diabetes Federation [IDF], 2015). The number of diabetics is increasing rapidly, and this also applies to the adolescents with diabetes type 1. In Finland the incidence and prevalence of type 1 diabetes in children and in adolescents is among the highest in the world (Tulokas, 2001). Currently around 500 children under 15 years old are diagnosed with diabetes type 1 every year (Finnish Diabetes Association, 2018). Adolescence poses new challenges for diabetes treatment, both psychologically and physically, which overall affects treatment adherence. The existing body of research suggests that medical treatment of diabetes does not fully address the problems faced in adolescence with this chronic disease and that it is therefore inadequate, especially when there is problems in glycemic control (Murphy, Rayman, & Skinner, 2006).

Especially vulnerable group of adolescents, in this case, are the adolescents with poor glycemic control, because up to date there is no treatment regimen which would be an evidence-based treatment for this population. Acceptance and Commitment Therapy (ACT) has been proposed to be suitable in addressing problems with chronic diseases and also problems faced in adolescence within glycemic control in diabetes treatment (Graham, Gouick, Krahé, & Gillanders, 2016; Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Hadlandsmyth, White, Nesin, & Greco, 2013; World Health Organization [WHO], 2017). Overall, in adolescence, a manifestation of different psychological problems is probable, and this calls for evidence-based treatment in response to multiple psychological problems. ACT interventions show promising results within a variety of psychological problems including diabetes. This study aims to examine the effectiveness of ACT-based group treatment for adolescents with poor glycemic control of type 1 diabetes, and to evaluate whether this intervention could be utilized as part of the diabetes treatment in future.

1.1 Diabetes

Diabetes is a chronic metabolic disease, in which the body's ability to produce or utilize insulin is impaired (WHO, 2017). Insulin is a hormone that regulates the blood glucose levels and is essential for energy production in a body; it transfers glucose from bloodstream into cells where glucose is used as energy (IDF, 2015; WHO, 2017). If glucose metabolism is disrupted, glucose remains in the bloodstream (IDF, 2015). If this state, also known as hyperglycemia, continues for long periods of time it will damage body's tissues and organs. These damages can be disabling or even lethal in their nature, including physical impairments as permanent loss of vision and kidney failure (WHO, 2017). World Health Organization estimates, that in 2015 diabetes was a direct cause of 1.6 million deaths and that it is the 6th of the leading causes of mortality (WHO, 2016a). What is more, the number of deaths to which high glucose levels is attributable, such as strokes or heart failures, is remarkable (WHO, 2017). The global objectives to halt the rise in diabetes prevalence do not seem likely to be fulfilled (less than 1%) (NCD Risk Factor Collaboration, 2016). This emphasizes the need of further research in interventions on behavioral and psychological level too.

There are three main types of diabetes: type 1 diabetes, type 2 diabetes and gestational diabetes (IDF, 2015). Because the differentiation of diabetes types requires subtle laboratory tests, that are not available worldwide, there exist no separate global prevalence estimates between type 1 and 2 (WHO, 2016b). Nevertheless, the rise in diabetes prevalence seems to display the obesity problem faced globally in recent centuries. Differentiation between the diabetes types is connected with the onset of the disease; type 1 is an autoimmune disease, in which insulin production is deficient. It can occur at any time of life, but the typical age of onset is childhood or adolescence. Type 2 diabetes is the most common type of diabetes, which usually occurs in adulthood, but which is growingly detected also in childhood and adolescence. In type 2 the insulin production is not impaired, but the body cannot utilize insulin effectively i.e. it becomes insulin resistant (IDF, 2015). Gestational diabetes refers to hyperglycemic levels of blood glucose during pregnancy. Furthermore, higher levels, but not diagnostically diabetic levels of blood glucose, are considered to be a risk for health of an individual, and undetected cases and also other types of diabetes are assumed to exist (IDF, 2015). Due to the serious consequences that diabetes has concerning the health and life expectancy of an individual, it is necessary to seek new approaches to improve the treatment of the sickness.

1.1.1 Type 1 Diabetes and Treatment

As stated above, type 1 diabetes is an autoimmune disease which means that the defense system in the body attacks against itself by destroying insulin-producing beta cells in the pancreas, which impairs insulin function permanently i.e. the body does not produce the needed insulin (IDF, 2015). This state is up to date incurable, which in terms of treatment means that after the diagnosis, daily administration of insulin is required to control the blood glucose level. This type of diabetes onset takes typically place in childhood or young adulthood (IDF, 2015). Symptoms of diabetes may appear as increased thirst and urination, fatigue, unintended loss of weight, increased feeling of hunger, sores that do not heal, blurry vision and numbness and tingling on hands or feet (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK], 2016b). In type 1 diabetes these symptoms usually appear quickly, within weeks or days. After these symptoms are detected, a blood test indicating the level of blood sugar is required to determine the diagnosis (NIDDK, 2016b).

Globally the range of variation in the incidence of diabetes 1 is wide, and for example, Sardinia and Finland are among the very high incidence countries (20 ≥ 100,000 per year) (Harjutsalo, Sjöberg, & Tuomilehto, 2008; Karvonen, 2000). Lowest incidence (>1/100,000 per year) was detected in China and in South America (Karvonen, 2000). In most populations, incidence was highest in children of 10–14 years of age (Karvonen, 2000). In Finland, the temporal trend estimations of type 1 diabetes in childhood showed, that this high incidence was still increasing 2008 and that the number of new cases (at or before 14) would double in 15 years time and that the age of onset would be between 0 to 4 years in future (Harjutsalo et al., 2008). Although more recent research has reported that after accelerated increase period, experienced between 1988 - 2005, incidence has ceased to increase, there is still a considerably large amount of children and adolescents affected by this disease (Forlenza & Rewers, 2011; Harjutsalo et al., 2008; Harjutsalo, 2013). These results suggesting that the need for efficient treatment, especially suitable for adolescents, will be even more needed in future both in Finland and globally.

In order to reduce the risk of diabetes-related complications the aim of diabetes treatment is to sustain the Hemoglobin A1C level normal or close to normal (i.e. HbA1c) (Hadlandsmyth et al., 2013). This level of blood glucose is evaluated both in long, and short term. The long term evaluation is based on the HbA1c level, which is a marker of blood glucose level, i.e it is a blood test measuring the average of blood glucose over the previous 3-month period. The general goal is

at or below 7% in adults, and 7,5% or less in children (Hunter, 2016). In order to achieve this goal, treatment requires intensive individual daily care, including tasks such as self-monitoring of blood glucose, which is a short term evaluation tool of glycemic control, and adjustment of insulin, for example with injections or with insulin pump, according that level (NIDDK, 2016a). In this study, the evaluation tool of glycemic control is HbA1c level. Also diet regulations and physical activity level management are part of the treatment plan (Hadlandsmyth et al., 2013).

1.1.2 Type 1 Diabetes in Adolescence

Adolescence is crucial time for people with type 1 diabetes. In youth, glycemic control and treatment adherence tend to deteriorate and in most cases they remain poor until late adolescence (Bryden, 2001; Lévy, 2011; Mann & Johnston, 1982). This contributes to the risk of developing long-term complications (Bryden, 2001). Moreover, typical lifestyle issues and developmental challenges of the age are further complicated when an adolescent has type 1 diabetes, and these age-related issues might as well bring about problems with glycemic control (Schreiner, Brow, & Phillips, 2000).

Hyperglycemic problems with regard to adolescence may result from a variety of reasons. In fact, physiological changes in puberty alone have been suggested to contribute to poor control (Bryden, 2001). Thorough changes in endocrinology are thought to be accountable for increasing insulin resistance of both males and females (Cameron, 2006; Lévy, 2011). In particular, changes in growth hormone (GH) axis are thought to be responsible for increasing overnight insulin resistance, otherwise known as the ‘dawn phenomenon’ (Cameron, 2006). As overnight secretion of GH increases, morning hyperglycemia is detected more commonly than before. Some adolescent females might also experience cyclical fluctuations, usually hyperglycemia, before menstruation (Cameron, 2006). In addition, age-related increase in body fat is also thought to challenge glycemic control (Lévy, 2011).

Existing research recognizes youth as a psychologically challenging timespan (Cameron, 2006; Schwartz, Klimstra, Luyckx, Hale, & Meeus, 2012). According to a widely held view, adolescents tend to have a strong sense of justice, and yet they find it difficult to compromise (Schreiner et al., 2000). This tendency could not only lead to such questions as “Why me?”,

implicating difficulties to accept a chronic illness, and leading to a poor control of it, but also to depression. On the other hand, being rebellious and defiant is also a well-known characteristic to adolescents, and it might also extend into diabetes self-care resulting refuse of care, and hate towards reminders of the sickness (Schreiner et al., 2000). Actions performed by adolescents can also at times be impulsive and seem to lack appreciation for consequences (Cameron, 2006). While it is common for youth to stay grounded in the present, diabetes and its' possible long-term complications inquire not only responsible decision making, but also future-oriented, long-term perspective (Schreiner et al., 2000).

Adolescence is often often described as a phase of development in which there is particular tension between the need to establish oneself as an autonomous individual and to maintain close attachments and need for parents (McElhaney, Allen, Stephenson, & Hare, 2009). On the other hand, a fully engaged and positively in collaboration working family could be the most idealistic for the management of type 1 diabetes of a young person (Lévy, 2011). This notice emphasizes the importance of external support for the well-being of diabetic adolescents.

1.1.3 Psychological Well-Being of Adolescents with Type 1 Diabetes

In general, there exists a relatively strong risk for psychological problems in adolescence, and if they occur together with a chronic disease such as diabetes 1, there is a risk to adherence of disease treatment. Non-optimal glycemic control is also associated with elevated levels of psychological distress, morbidity and mortality (Winkley, Landau, Eisler, & Ismail, 2006). A review evaluating the occurence rate of psychiatric disorders together with type 1 diabetes, reports this rate to be between 33–42% in adolescents and young adult population (Northam, Matthews, Anderson, Cameron, & Werther, 2005). When compared to community levels of psychiatric morbidity, the difference is two to three times higher (Cameron, Northam, Ambler, & Daneman, 2007; Northam et al., 2005). There are reports in which no difference in morbidity between the general population has been observed. In one study which reported no difference in morbidity, possible psychological difficulties associated with diabetes were also noted, such as social difficulties and disturbances on eating (Helgeson, Snyder, Escobar, Siminerio, & Becker, 2007). Coexistence of psychological problems in young adulthood is a risk for decreased adherence to treatment, which is a risk for

overall health in short and long term, because development of more severe disabilities or diseases connected related to diabetes, are based on poor glycemic control (Bernstein, 2013; Egede & Ellis, 2010). This is more likely to occur if psychological problems are involved (Bernstein, 2013; Egede & Ellis, 2010).

According to previous studies also comorbidity of varying psychiatric diagnoses is notably high in adolescents having diabetes (Northam et al., 2005). This, however, is a consistent finding also in association with adolescence as age phase. The results imply that comorbidity is actually a characteristic for adolescent psychopathology, instead being specific on type 1 diabetic adolescents (Northam et al., 2005). In a longitudinal study in which adolescents (n=92) were followed after the onset of diabetes type 1, Kovacs et al. (1997) reported that 47,5% of them developed a psychiatric disorder during the next ten years after diagnosis. The most prevalent disorders were major depression, general anxiety and conduct disorder, and that incidence was highest during the first year after the diabetes diagnosis. So although anxiety and depression are more prevalent in adolescent population overall, the incidence seems to be higher with diabetic youths (Kovacs, Goldston, Obrosky, & Bonar, 1997). A systematic review and meta-analysis also concludes that anxiety and depression are most prevalent in adolescent population (Buchberger et al., 2016). Recents studies also indicate that anxiety would be slightly more common than depression and that disordered eating behaviours are also related to diabetes (Bernstein, 2013; Buchberger et al., 2016). When the rates of psychiatric diagnoses were compared between the genders, females were significantly more likely to receive diagnose (Northam et al., 2005).

A meta-analysis highlights that high prevalence of depression and anxiety symptoms are associated with compromised treatment of diabetes and glycemic control (Buchberger et al., 2016). A review evaluating the association between depression and diabetes association concludes that coexistence of diabetes and depression is related to reduced treatment adherence, poor metabolic control and decrease in quality of life (Egede & Ellis, 2010). Also increased complication rates, disability and both use and costs of healthcare are connected to coexistence of these states (Egede & Ellis, 2010). Bächle et al. (2015) also presented results according which the association between specific depression symptoms and Hba1c levels differ by symptom and gender. These levels, for example were increased in women, if psychomotor agitation or retardation (a criterion for depressive symptoms in DSM-IV) was present (Bächle et al., 2015). What is known about this association between symptoms of anxiety, is that symptoms overall are associated with higher levels of Hba1c (Rechenberg, Whittemore, & Grey, 2017).

1.1.4 Psychological Treatment for Adolescents with Type 1 Diabetes

A large number of psychological interventions for diabetic adolescents have been studied, evidence is still insufficient for further practice recommendations for any of studied programmes (Murphy et al., 2006). Research has so far covered cognitive-behavioral therapy (CBT), motivational interviewing, peer-group interventions, family therapy, coping skills and stress management training, problem solving and telephone support (Hadlandsmyth et al., 2013; Murphy et al., 2006). Among different intervention models, CBT was the most common model of treatment when it was compared to psychoanalytical or counselling techniques (Winkley et al., 2006) . When family-based approaches have been compared with individual approaches in children and adolescent treatment, results indicate that family-based approach is more effective (Winkley et al., 2006). Psychosocial group interventions, such as psychoeducation or skill training groups, tend to show effect when psychosocial adjustment and adherence towards treatment is evaluated, but improvement in glycaemic control has not consistently followed these changes (Plante & Lobato, 2008). However, results of previous psychological interventions studies indicate, that they may be helpful in improving glycaemic control, although the effect usually remains small (Murphy et al., 2006; Winkley et al., 2006).

In their meta-analysis Winkley et al. (2006) conclude that even though psychological treatments on adults have not shown convincing evidence for achieving better glycemic control, there is proof for psychological treatments to improve glycemic control in childhood and adolescence (pooled reduction being 0.5%). Although the evidence of improvement is modest or even weak, and the results seem equivocal when evaluating treatment effectiveness for glycemic control, the need for psychological treatment can not be undermined as it affects treatment adherence of diabetes and psychological well-being of adolescents. However, further studies need to be carried out in order to determine the relation of glycaemic control and psychological treatment. Especially in adolescence, problems related to both psychological and chronic disease management are likely to manifest. Among cognitive behavioral therapies one of the third wave of therapies titled as Acceptance and Commitment Therapy (ACT), has shown promising result on different areas of health psychology, for instance with chronic pain and cancer patients, and it has been proposed to be especially suitable for adolescents (Hadlandsmyth et al., 2013). The next

section describes the principles of ACT and examines its' role in the treatment of patients with diabetes type 1 in adolescence.

1.2 Acceptance and Commitment Therapy

Acceptance and Commitment Therapy (ACT, said as one word, not initials: Accept, Choose and Take action) is a behavior analytically derived psychotherapy approach, which belongs into third wave behavior therapies - that is, a more recent generation of functional contextual psychotherapy approaches (Hayes & Wilson, 1994; Hayes, Strosahl, & Wilson, 1999; Hayes, 2016). ACT's main purpose is to promote psychological flexibility, which core components are psychological acceptance and committed action towards one's values (Hayes, Luoma, Bond, Masuda, & Lillis, 2006).

ACT is grounded in a philosophy of science termed functional contextualism, and a basic experimental analysis of human language and cognition called Relational Frame Theory (RFT). Functional contextualism highlights that we know the world only through our interactions with it, and these interactions are always contextually limited (Hayes, 2016). No event is believed to affect another in a mechanical way, and there exists a continuous scepticism about the worth of "truth" (Hayes, 2004). On the other hand, functional contextualism has a holistic focus. In ACT, these premises can be seen as conscious openness and acceptance towards all psychological events, without regard to their form (e.g. "negative", or "irrational"), as well as encouragement to adopt an ongoing interest in how to live according to one's values, while giving away the control of the literal truth of thoughts (Hayes, 2004). Content or existence of life difficulties (e.g. emotions, thoughts or events) is not a problem, while their contextually established function or meaning is (Hayes, 2004). Therefore, it is possible to go beyond attempting to change thoughts or feelings, and to target overt behavior and the context that causally links these psychological domains (Hayes et al., 2006). For example, "depression" is not assumed to be the problem when an individual is depressed (Hayes, 2004). Instead, it is the tendency to take our experiences literally and then to fight against them that is seen as destructive.

From an ACT's point of view, a primary source of psychopathology is the way which language and cognition produce an inability to persist or change behaviour to serve long-term

valued ends (Hayes et al., 2006). This kind of psychological inflexibility is argued in ACT and RFT to emerge from weak or unhelpful contextual control over language processes themselves (Hayes et al., 2006). This is particularly due to RFT's premise according to which the core of human language and cognition is the ability to formulate relations between events not only on the basis of their formal properties (e.g., size, shape), but also on the basis of arbitrary cues, and furthermore, to change the functions of specific events based on their relations to others (Hayes, 2016). While these relational frames are also beneficial, for example in deduction, they may cause harm to psychological well-being. For example, if a diabetic adolescent has learned that well-being is the same as not taking prescribed medicine, she or he might consider her or himself as incapable to feel comfortable and happy when obligated doing so. A primary concern of ACT is to treat experiential avoidance, excessive literal response to cognitive content, and the inability to make and keep commitments related to behavior change (Hayes, Levin, Plumb-Vilardaga, Villatte, & Pistorello, 2013). ACT targets these problems by increasing psychological flexibility (Hayes et al., 2006). A more detailed account of psychological flexibility is given in the following section.

1.2.1 Psychological Flexibility

According to a definition provided by Hayes, Pistorello, and Levin (2012), psychological flexibility refers to contacting the present moment as a conscious human been, fully and without defenses, and persisting or changing behavior in order to serve chosen values. Psychological flexibility is used to describe both the aim, and the theoretical model underlying Acceptance and Commitment Therapy (Levin, Hildebrandt, Lillis, & Hayes, 2012). The psychological flexibility model is composed of six processes that are considered to impact the psychological well-being of a person. These processes are described more in detail below.

Acceptance vs. Experiential avoidance. Experiential avoidance refers to a phenomenon in which an individual seeks to avoid contact with certain private experiences, such as bodily sensations, emotions, thoughts, memories, and behavioral predispositions (Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). As a consequence, one endeavours to alter the form, frequency of these events, or contexts that bring these experiences about; this is often done by constructing rules (Hayes et al., 2013). This, in turn, raises risk for a paradoxical twist, as distracting rules and events become related to what one wanted to avoid. For example, an attempt of a diabetic adolescent to

avoid contact with a feeling of being an outsider can actually create more opportunities for the aversive event, as this thought and control effort becomes, not only more aversive to an individual, but also verbally linked to negative outcomes, and so this attempt tends to narrow the range of acceptable behaviors since many behaviours (such as talking about one's diabetes) might evoke this feared private event. In ACT, Acceptance is a skill which can be taught (Hayes et al., 2006). It encompasses active and aware confronting of private experiences without attempts to change their form or density. For instance, a young diabetic would be encouraged to feel being an outsider or different as an emotion without battling against it. Furthermore, acceptance is a method to increase value-based action (Hayes et al., 2006). It is thought, that acceptance leads an individual towards value-based action through active curiosity, interest, and inspection of feelings, memories, bodily sensations, and thoughts, that are embraced with flexibility and presence in this moment.

Cognitive defusion vs. Fusion. The term 'fusion' refers to excessive or improper regulation of behavior by verbal processes, for example by rules (Hayes et al., 2012). Under cognitive fusion, human behavior is thought to be channeled rather by inflexible verbal networks than by possible opportunities provided by the environment. On the other hand, cognitive fusion is not always troublesome. For instance, to learn that you should check your blood sugar one hour after consumption of carbohydrates, is helpful for a diabetic person. However, if fusion is chronic it makes behavior narrow and rigid (Hayes et al., 2012). For example, it may not be helpful for a diabetic to learn to block emotion of being worried by measuring one's blood sugar. In contrast, cognitive defusion techniques aim to modify the unwanted impact of thoughts by creating contexts in which their unuseful impact is reduced, and by changing one's way to interact with his or her private events (Hayes et al., 2006; Hayes et al., 2013). For instance, when negative thoughts (e.g. "I cannot be worrying my diabetes or it gets worse") occur, an individual may be advised to thank one's mind for a thought, or to watch them go by as if they were written on leaves floating down a stream (Hayes et al., 2013). Labeling the process of thinking (e.g. "I am having the thought that I cannot be worrying my diabetes or it gets worse"), and to practice behaving in ways that are in contradiction with a thought (e.g. saying "I cannot be worrying my diabetes or it gets worse" while noticing that feeling worried itself actually does no harm to one's sugar levels) are also used methods.

Being present vs. Attentional rigidity to the past and future. Attention is often steered either towards the past (e.g. I ate some cake) or the future (e.g. I will eat some cake) or, for example, towards how things should (e.g. I should have eaten a fruit) or shouldn't be (I shouldn't have eaten cake) (Hayes et al., 2012). However, according to ACT life is what occurs to us only in this

moment. The term 'being present' is used to refer contacting with the present moment consciously and engaging in whatever is happening here and now in a flexible and voluntary manner (Hayes, Pistorello, & Levin, 2012; Russ, 2009). For instance, following one's breath is thought to provide opportunities to focus and bring attention back after it has wandered away.

Self as context vs Conceptualized self. When people are asked to describe themselves, they seem to have tendency to describe the conceptualized self, also known as self-narrative (e.g. "I am someone who takes good care of my blood sugar") (Hayes et al., 2012). However, the attempt to be right about these descriptions can lead to denial of conflicting content. This might, in turn, decrease behavioral flexibility, and increase experiential avoidance of events that threaten the conceptualized self (Hayes et al., 2012). For instance, overidentifying with a self-conceptualization "I am someone who takes good care of my diabetes", could lead an individual to experience strong emotions and conduct heightened experiential avoidance, for example not to measure one's sugar levels, in a situation in which one's blood sugar is not following the ideal range. In contrast, ACT's aim is to work towards a conscious sense of self in the present moment (Hayes et al., 2013). From this perspective, self is a context of verbal knowing, not the content of that knowing (Hayes et al., 2006). The limits of the self cannot be consciously known. Moreover, one can more easily have awareness of one's experiences without attachment to them (Hayes et al., 2006). Self as a context is worked forward by mindfulness exercises, metaphors, and experiential processes.

Values vs. Unclear, compliant, or avoidant motives. Values describe how we want to behave on an ongoing basis (Russ, 2009) . In ACT they are often referred as chosen life directions. The key problem in the domain of values are lack of clarity, them being based on attempts to avoid social criticism or to achieve approval, and values being based on avoidant rules made for escaping difficult emotions, such as shame (Hayes et al., 2012). A diabetic individual could, for example, strive for studying a certain subject because of being afraid of one's sickness causing problems if one strived for a career that actually interests him or her. ACT uses various exercises to help a client in establishing more clear, deeply held, freely chosen values in important domains, such as family, relationships, health, career and spirituality (Hayes et al., 2006); Hayes et al., 2012). For example, a client could be asked to write what she/he would most like to see on his/her tombstone. When values are clarified it is time to identify achievable goals that are compatible with them, concrete actions towards them and possible barriers to these actions (Hayes et al., 2004).

Commitment vs. Inaction, impulsivity, or avoidant persistence. In ACT, it is not only knowing what matters to you, what makes life rich, full and meaningful, but also taking an effective action accordingly (Russ, 2009). Whilst coming to this, inaction, impulsivity and avoidant

persistence are possible psychological barriers, and they are addressed through before mentioned ATC processes, such as acceptance and defusion. When seeking for commitment, ACT aims to link behavior into client's values (Hayes et al., 2012). This is done by continual redirecting of behaviour, as well as protocols and homework linked into therapy work (Hayes et al., 2004). Commitments are self-selected and self-monitored, and failure to meet them is treated with curiosity and non-judgment - as a valuable source of information about barriers to value-based actions (Hayes et al., 2012).

1.2.2 Effectiveness of Acceptance and Commitment therapy

Interventions based on ACT are a relatively new form of treatment. Scientific interest during almost twenty years has provided information about effectiveness of ACT in multiple application areas, including both psychological and somatic problems (Öst, 2014). A meta-analysis and review summarising the ACT effectiveness concludes that ACT interventions are *probably* efficacious for tinnitus and chronic pain and *possibly* efficacious for depression, mixed anxiety, obsessive compulsive disorder, psychotic symptoms, work related stress and drug abuse (Öst, 2014). Both Öst (2014) and Hayes et al. (2006) conclude, that ACT interventions are not yet confirmed to be evidence-based treatment for any disorder, although some promising results have been obtained. This is the case with diabetes treatment also and studies have covered so far mainly interventions for adults with type 2 diabetes (Gregg et al., 2007; Hoseini, Rezaei, & Azadi, 2014; Kaboudi, Dehghan, & Ziapour, 2017; Shayeghian, Hassanabadi, Aguilar-Vafaie, Amiri, & Besharat, 2016)

ACT-based intervention have been suggested to be effective in improving long term conditions and chronic diseases (Graham et al., 2016). In long term conditions, promising results about effectiveness have been observed with regard to psychological flexibility, seizure control in epilepsy, parenting of children with long-term conditions and disease management (Graham et al., 2016; Lundgren, Dahl, Melin, & Kies, 2006). Within ACT interventions for diabetes type 2 results report that ACT intervention participants were more likely to use effective coping strategies or use strategies that intervention taught, report improvement in self-care and have their HbA1c levels in the target level afterwards (Gregg et al., 2007). An ACT intervention promoted self-management behaviors (Hoseini et al., 2014) and had significant impact on participants mental health (Kaboudi

et al., 2017). According to Gregg et al. (2007), observed impact on HbA1c level was mediated by both changes in diabetes-related acceptance and self-management behaviors.

1.2.3 Acceptance and Commitment Therapy for Adolescents with Type 1 Diabetes

There is a growing body of literature that recognises ACT as a prominent psychological intervention for chronic health conditions (Hadlandsmyth et al., 2013). Furthermore, ACT intervention is proposed to be particularly applicable to adolescents with diabetes type 1. Hadlandsmyth et al. (2013) suggest that cognitive fusion and experiential avoidance have a particularly negative influence on diabetes management behaviors in adolescents. Diabetic youth may especially fuse with thoughts such as "My diabetes makes me fat and different", and hence engage in unhealthy eating or avoidance of insulin injections in order to alleviate the painful thoughts and to hide their illness. Moreover, in a study investigating diabetic children by using the Diabetes Acceptance and Action Scale for Children and Adolescents (Greco & Hart, 2005) revealed, that psychological flexibility was significantly correlated with better diabetes-related quality of life, adherence to medication, and with less diabetes-related worry (Ciarrochi & Bilich, 2006). In short, promoting psychological flexibility (opposite to experiential avoidance and cognitive fusion), could be a promising approach with young diabetics.

So far there is scarce literature supporting Acceptance and Commitment Therapy as a psychological treatment for adolescents with type 1 diabetes. In a study of 12 - 15 year-old children and adolescents with diabetes, it was found that ACT as a group intervention was effective in reducing depression, and feeling of guilt, and in increasing the psychological well-being of diabetic children (Moghanloo, Moghanloo, & Moazezi, 2015). However, the study fails to consider the different types of diabetes while mixing them in one study setting despite the fairly different treatment regimen of diabetes type 1 and 2 (Moghanloo et al., 2015). Similarly, in a study conducted with the same target group found that a structured ACT group intervention was effective in reducing stress and in increasing health-related self-efficacy of children with diabetes (Moazzezi, Ataie Moghanloo, Ataie Moghanloo, & Pishvaei, 2015).

Previous studies on diabetes type 1 and type 2 have suggested an association between diabetes-related acceptance of thoughts and emotions and glycemic control. For instance, in a study

investigating acceptance and coping-ability of persons with insulin-dependent diabetes mellitus, Richardson, Adner, and Nordstrom (2001) reported, that individuals with high degrees of diabetes acceptance had a high sense of coherence. In addition, a greater acceptance of the disease was associated with lower HbA1c levels. Furthermore, in their study Weijman and colleagues (2005) found that avoidant coping style with regard to diabetes (i.e. avoidance of negative thoughts and feelings associated with diabetes) was associated with poor blood glucose monitoring and a high sense of being burdened by the management of the disease. In their controlled study investigating the relationship between coping style and perceived quality of life, Coelho, Amorim, & Prata (2003) discovered that avoidant coping styles were more common among type 2 diabetic patients than in a non-diabetic control group, and that avoidance of negative emotions was associated with lower quality of life.

In the pilot study of the current research project, the ACT intervention had a significant effect on psychological flexibility, but not on depressive symptoms and glycemic control, although the clinical effect was observed to be large in depression and a small clinical effect was observed in glycemic control (Ristolainen & Räihä, 2016). Our work aims to contribute to the previous study, by examining the effectiveness of the ACT intervention on psychological well-being including anxiety, and also examine whether the results obtained in the pilot study remain when the number of participants increases. Taken together, these studies presented so far support the fact that providing an ACT intervention to adolescents with type 1 diabetes could be beneficial to their glycemic control, psychological flexibility and psychological well-being.

1.3 The Aim of the Study

Diabetes type 1 is a common condition which nevertheless has considerable consequences not only for well-being and health of an individual but also on a societal level. Psychological flexibility, in turn, has been noted to have promising effects on well-being among different kind of populations. However, few studies have investigated, firstly, if improving psychological flexibility is associated with better well-being and better glycemic control (here, HbA1c) among youth with diabetes type 1, and, secondly, whether psychological flexibility of adolescents with type 1 diabetes could be increased by using an ACT-based short intervention. In this thesis, we attempted to examine the

effect that ACT-based short intervention had on diabetic adolescents' psychological well-being, glycemic control and psychological flexibility. The research questions are as follows:

(i) First, our aim was to investigate the associations between glycemic control, psychological flexibility and psychological well-being in a cross-sectional setting, based on the pre-measurement. Several studies have shown promising benefits for psychological flexibility and psychological well-being. However, previous studies evaluating the association between psychological well-being and glycemic control have observed inconsistent results. This paper attempts to examine also the relationship between these two.

(ii) The main purpose of this study was to determine how acceptance and commitment therapy -based group intervention for adolescents with type 1 diabetes and poor glycemic control (i.e HbA1c over 7.5%) affects their HbA1c levels, their psychological flexibility and psychological well-being. According to previous studies we suggested (a) the group intervention may slightly improve the HbA1c level of adolescents, (b) their psychological flexibility skills are likely to improve and (c) their psychological well-being may improve during the intervention. Effectiveness of the intervention was compared to control group receiving treatment as usual (TAU), while the intervention group received both the intervention as well as the treatment as usual (ACT+TAU).

(iii) The third aim was to establish (a) whether change in adolescent's psychological well-being was associated with the change in glycemic control, (b) whether change in psychological flexibility of adolescence was associated with the change in glycemic control (HbA1c), and (c) whether change in psychological flexibility was associated with change in psychological well-being. This question attempts to define whether possible change in one variable of interest (e.g. in psychological flexibility) could be related with change in another or same variable of interest (e.g. with change in glycemic control).

(iiii) The fourth objective was to examine whether pre-measurement levels were associated with possible changes in the HbA1c level, psychological flexibility and psychological well-being (i.e. depression and anxiety symptoms) during the intervention. In particular, our purpose was to investigate if a value of a variable in pre-measurement (e.g. high blood glucose) could have some explanatory value for the change in the same or in another variable (e.g. for notable decrease in blood glucose).

(iiiii) Our final aim was to explore, first, the individual path of a participant that seemed to benefit from the intervention, based on changes of HbA1C level during the intervention (i.e levels showed a decrease). Second, we wanted to investigate the path of a participant that seemed not to benefit from the intervention (i.e levels showed an increase), in order to gain further understanding whether these two paths differed from each other and if so, in which way.

2 METHODS

The research data in this thesis is drawn from a collaboration project between the University of Jyväskylä and the Central Finland Health District, which seeks to investigate the usefulness of a Acceptance and Commitment therapy -based group intervention in the treatment of adolescents with type 1 diabetes. The project is part of psychologist Iina Alho's doctoral thesis study in health psychology. The project begun 2015 and from which first publication was released in 2018 (Alho, 2018). The group intervention has been developed for this study (Alho & Lappalainen, 2015), and it will be presented in detail in further sections. This thesis consists of data collected between spring 2016 and spring 2017.

2.1 Participants

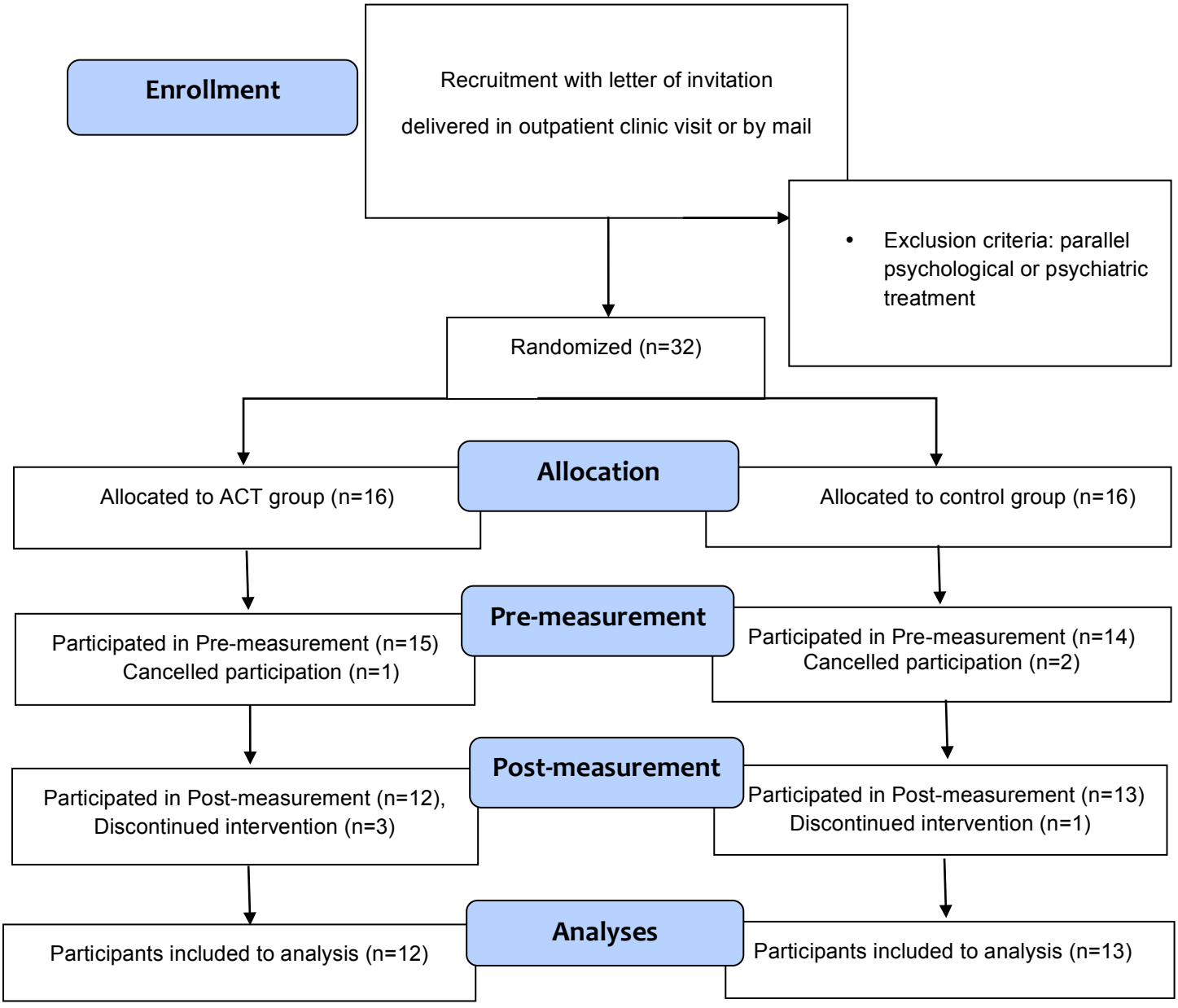
The target group of this study were adolescents with type 1 diabetes aged 12 to 16 years, whose glycemic control was over the recommended value (HbA1c > 7,5%) at recruitment. They had a doctor-patient relationship at the outpatient clinic of paediatric diseases at the Central Hospital of Central Finland. Prior to undertaking the investigation, ethical approval was obtained from the Central Finland Health District's Ethical committee. All adolescents of target group and their parents, were invited to participate in the study. Both oral and written information about the study were provided, and informed consent was obtained in written form. Enrolled participants (Figure 1.), were randomly assigned into the intervention and control group, which were controlled for age and gender. However, the duration of diabetes or the age of onset was not used as controlling factors. Both the ACT intervention group and the control group received treatment as usual (TAU) and completed pre-and post-measurements. The intervention group completed these measures also at the third meeting. Follow-up measurements were collected 8 months post intervention from both groups. However, this data is not yet fully collected and therefore not included in this thesis. Of a total of 32 participants (see detailed information about participant characteristics in Table 1.), three cancelled their participation before the pre-measurement and four discontinued participation during the intervention. Among adolescents who cancelled or discontinued four were girls and three were boys. Thus, the sample consisted of 25 adolescents. The age of the participants ranged between 12 -

15 (Mean 13.71, SD 1.38) and their HbA1c levels between 7.50 - 13.20 % (M 9.51 and SD 2.11). In our analyses data from pre-and post-measurement points is utilized.

Table 1. Participant Characteristics after randomization

Baseline characteristic	**ACT+TAU (n=16)**	**TAU (n=16)**
Age		
Mean (SD)	13.44 (1.03)	13.63 (1.41)
Range	12 - 15	12 - 16
Gender n (%)		
Girls	12 (75.0%)	10 (62.5%)
Boys	4 (25.0%)	6 (37.5%)
HbA1c (%)		
Mean (SD)	8.69 (1.17)	9.74 (1.72)
CI (95%)	8.07 - 9.32	8.83 - 10.66
Duration of diabetes		
Mean (SD)	5yrs 7mos (4yrs 3mos)	7yrs 5mos (3yrs 7mos)
Range	4 mos - 12 yrs 8mos	4 mos - 15yrs

Figure 1. Participant flow diagram



2.2 Procedure

To establish the effect of acceptance and commitment therapy based treatment in contrast to treatment as usual, the participants were randomized either to ACT+TAU (TAU = treatment as usual) or to TAU group. Glycated haemoglobin (HbA1c), psychological flexibility, diabetes-related acceptance, and depressive symptoms were observed in both groups.

The ACT based group program developed for the study is presented in Table 2. Themes and practices were prepared to suit the adolescents according to the ACT theory developed by Hayes et al. (1995). The intervention was composed of 5 x 1,5 hour sessions held every two weeks. Meetings took place at the Central Finland Central Hospital and included discussion and exercises. To improve learning, voluntary homework was given during each session. For this purpose, an exercise book composed by Iina Alho and Raimo Lappalainen was given to the participants (Alho & Lappalainen, 2015). Parents of the adolescents were invited to join the first and the last sessions of the intervention to enhance the collection of data. The meetings were instructed by psychologist Iina Alho assisted with psychology students from the university of Jyväskylä.

Table 2. The ACT based group program.

Session	*Goals and practices/assignments*	*Homework*	*Forms and interviews*
1.	Getting acquainted with the group ● Introductory games Behavioural analysis ● Current situation and previous solutions with glycemic control Values ● Value cards and personal goals ● Path of well-being and committed action	Value based action ● to perform one action based on individual's personal values per day	For the adolescents ● Pre-interview ● CAMM ● DAAS ● RBDI ● Kiddo-KINDL For the parents ● Pre-interview ● Kid- & Kiddo-KINDL

2.	Mindfulness ● Leaves on a stream Values ● Stepping out of the box Thoughts and emotions ● Breaking the routines ● Experiential practice about one's own comfort zone	Value based action ● To perform one action based on individual's personal values per day Achievement of realistic goals ● Setting realistic goals step by step	
3.	Thoughts and emotions ● "I cannot do" and do not think about *it* ● Identifying/recognizing obstacles, and working with them Mindfulness ● Mindful breathing and mindful eating Acceptance ● A metaphor: "Tug of war with a monster"	Value based action ● To perform one action based on individual's personal values per day Being present ● Piece of music, taking a walk and/or eating	For the adolescents ● CAMM ● RBDI ● Kiddo-KINDL's diabetes section
4.	Self as a context ● Metaphors: "House", "Sky and weather" ● Strength cards Acceptance ● Metaphors: "Uninvited guest", "Rock on a beach" ● Pop up announcements	Value based action ● To perform one action based on individual's personal values per day ● Who could help me in achieving my goals?	
5.	Review of the addressed themes ● Value cards ● Path of well-being ● Setting goals for the future ● Making a future plan to promote one's well-being ● Leaves on a stream ● Praising cards		For the adolescents ● Post-interview ● CAMM ● DAAS ● RBDI ● Kiddo-KINDL For the parents ● post-intervie ● Kid- & Kiddo-KINDL

2.3 Measures

The following measurements were employed in this study. The primary medical outcome variable and the marker of glycemic control was HbA1c. Psychological flexibility was measured with two different questionnaires: CAMM (Child and Adolescent Mindfulness Measure) measures adolescents general level of psychological flexibility and mindfulness, and DAAS (The Diabetes Acceptance and Action Scale for Children and Adolescents) assess diabetes specific psychological flexibility. Psychological well-being was assessed with Revised Beck Depression inventory. Life-quality was also measured with KINDL-R for adolescents and KIDDO-Kindl for parents. In this study, however, the life-quality data from neither adolescents or parents was not assessed.

2.3.1 HbA1c

Glycemic control was evaluated with HbA1c value, which measures the average level of blood glucose during the past three months (NIDDK, 2018). Regular monitoring of HbA1c level provides long term information about diabetes management, this monitoring is part of the standard treatment in Finland, and it is measured every three months. In general, levels over 7,5% are considered as marker of poor diabetes control, because the greater sugar levels are, the greater are the risks for further diseases and complications. HbA1c values utilized in this study were collected from the patient information system. This was collected at pre intervention, post intervention and also at 8-month follow-up. Overall HbA1c is the primary test used for diabetes, both in clinical and research settings (NIDDK, 2018).

2.3.2 CAMM

To assess acceptance and mindfulness for youth the Finnish version of Child and Adolescent Mindfulness Measure (CAMM) was used (Greco, 2011). CAMM is a measure for adolescents over the age of nine years (Greco, 2011). It includes 10 items, such as *"I pay close attention to my thoughts"* and *"I get upset with myself for having certain thoughts"* (reverse scored). Participants are asked to rate how often each item is true for them using a 5-point likert scale (0 never true; 4 always true) (Greco, 2011). Total scores are computed by summing the responses to the 10 items, yielding a possible range of 0 - 40 (Cronbach alpha, for pre-measurement α=.82 and for post-measurement α=.91). High scores on the CAMM reflect higher levels of present-moment awareness and nonjudgmental, non-avoidant responses to thoughts and feelings.

2.3.3 DAAS

The Diabetes Acceptance and Action Scale for Children and Adolescents (DAAS) is a 42-item measure that is used to assess the levels of diabetes related psychological flexibility and acceptance skills in youth with Type 1 diabetes (Greco & Hart, 2005) In the current study, a Finnish version of this scale, translated from English to Finnish by Iina Alho and PhD Päivi Lappalainen with the permission from Laurie Greco, was used (Alho, 2018). DAAS asks respondents to rate how often each item is true for them using a 5-point likert scale (0 never true; 4 always true). The propositions include such as *"I worry about my health a lot."*, *"I can live good life with my diabetes."* or *"I do things that are important to me even though I have diabetes."* To score DAAS, negatively worded items are first reversely scored, and then summed. The possible range yields from 0 to 168 (Cronbach alpha, for pre-measurement α=.87 and for post-measurement α=.88). High scores should reflect higher levels of diabetes-related acceptance and action (Greco & Hart, 2005).

2.3.4 RBDI

RBDI (Revised Beck Depression Inventory) is a mood questionnaire, which charts experienced, expressed and self-acknowledged mood of individual (Raitasalo, 2007). RBDI is a Finnish modification of the short form of Beck Depression Inventory and it consist of 13 questions concerning depression symptoms; such as sadness "How are you feeling", pessimism " How do you see your future" and self-harm "Do you have any thoughts of harming yourself" and one question about anxiety "Are you tense or distressed" (Raitasalo, 2007). Respondents are asked to rate the verbal alternative from 1-5 which best describes their feelings at present time. All these 14 questions are scored in similar manner: alternatives one and two are both scored as 0, alternative three as 1, alternative four as 2 and fifth alternative as 3. From section measuring depression symptoms, i.e questions 1-13, sum score is counted to evaluate symptom severity (Cronbach alpha, for pre-measurement $\alpha = .87$ and for post-measurement $\alpha = .75$). Values in this area are between 0-39, in which values 5-7 are considered as mild symptoms of depression, values 8–15 as moderate symptoms and values over 16 as severe symptoms. Within anxiety question the maximum score is 3, and results are suggestive about the experienced anxiety and severity of it (1=mild anxiety, 2=moderate anxiety, 3=severe anxiety). Reliability for anxiety were evaluated with repeated measures (.92) due this measure contains only one question. It should be noted that this inventory measures degree of depression symptoms difficulty and is suggestive about the level of anxiety, but it does not measure clinical depression or anxiety (Raitasalo, 2007). However, it has been reported to be suitable for measuring the self-experienced mood of youth and their symptom levels (Mäki, Wikström, Hakulinen-Viitanen, & Laatikainen, 2014).

2.4 Analysis

Data management and analysis were performed using IBM SPSS Statistics, version 24. Power Point Office tool - version 16 were used for graphical description of data. The connections (i) between psychological well-being (i.e amount of depressive and anxiety symptoms), psychological flexibility and glycemic control in pre-measurement were assessed by exploring correlation

relationships between the mean values. The same method was chosen to investigate the associations (iii) between the possible changes in psychological well-being, psychological flexibility, and glycemic control, as well as to assess the associations (iiii) between pre-measurement levels and possible changes on the variables. The distribution assumptions for parametric test got fulfilled for all other variables except for the measures of psychological well-being (RBDI depression & RBDI anxiety). When scrutinised with scatterplots, these measurements failed to fulfill the assumptions of parametric test for normality of variables. Hence, to see if a nonparametric measure gave the same measurement, measurements were carried out both by Spearman's rank correlation coefficient test and Pearson's product-moment coefficients of correlation. As comparison of the results exposed no anomaly between the two tests, a parametric Pearson's product-moment coefficients of correlation was adopted. The coefficients were determined for correlation as follows: $r \geq .70$ = strong correlation, $.70 > r > .30$ = moderate correlation, and $.30 \geq r$ = weak correlation. Since a search of the literature revealed few studies investigating the connections between glycemic control, psychological flexibility and psychological well-being, this study utilizes a two-tailed test. A major advantage of using a two-tailed test is that the direction of the relationship between variables is not specified, and hence, it becomes possible to gain more insight into a largely unexplored area. Value $p \leq 0.05$. was used as a limit for the statistical significance, while values ranging from $0.05 < p \leq 0.10$ were considered to be 'approaching significance'. The measures for psychological flexibility (CAMM & DAAS) as well as the measures for psychological well-being (RBDI depression & RBDI anxiety) were analysed separately.

To examine effectiveness of intervention (ii) possible changes within intervention and control group in HbA1c, psychological well-being (i.e amount of depressive and anxiety symptoms), and psychological flexibility (DAAS & CAMM) between pre-and post-measurement points, mean scores and standard deviations were calculated separately for both groups. Furthermore, to gain more detailed information about change between pre-and post-measurement, change score variables for each variable were calculated by subtracting pre-measurement from post-measurement. With change score variables mean scores and standard deviations were also computed,and reported separately with both groups. For statistical testing of group comparisons nonparametric tests were selected, due to the small amount of participants. Group comparisons within groups, i.e. between pre-and post-measurements with both groups, were performed with the Wilcoxon signed-rank test. Effect size were computed with rank correlation (r = W/S, in which W = test statistic, S = sum of ranks), which is effect size measure suitable for signed-rank test (Kerby, 2014). Group comparison between intervention and control group were evaluated with Mann-

Whitney U, with which effect sizes were computed with rank-biserial correlation (r = 1 - 2U÷$n1 \times n2$, in which U is test statistic and *n* amount of participants in group 1 and 2) (Wendt, 1972). To provide descriptive information of comparison between groups, line charts were also produced for selected variables (HbA1c, RBDI dep. and RBDI anx.).

To explore (iiiii) the individual path of a participant that seemed to benefit and a path of a participant that seemed not to benefit from the intervention, line charts for each participant of the intervention group were drawn, firstly for the HbA1c variable. Benefit was determined on the basis of change in HbA1c level (i.e level were declining or increasing). Participants were selected from line chart on the basis of high level of HbA1c (values close to 10 %) and similar starting point of the levels between participants at pre-measurement point. Individual paths were described by reporting descriptive information of these two participants (age, sex, duration of diabetes). Line charts were also drawn to other variables for all the participants in the intervention group (see Appendix). Moreover, the line charts of the two selected participants were distinguish from others for closer inspection. Variable information reported in Table 7 consists the descriptive information, pre-and post measurement values per each variable (HbA1c, RBDI dep., RBDI anx., CAMM, DAAS), and change between these measurement points.

3 RESULTS

3.1 The Connections Between Glycemic Control, Psychological Flexibility and Psychological Well-Being in Pre-Measurement

The relationship between glycemic control, psychological flexibility and psychological well-being in the pre-measurement in our study population was investigated with Pearson's product-moment correlation coefficient. As we can see from Table 3 (below), a negative correlation was found between the general diabetes-related psychological flexibility (DAAS) and glycemic control. Furthermore, Pearson's product-moment correlation coefficient revealed that there was a significant positive correlation between the number of anxiety symptoms and glycemic control. A significant negative correlation was found both between the general psychological flexibility (CAMM) and

depression and anxiety symptoms and also between the diabetes-related psychological flexibility (DAAS) and depression. These results suggest that higher psychological flexibility was associated with lower blood glucose levels and lower level of depression and anxiety (i.e. better psychological well-being), while a higher amount of anxiety symptoms was associated with a poorer glycemic control.

There was a significant positive correlation between the amount of depression and anxiety symptoms implicating, that adolescents who reported a high level of depression, also reported a significantly higher amount of anxiety. Finally, a positive significant correlation was also found between CAMM and DAAS, suggesting that respondents with a high level of acceptance and mindfulness skills had also a high level of diabetes-related acceptance and action.

Table 3. The connections between glycemic control (HbA1c), psychological flexibility (CAMM & DAAS) and psychological well-being (RBDI depression & RBDI anxiety) in pre-measurement in both groups (n=25). Calculated with Pearson's (r) product-moment correlation coefficient.

	HbA1c pre	CAMM pre	DAAS pre	RBDI depression pre	RBDI anxiety pre
HbA1c pre	1.000				
CAMM pre	-.15	1.000			
DAAS pre	-.44*	.61**	1.000		
RBDI depression pre	.32	-.53**	-.43*	1.000	
RBDI anxiety pre	.41*	-.42*	-.26	.61**	1.000

p* < .05, p**< .01, p*** < .001

DAAS = Diabetes Acceptance and Action Scale for Children and Adolescents
CAMM = The Child and Adolescent Mindfulness Measure

3.2 Intervention Effectiveness on Glycemic Control, Psychological Flexibility and Psychological Well-Being

The main purpose of this study was to determine the intervention effectiveness. Table 4 presents the mean scores and the standard deviations for both the intervention and control group's HbA1c level, psychological flexibility and psychological well-being at pre and post measurements. Changes during the intervention within both groups are reported, and significance of the change is evaluated both within groups and between groups. Effect sizes are also reported in order to determine the clinical effectiveness of the intervention.

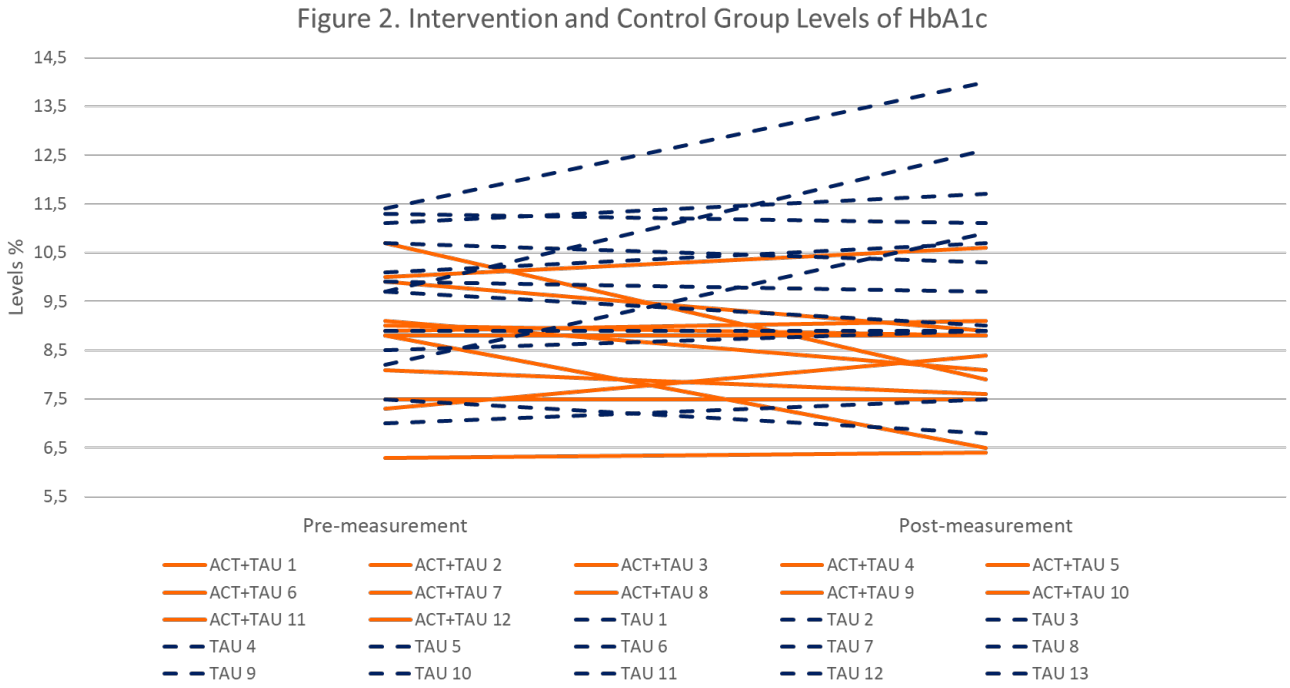
It can be seen from the Table 4, that acceptance and commitment therapy -based short intervention significantly increased diabetes-related psychological flexibility and the ability to manage diabetes (DAAS), and the change was significant both within and between groups. Comparison of the pre and post-measurement reveals, that this difference was significant, $Z = 2.18$, $p < .05$, within intervention group (ACT+TAU) and the effect size was large, $r = .74$. Moreover, whereas the diabetes-related psychological flexibility decreased (M = 0.54) in the control group (TAU), it increased in the intervention group. It must be noted, however, that the pre-post within group change in the control group was not statistically significant. Nevertheless, the effect size illustrates a moderate change, $r = .45$. The results indicate, that not only did the intervention group's scores on DAAS improve on an average level (M = 6.5 points), but standard deviation declined as well. When the intervention and the control group were compared (change scores in Table 4), a significant difference between groups was detected, $U = 36.0$, $p < .05$. Furthermore, the effect size of this difference was large, $r = .54$, indicating that the change was meaning significantly different in the intervention and the control group.

With regard to acceptance and mindfulness skills (CAMM), we can see that there was no statistically significant difference within or between groups. The within group effect sizes, however, implicate that there was a moderate change both in the intervention group, $r = .47$, and in the control group, $r = .30$, in the acceptance and mindfulness skills. However, in the intervention group this difference was smaller (M = - 0.42) than in control group (M = - 1.08). In the intervention group, differences in skills between the participants appeared to be increasing more than in the control group, which can be seen from the increase of standard deviation between the pre and post-measurements, even though the nature of these differences remains suggestive. When the intervention effect was compared between the groups, no statistical difference, or effect was

detected, *r* =.08. This implicates, that control and intervention group were not different from each other after intervention.

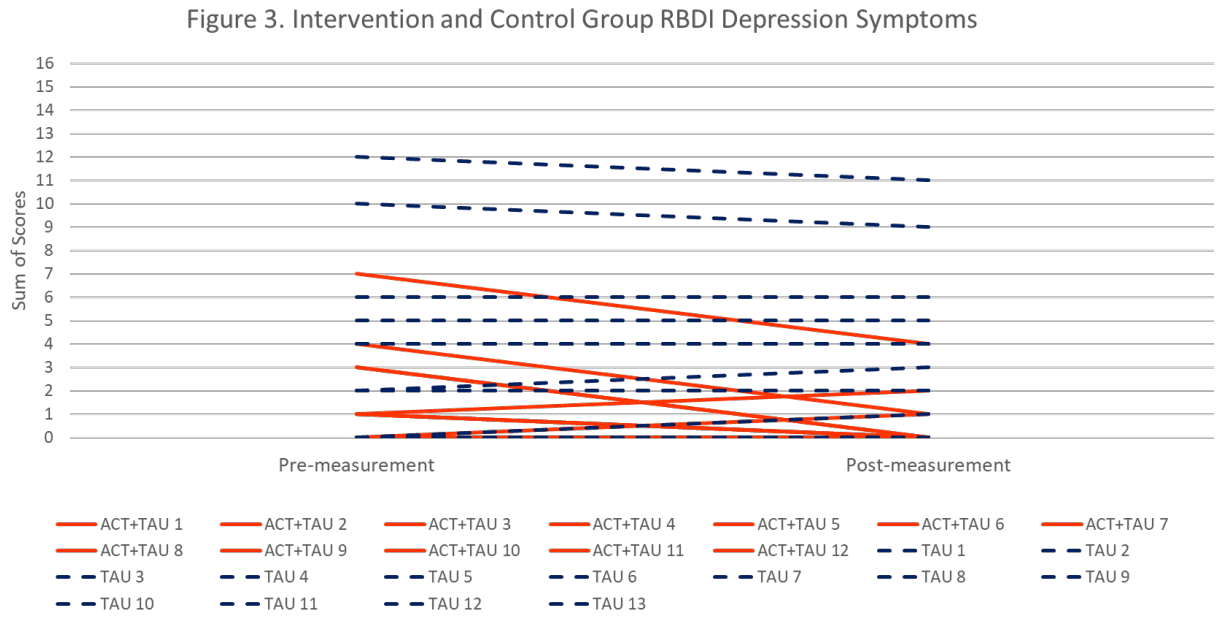
The intervention had no significant effect on glycemic control (i.e on the levels of HbA1c). Table 4 shows that within-group comparison, the effect size in the intervention group was small, r = .21. Also, the blood sugar levels in the intervention group decreased (M = 0.48). Although the changes were not statistically significant, HbA1c levels increased during the study period (M = - 0 .62), in the control group, and effect size of this change was large r = .60. The intervention and the control group did not differ from each other significantly. However, the effect size between the groups was moderate, r = .38. This implicates, that between the groups the change in HbA1c was moderately different between the groups. Closer examination of the individual changes between groups, that while the blood sugar levels tended to decrease in the intervention group, in the control group they tended to increase (Figure 2). Taken together, the mean of HbA1c was lower in the intervention group than in the control group both at the pre and the post measurements and the trend of change in the intervention group was descending. Nevertheless, it must be noted that the difference did not reach statistical significance in either of the groups.

Figure 2. Individual changes in glycemic control between intervention group (ACT+TAU, in graph solid orange line) and control group (TAU, in graph blue dash line).



No statistically significant increase in psychological well-being was detected in the intervention group. Nevertheless, the results, as shown in Table 4, indicate that the intervention had a small clinical effect in both the depression and the anxiety symptoms. Even though the depression symptoms declined, there was no significant difference in the intervention group between the pre and the post-measurements, Z = - 1.27. As noted before, the effect size was small *r* =.15. In the control group, no effect, *r* = .05, was detected. Although there was not significant difference in change scores between the groups the effect size implicated a small difference between groups, *r* =.24. A comparison of the groups revealed, that there was also some difference in both the level of depression and the anxiety symptoms. That is, on an average level, there were fewer symptoms in the intervention group. As shown in Figure 3, at the end of the treatment there were fewer depression symptoms in the intervention group than in the control group, and, what is more, if symptoms existed they seemed to decrease. Treatment as usual (TAU) did not seem to have an effect on depressive symptoms.

Figure 3. Individual changes in depressive symptoms between intervention group (ACT+TAU, in graph solid orange line) and in control group (TAU, in graph blue dash line).



There was no significant change in the groups in anxiety symptoms (RBDI anx.). The between group effect size was small, $r = 0.23$. In the intervention group, there was a small decline (M=0.17) in the number of symptoms, while there was a small increase in symptoms (M=- 0.08) in the control group. Figure 4 provides an overview of anxiety symptoms within both groups. As can be seen in the Figure, most participants (n=14) in both groups did not have any anxiety symptoms, and only in the control group the symptoms reached a moderate level (n=2). At pre and post-measurements, mild symptoms were reported similarly (n=6) in the groups. In the 'symptoms decrease' category (i.e from mild to no symptoms), there were only participants from the intervention group (n=2), while in the 'symptom increase' category (i.e from no symptoms to mild symptoms) all the participants were from the control group (n=1).

Figure 4. Individual changes in anxiety symptoms, which are categorized into five different classes according to the symptom severity. Within categorization amount of participants (n) who belonged into this category in intervention and in control group is described.

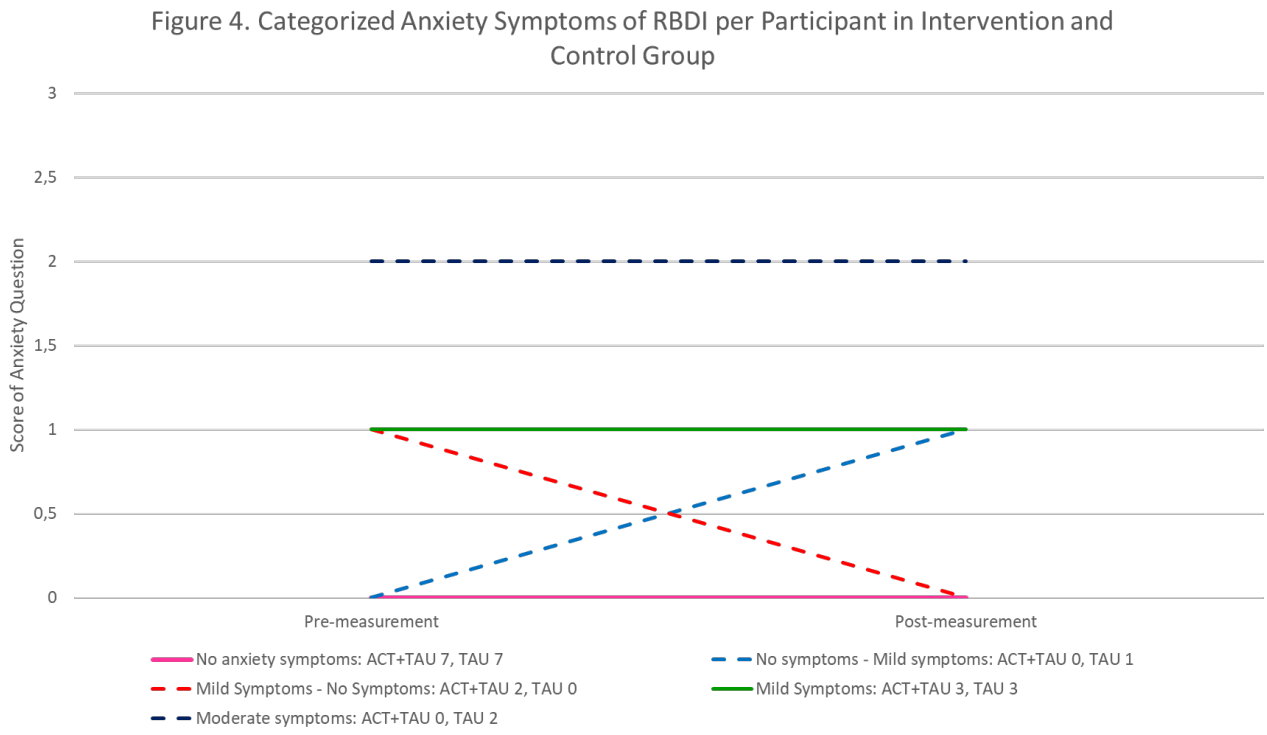


Table 4. Mean Scores and Standard Deviations at pre- and post-measurement, Change Score Mean and Standard Deviation between pre-and post measurements within both groups. Non-parametric test results of group comparison, within group changes reported with Wilcoxon Z, and between groups with Mann-Whitney U, significance level (*) and effect size for glycaemic control (HbA1C), psychological flexibility (CAMM & DAAS), depression and anxiety symptoms (RBDI dep./anx.).

	Pre-measurement **M (SD)**	**Post-measurement** **M (SD)**	**Change Score, (pre – post)** **M (SD)**	**Wilcoxon $Z^{(a)}$, Effect size r**	**Mann-Whitney $U^{(b)}$, Effect size r**
HbA1c					
ACT+TAU	8.70 (1.24)	8.22 (1.16)	0.48 (1.14)	-1.22 r = 0.21	48.00 r = 0.38
TAU	9.54 (1.44)	10.16 (2.0)	-0.62 (1.28)	1.22 r = 0.60	
CAMM					
ACT+TAU	29.50 (6.88)	29.92 (8.39)	-0.42 (4.40)	0.31 r = 0.47	71.50 r = 0.08
TAU	30.23 (5.66)	31.31 (6.05)	-1.08 (3.20)	1.27 r= 0.30	
DAAS					
ACT+TAU	127.50 (15.94)	134.00 (14.62)	-6.50 (8.87)	2.18* r = 0.74	36.00* r = 0.54
TAU	127.08 (17.04)	126.54 (17.39)	0.54 (6.09)	0.16 r = 0.45	
RBDI dep.					
ACT+TAU	1.75 (2.14)	1.08 (1.98)	0.67 (1.67)	-1.27 r = 0.15	59.50 r = 0.24
TAU	3.92 (3.71)	3.92 (3.28)	0.00 (0.58)	0.00 r = 0.05	
RBDI anx.					
ACT+TAU	0.42 (0.52)	0.25 (0.45)	0.17 (0.39)	-1.41 r = 0.00	60.00 r = 0.23
TAU	0.54 (0.78)	0.62 (0.77)	-0.08 (0.28)	1.00 r = 0.01	

*p < .05, **p < .01, ***p < .001,
r = rank correlations i.e. effect size, r < 0.1 small, r < 0.3 moderate, r < 0.5 large
Difference between two conditions (a) within groups (b) between groups
HbA1C= glycaemic control, %
CAMM= The Child and Adolescent Mindfulness Measure (min = 0, max = 40)
DAAS = The Diabetes Acceptance and Action Scale for Children and Adolescents (min = 0, max =168)
RBDI dep. = Revised Beck Depression Inventory for Depression (0-4 no symptoms, 5-7 mild symptoms, 8-15 modest symptoms, 16 or more = severe symptoms); RBDI anx. = RBDI– Question for Anxiety (1= mild symptoms, 2= moderate symptoms, 3= severe symptoms)

3.3 Connections of the Possible Changes Glycemic Control, Psychological Flexibility and Psychological Well-Being

The results of the correlational analysis conducted with Pearson's product-moment correlation coefficient between the changes in glycemic control, psychological flexibility, and psychological well-being both in the intervention group and in the control group are shown in Table 5. In intervention group the change in acceptance and mindfulness skills (CAMM) correlated strongly with the change in diabetes-related psychological flexibility (DAAS). This indicates that respondents who reported change in CAMM also reported change in DAAS. Meanwhile, in the control group, only a weak correlation was found between the change in CAMM and the change in DAAS.

We can see from Table 5 that there were no other significant correlations between the changes in glycemic control, psychological flexibility or psychological well-being. As can be seen from the Table 5, the connection between the change in glycemic control and the change in psychological flexibility (CAMM & DAAS) was low. Similarly, the change in glycemic control and depression and anxiety symptoms was relatively low.

The correlations between the change in psychological flexibility and the change in depression and anxiety were not significant in neither of the groups. Nevertheless, the table reveals a positive moderate correlation between the change in diabetes-related psychological flexibility (DAAS) and the change in anxiety symptoms in the intervention group. The result suggests that decrease in the levels in DAAS is associated with a decrease in anxiety symptoms.

As can be seen from the Table 5, even though the correlation between the change in depression symptoms and the change in anxiety symptoms was neither significant in either of the groups, there was a negative moderate correlation between the change in anxiety and change in depression symptoms in control group, that was interpreted to be approaching significance. This implicates that the decrease in depression was moderately associated with an increase in anxiety symptoms.

Table 5. Correlations (p-values in parentheses) between changes (pre-post) in glycemic control (HbA1c), and in psychological well-being (CAMM & DAAS) and psychological well-being (RBDI depression & RBDI anxiety) in the intervention group (ACT, n=12) and in the control group (TAU, n=13). Calculated with Pearson's (r) product-moment correlation coefficient *r* (sig.).

	Change in HbA1c	Change in CAMM	Change in DAAS	Change in RBDI depression	Change in RBDI anxiety
Change in HbA1c	1.000				
Change in CAMM	ACT -.04 (.910) TAU .10 (.753)	1.000			
Change in DAAS	ACT -.22 (.490) TAU -.06 (.837)	ACT .79** (.002) TAU .08 (.786)	1.000		
Change in RBDI depression	ACT .24 (.451) TAU -.20 (.507)	ACT -.47(.127) TAU -.18 (.555)	ACT -.39 (.214) TAU -.19 (.535)	1.000	
Change in RBDI anxiety	ACT -.34 (.276) TAU -.24 (.431)	ACT .31 (.327) TAU -.01 (.981)	ACT .55 (.062) TAU .18 (.568)	ACT .37 (.232) TAU -.52 (.068)	1.000

p* < .05, p**< .01, p*** < .001

DAAS = Diabetes Acceptance and Action Scale for Children and Adolescents
CAMM = The Child and Adolescent Mindfulness Measure

3.4 Correlations Between Pre-Measurements and Changes in Glycemic Control, Psychological flexibility and Psychological Well-Being

The relationship between pre-measurements and changes in glycemic control, psychological flexibility, and psychological well-being was also investigated with Pearson's product-moment correlation coefficient. Table 6 (below) provides the summary of the correlational analysis for pre-measurement levels and changes during the intervention. Overall, no significant correlation was found between the pre-scores and the change scores.

However Table 6 illustrates, that there was a moderate negative correlation between the pre-measurement of glycemic control and the change in diabetes-related psychological flexibility (DAAS; p=.069). This seems to suggest, that respondents who reported high blood glucose levels in the pre-measurement, reported more increase in diabetes-related psychological flexibility. Moreover, a positive moderate correlation was found between the pre-measurement values on HbA1c and the change in depression (p=.068), which seems to suggest that the higher a participant's blood glucose was the more one's depression symptoms decreased.

A positive moderate association was also found between the pre-measurement and change scores in anxiety (p=.077). This, in turn, suggests that the participants with more pre-measured anxiety reported decrease in the level of their symptoms.

Table 6. The connections between pre-measurement levels and possible changes during the intervention on HbA1c level, psychological flexibility (CAMM & DAAS) and psychological well-being (RBDI depression & RBDI anxiety) in intervention group (ACT+TAU; n=12). Calculated with Pearson's (r) product-moment correlation coefficient.

	HbA1c change	CAMM change	DAAS change	RBDI depression change	RBDI anxiety change
HbA1c pre	.52	-.22	-.54	.54	-.21
CAMM pre	-.12	-.06	.12	-.24	-.10
DAAS pre	-.08	.23	.42	-.42	.00
RBDI depression pre	.33	.12	-.18	.48	.06
RBDI anxiety pre	.08	.32	.15	.49	.53

p* < .05, p**< .01, p*** < .001

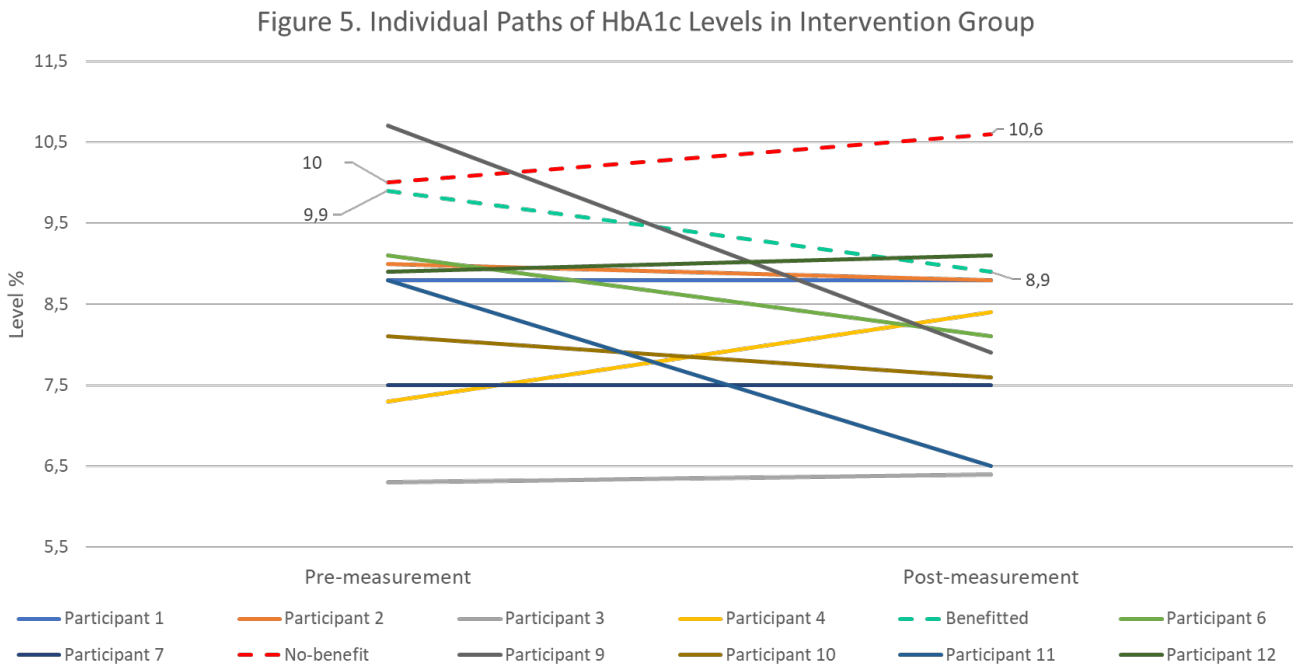
DAAS = Diabetes Acceptance and Action Scale for Children and Adolescents
CAMM = The Child and Adolescent Mindfulness Measure

3.5 Individual Paths

Our final aim was to explore the individual path of a participant that seemed to benefit from the intervention and a path of a participant that seemed not to benefit from the intervention regarding the changes in glycemic control (i.e. HbA1c level) were under observation. Figure 5 (below) illustrates HbA1c levels of all participants in the intervention group, from which participants 5 (see graph green dash line) and 8 (see graph red dash line) was selected to closer examination. Their levels were at the starting point on average 2,5% above the treatment recommendation value 7,5%

and they showed different trends for change. The path of the participant 5 was in this description seen therefore beneficial and the path of the participant 8 non-beneficial in terms of intervention utility for their glycemic control.

Figure 5. Intervention group participants (n=12) individual paths of HbA1c between pre-and post-measurments.



Between pre-and post-measurement, the HbA1c level of the benefitted participant decreased 1.0 %, while the HbA1c level of the participant who did not benefit increased 0.6 %. Background information reveals that participants were same gender and the mean of the duration of their diabetes was 8,5 years. Participant who benefitted from the intervention was, however, older than the no-benefitted participant - the difference was three years between them. This is an important notion because it raises the possibility of age and growth-related changes, which may have an effect on glycemic control.

The most obvious difference between participants appeared to be in the Diabetes-related Acceptance and Action (DAAS) scores, in which at pre-measurement both were approximately at a similar level, but at post-measurement there was a clear difference in these scores, the participant who benefitted from intervention, having higher levels in this measure A similar trend was observed

in Children's Acceptance and Mindfulness Measure (CAMM). Higher scores in CAMM implicating more acceptance and mindfulness (min 0, max 40) related skills with the no-benefitted participant at pre-measurement, but greater change within this measure with the benefitted participant during the intervention. Within RBDI depression symptoms measure, both participants are categorized not having symptoms of depression (cut-off for mild symptoms being 4), however during the intervention change is similar and they report no symptoms at all in post-measurement. In RBDI anxiety measure both participants report mild anxiety symptoms at pre-measurement, but at the post-measurement, the only participant whose glycaemic control did not improve, reports no symptoms at all.

Table 7. Descriptive information, variable data, and measured change (+/-) between pre-and post-measurements on participants from whom the other benefited and the other did not benefit from the intervention. The benefit of the intervention was determined on the basis of the HbA1c level change.

Descriptive information and Variables Pre-and post values (+/- amount of change)	**Benefitted from the intervention** Participant 5	**No-benefit from the intervention** Participant 8
Age	15	13
Sex	Girl	Girl
Duration of Diabetes (y)	9	8
HbA1c, %	9.9, 8.9 (-1.0)	10.0, 10.6 (+0.6)
RBDI Dep.	3, 0 (-3)	3, 0 (-3)
RBDI Anx.	1, 1 (0)	1, 0 (-1)
CAMM	19, 26 (+7)	34, 33 (-1)
DAAS	116, 139 (+23)	Pre 114, Post 117 (+3)

4 DISCUSSION

This thesis is a part of an intervention study examining the use of an ACT group therapy among adolescents with diabetes type 1. We aimed to assess the associations between glycemic control, psychological flexibility and psychological well-being of adolescents with diabetes type 1. Secondly, the main goal of the present study was to determine the efficacy of acceptance and commitment group therapy on glycemic control, psychological flexibility and psychological well-being of the adolescents. Thirdly, this thesis evaluated whether changes in psychological flexibility during the intervention was associated with changes in glycemic control, depression and anxiety symptoms. The fourth aim was to investigate if pre-measurements (e.g. high acceptance and mindfulness skills) could explain changes during the intervention (e.g. for notable decrease in blood glucose). The final aim of this paper was to explore the individual path of a participant that seemed to benefit from the intervention and a path of a participant that seemed not to benefit from the intervention, and furthermore to describe the possible accounts for these different trajectories.

4.1 The Connections Between Glycemic Control, Psychological Flexibility and Psychological Well-Being

The current study found that the better diabetes-related acceptance skills a respondent had, the lower blood glucose levels one also tended to have. A relationship between psychological flexibility skills and glycemic control has been reported in the literature. Gregg et al. (2007) found, that a diabetes education workshop combined with acceptance and commitment therapy improved the HbA1c levels of patients with type 2 diabetes, and, what is more, this effect was also mediated by diabetes-related acceptance and self-management. Also in accordance with the present results, previous studies have demonstrated that individuals with poorer diabetes-related flexibility skills have lower adherence to medical regimen, have poorer glycemic control, perform self-management activities less frequently, and also perceive these self-management tasks as a burden (Iturralde, 2017; Weijman et al., 2005). Thus, consistent with the literature, this study provides further support for the help of diabetics to develop better psychological flexibility abilities to better manage their glycemic control.

Another important finding was that the more anxiety an individual had, the higher one's blood glucose also was. This finding reflects those of Rechenberg et al. (2017) who also studied youth with type 1 diabetes and found that anxiety symptoms were associated with higher glycosylated hemoglobin (HbA1c) levels. Other studies on adolescents with type 1 diabetes have linked anxiety with poorer self-management and coping behaviors, depression symptoms, fear of hypoglycemia, and lower blood glucose monitoring frequency (Buchberger et al., 2016; Rechenberg, Whittemore, & Grey, 2017). Therefore, it is possible to hypothesize that anxiety is a significant risk factor for poor care and monitoring of type 1 diabetes that, despite its' autonomic management, requires good self-management and monitoring of blood glucose as well as attention to diet, physical activity, and coherent administration of insulin.

It is noteworthy that adolescents with diabetes type 1 have been found to have increased incidence of anxiety (Kovacs et al., 1997). Interestingly, this study found that general psychological flexibility was correlated with a smaller number of anxiety symptoms. It could conceivably be hypothesized that by supplementing treatment as usual with a training of acceptance and mindfulness skills can not only be beneficial due to it's direct effect to the management of diabetes, but also, because of it's possible indirect effect on glycemic control by altering the amount of anxiety.

The current study also found that the higher the level of general psychological flexibility an individual had, the better the psychological well-being he or she had as well (i.e. less depression and anxiety symptoms). Moreover, the higher the diabetes-related psychological flexibility was, the lower was the level of depressive symptoms. Consistent with the literature, these results suggest that high psychological flexibility is associated with better well-being in adolescents with type 1 diabetes. This finding is not surprising since enhancing one's psychological flexibility skills has been regarded as a way to promote one's well-being. Awareness and nonjudgmental acceptance of one's moment-to-moment experience are regarded as potentially effective antidotes against psychological distress, such as rumination, anxiety, worry, fear, and anger, many of which involve maladaptive tendencies to avoid, suppress, or over-engage with one's distressing thoughts and emotions (Keng, Smoski, & Robins, 2011). According to previous findings, mindfulness, which is regarded as a major process in ACT, produces many positive psychological effects, such as increased subjective well-being, reduced psychological symptoms and emotional reactivity, and improved behavioral regulation.

4.2 Intervention Effectiveness

The main purpose of this study was to determine the impact of acceptance and commitment therapy group intervention for adolescents with type 1 diabetes and poor glycaemic control (i.e HbA1c over 7.5%) on glycaemic control i.e levels of HbA1c, psychological flexibility and psychological well-being.

The main finding concerning effectivity was that the intervention increased diabetes-related psychological flexibility and ability to manage the disease. Clinical effectiveness of the ACT intervention on diabetes-related psychological flexibility and ability to manage diabetes was large. While the ACT intervention enhanced psychological flexibility and diabetes self-management, these skills seemed to weaken in the control group. These results seem to be consistent with previous research regarding the effectiveness of ACT interventions in long-term conditions in general (Graham et al., 2016; Lundgren, Dahl, Melin, & Kies, 2006). In earlier studies, ACT intervention effectiveness results are mainly obtained among diabetes 2 patients. Results of Hoseini et al. (2014) which reported ACT benefits on self-management behaviors with diabetes 2 patients, are in line with the observations made in this study. The present results are important taking into consideration that changes in diabetes-related acceptance and self-management behaviors are previously observed to be mediating the impact of ACT intervention on the glycaemic control level (Gregg et al., 2007).

In this study, the acceptance and commitment therapy group intervention was observed not to have significant effect on the levels of HbA1c. However, when clinical effects of the intervention were evaluated with effect size, small effect on HbA1c was detected, and the levels were decreasing. This result seems to be in accordance with previous intervention studies, which conclude that psychosocial interventions for type 1 diabetic children and adolescents had only limited effect on glycaemic control and with small effect size for decrease (Hadlandsmyth et al., 2013; Murphy et al., 2006). This observation is also in line with previous meta-analysis of psychological treatment efficacy in childhood and young adulthood. In their meta-analysis, Winkley et al. (2006) concluded that there is little evidence that psychological treatments could produce improvement on HbA1c level. Furthermore, in meta-analysis improvement on glycaemic control was detected to be around 0.5% (Winkley, Landau, Eisler, & Ismail, 2006). Similar improvement was also established in our study, although this change did not reach statistical significance. Results in this study were, however, obtained from a small number of participants. Further studies, with

larger number of participants, need to be carried out in order to validate, whether small clinical effectivity of ACT intervention is still observed on glycaemic control. As a limitation of this study can be seen the fact that HbA1c level was mean of past three months. In order to make further conclusions about acceptance and commitment therapy intervention possibilities to enhance glycaemic control especially among adolescents with weak glycaemic control, also follow-up measures should be included into the study. Treatment as usual was associated with an increase of the levels of HbA1c level, while in intervention group glycaemic control were slightly improving. This is in accordance with previous studies, suggesting that treatment as usual seems to be insufficient treatment for reaching optimal glycaemic control (Murphy et al., 2006).

Contrary to expectations and to previous results from pilot study of Räihä & Ristolainen concerning intervention effectivity (2016), this study did not find a significant effect on general acceptance and mindfulness skills, although an effect was found regarding diabetes related flexibility skills. Both the intervention and the control group had moderate increase in these skills, but groups remained similar on this measure during the observation period. An interesting observation in the intervention group was that, during the intervention differences in skills were increasing between the participants and there were both increase and decline in these scores. Thus, there were individual differences in the impact of the ACT intervention on the flexibility skills. Figure 7 shows that most of the participants obtained high scores in this measure already at the pre-measurement. This could explain why no statistical changes in this measure appeared. However, this matter should be further studied in order to establish whether this result that was contrary to what was expected remains.

Psychological well-being was in this study assessed with symptoms of depression and anxiety. Intervention effect on well-being was not observed in statistical analyses, although small clinical effect, in this case manifested as decline, was observed within both symptoms of depression and anxiety. These results are in line with previous studies of ACT interventions in general, which suggests that the ACT intervention is possibly effective for treatment of depression and anxiety (Öst, 2014). Also, in previous studies the ACT interventions with diabetic patients have been shown to be beneficial for improving participants mental health in general, reducing depression and increasing psychological-well being (Kaboudi, Dehghan, & Ziapour, 2017; Moghanloo, Moghanloo, & Moazezi, 2015). The results of this study concerning psychological well-being seems to be in agreement with ACT intervention effectiveness with diabetes. Although when interpreting our results, important notion is that in the intervention group symptoms with both well-being measures were lower than in the control group, and most participants were categorized into

no or mild symptom category already at the beginning of the intervention. Due these low symptom levels descriptive information was obtained in order to gain more accurate information on these changes in groups and individual level. It turned out that if symptoms of depression existed intervention decreased them in five participants (see appendix Figure 8), and only two participants experienced more symptoms, and rest no symptoms at all. As can be expected in the control group no similar effect was observed with depression or anxiety symptoms, when treatment as usual contained no psychological counseling.

Regarding the anxiety symptoms, no changes within groups during intervention were observed neither in the intervention nor in the control group. However descriptive information revealed that most participants in both groups remained at no symptom category during the whole intervention, this observation possibly explaining why no change occurs. Figure 4 also illustrated that only in the intervention group there were a category in which symptoms decreased from mild to no symptoms. These findings may be somewhat limited by the fact that the study included small number of subjects and the anxiety measure consisted only of one question (Raitasalo, 2007).

4.3 Associations between Changes in Glycemic Control, Psychological Flexibility and Psychological Well-Being

Interestingly, in the control group, whether a participant's diabetes-related psychological flexibility (DAAS) decreased, one's anxiety symptoms seemed to decrease as well. This result has not previously been described, and it is contrary to previous studies which have suggested that psychological flexibility could actually have a significant mediating role in the treatment and reducing of anxiety symptoms, and that ACT-based treatment works more efficiently on anxiety of individuals with higher levels of psychological flexibility (Fiorillo, McLean, Pistorello, Hayes, & Follette, 2017; Fledderus, Bohlmeijer, Fox, Schreurs, & Spinhoven, 2013; Yadavaia, Hayes, & Vilardaga, 2014). This rather contradictory result in our study may be due to small sample size (here, 13 participants), and low prevalence of anxiety symptoms in our sample. Furthermore, the Pearson's product-moment coefficients of correlation showed that this association was only approaching significance.

Contrary to expectations, these results did not provide further support for connections between the changes in glycemic control, psychological flexibility, and psychological well-being. However, there are multiple reasons to interpret these results with caution.

4.4 Correlations Between Pre-measurements and Changes in Glycemic Control, Psychological Flexibility and Psychological Well-Being

In the current study, exploring the relationship between the pre-measurement and changes in glycemic control, psychological flexibility and psychological well-being in the intervention group showed no statistically significant associations. In other words, these results do not give support for the idea that the level of glycemic control, psychological flexibility skills nor psychological well-being before the intervention could predict the change in the intervention. When reviewing the literature, no studies were found investigating these associations.

However, the pre-measure level of HbA1c and the change in HbA1c level were discovered to have a moderate positive correlation (p=.080) suggesting, that participants whose blood sugar levels were at a higher level in the pre-measurement, also tended to have more decrease in their levels of blood glucose.

There was also a moderate negative correlation between the pre-measurement of glycemic control and the change in diabetes related psychological flexibility. This seems to suggests, that respondents who had high blood glucose in the pre-measurement, reported more increase in their diabetes related psychological flexibility. A possible explanation for this might be, that adolescents who were more in need of the intervention (i.e. their glycemic control was worse), also profited from it. This interpretation is in agreement with previous research that has shown ACT therapy to be more beneficial for those in a higher need of it, for instance, because of having more stressful life events, having higher distress or manifesting more experiential avoidance (Muto, Hayes, & Jeffcoat, 2011; Yadavaia et al., 2014). It is also possible to hypothesise, that the adolescents with higher HbA1c were more motivated to the therapy and, hence, to train their diabetes-related flexibility abilities. This, in turn, could be mediated by another factor, such as social support from the medical personnel or the family. This result may also be explained by the fact that the individuals whose

glycemic control was worse in the pre-measurement had also lower points in DAAS. That is to say, these individuals had more space for improvement in their diabetes-related flexibility skills.

Moreover, our results cautiously suggest that the higher a participant's blood glucose was before the intervention, the more decrease was in one's depression symptoms. This result might be related to similar factors as the previous finding. High blood glucose could reflect a greater need for an intervention or serve a link for a better motivation, or for more support or pressure, and hence, contribute to the intervention outcomes. Moreover, if the management of diabetes associated with an adolescent's depression, presenting new working models for better mastery and relationship with her/his diabetes could also make her/him to feel less depressed.

Even though only approximate, the present results might be significant in at least two major respects. They suggest that the ACT-based intervention could be especially beneficial for the adolescents under a greater risk of medical complications by increasing their diabetes-related psychological flexibility and by targeting their symptoms of depression. Nevertheless, it is important to bear in mind that this account must be approached with caution as the associations in this section did not reach statistical significance.

4.5 Individual paths

Our final aim was to explore individual paths of a participant that seemed to benefit and not to benefit from the intervention. Main finding concerning these path-differences was that the diabetes-related acceptance and action changes were larger with the participant who benefitted from the intervention. This observation seems to reflect the results of Gregg et al. (2007), which concluded impact on HbA1c level to be mediated by the changes in diabetes acceptance and self-management behaviors. Also, change in glycaemic control was associated with larger change in scores of acceptance and mindfulness skills.

It is somewhat surprising that in psychological well-being, both the symptom levels and the changes in these symptoms were almost similar. Both the participant who benefitted or did not benefit from the intervention experienced a decrease in depression symptoms. Surprisingly also, regarding anxiety, the participant whose glycaemic control level had increased during the

intervention did not report anxiety symptoms, and participant who benefitted still experienced mild anxiety symptom after intervention.

Why these results are surprising, is that the previous literature suggests the occurrence of psychological problems would be associated with poor glycaemic control (Bächle et al., 2015; Buchberger et al., 2016; Egede & Ellis, 2010; Rechenberg et al., 2017). Regarding the glycaemic control, it has to be taken into account, that participants belonged into different age groups. Thus, these changes may be due to other explanatory factors, such as hormonal fluctuations (Bryden, 2001; Cameron, 2006; Lévy, 2011).

4.6 Limitations and Strengths of This Study

The major limitation of this study is it's small sample size. This was partly due to regional issues, in Central Finland the population of adolescents with diabetes type 1 is relatively small and data collection is still ongoing. Due to the small sample size, the methods to analyze effectiveness of the intervention were restricted into non-parametric methods, which are less powerful and therefore less reliable. When drawing conclusions of the effectiveness of the intervention, the reader must observe the limitations associated with the small sample size.

Selection bias is also a potential concern as the individuals with frequent psychiatric or psychological contacts were excluded from the study. Hence, this study may be limited by the absence of diabetic adolescents with psychological symptoms and furthermore of individuals whom might have show more response to the intervention. As mentioned in the literature review, ACT therapy has founded to be more effective for those in a higher need of it (Yadavaia et al., 2014). This exclusion criteria might also explain why the psychological intervention did not produce notable effect on psychological well-being. Other possible sources of selection bias were that, the respondents were individuals and families that were motivated to participate in the study and also the attrition of participants.

Finally, a possible limitation of this study is that the values for psychological flexibility and well-being were based on self-reported estimates. This might be a source of weakness because it allows an individual to respond in a socially desirable manner instead of giving a more objective or

truthful answer. Furthermore, what is also noteworthy is that anxiety was measured only by one question. It is possible that one question is not sensitive enough to capture the phenomenon of anxiety or to be equivalent to an anxious individual's perception of one's state.

A strength of this study is that it utilized pretest-posttest design, and that it included a control group. Because of this, it provides extended information about the intervention effects. Also measurement tools reliability (e.g. internal consistency) was evaluated to be good with all measurements, Cronbach's alpha >.60, which can be considered as a strength. As a final strength of the present study is that it examined the ACT intervention impact on type 1 diabetic adolescents and the effects that improving psychological flexibility on adolescents with type 1 diabetes could have, and lays therefore groundwork for future research in this matter.

4.7 Clinical Implications and Future Directions

The findings of the study suggest, that psychological flexibility may have a vital role both in glycemic control and well-being of adolescents with type 1 diabetes. Furthermore, anxiety seems to be associated with problems in glycemic control. Prior studies have also noted many positive effects of psychological flexibility on different target groups and chronic illnesses (Graham et al., 2016). However, the findings reported here, shed new light in psychological flexibility on adolescents with diabetes. Anxiety may pose a risk for management of diabetes in adolescence and therefore anxiety symptoms and their treatment need better recognition and care.

The current study implicates that ACT-based group intervention is effective in improving diabetes-related acceptance and the ability to manage the diabetes among adolescents with type 1 diabetes and poor glycaemic control. Further research is, however, required to establish the therapeutic efficiency and long-term effects of this type of intervention. Follow-up studies are needed to assess whether the detected changes and improvement have stability and to examine the long-term consequences of the improvements.

ACT-based short intervention had clinical effectiveness on glycemic control, at least with some participants. Further work is needed for better understanding the individual paths and, on the other hand, underlying mechanisms of enhancement in glycaemic control. HbA1c value does not

capture the daily fluctuations or address the management issues of blood sugar. Therefore experiments, using a broader range of tools to evaluate glycemic control, could shed more light on the management of diabetes.

With regard to psychological well-being, studies should also include adolescents from clinical populations with more severe depression and anxiety symptoms. This study could not reliably reveal connections related to changes in HbA1c, flexibility skills and well-being, even though it provided some suggestions for future studies. It seems that worse glycemic control could be associated with better intervention effectivity on psychological flexibility and psychological well-being. Further experimental investigations are, needed to estimate these suggested associations. In future, also healthy participants group should be included in the comparison condition.

Supplementing treatment as usual with the training of acceptance and mindfulness skills can not only be beneficial due to it's direct effect to the management of diabetes, but also, because of it's possible indirect effect on glycemic control by altering the amount of anxiety. ACT intervention in a group form also offers a source of peer support, which could be especially relevant in adolescence. On the basis of this study, ACT group intervention can be recommended to be included in the treatment of adolescents with diabetes type 1, in order to provide support and develop skills to manage with diabetes.

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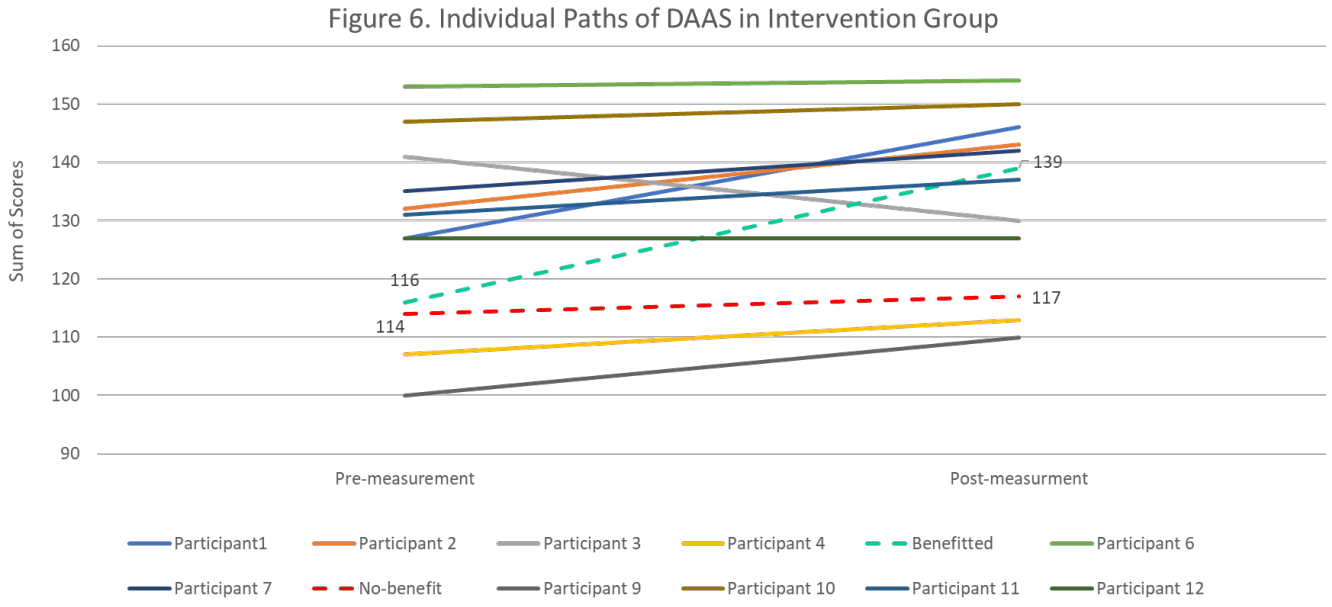
APPENDIX

Figures 6-9 Intervention group individual paths in each variable between pre-and post-measurements.



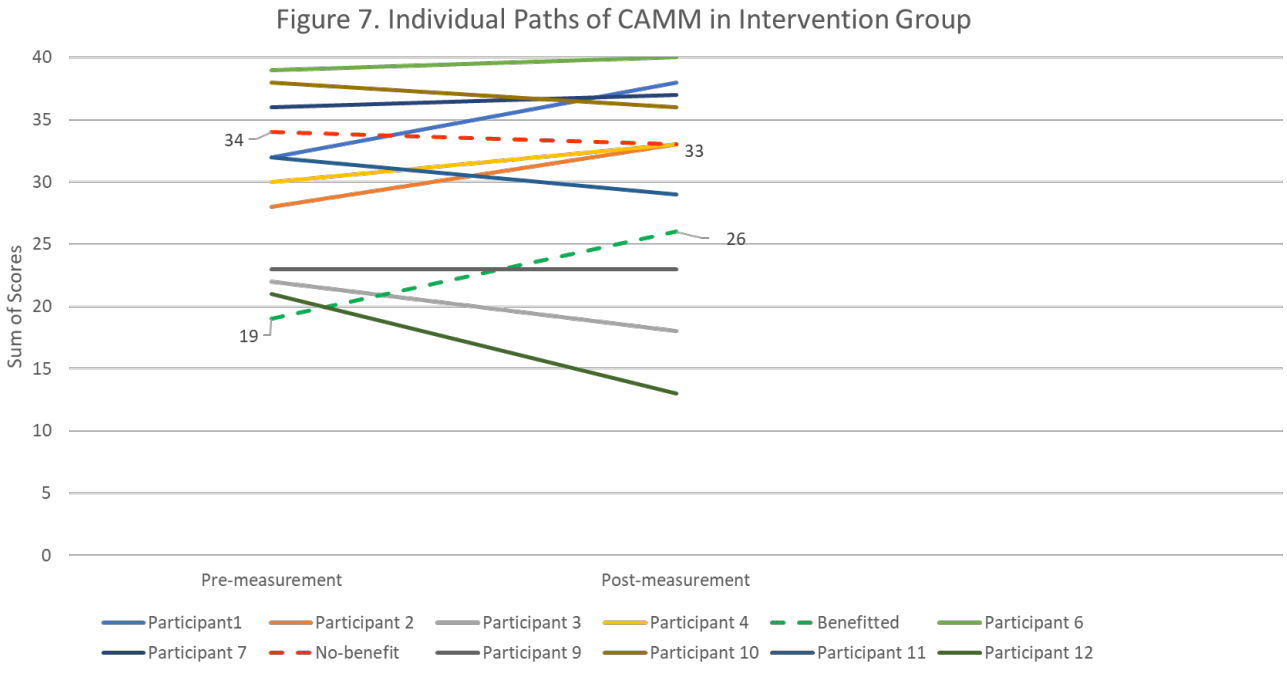


Figure 8. Individual Paths of RBDI Depressive Symptoms in Intervention Group

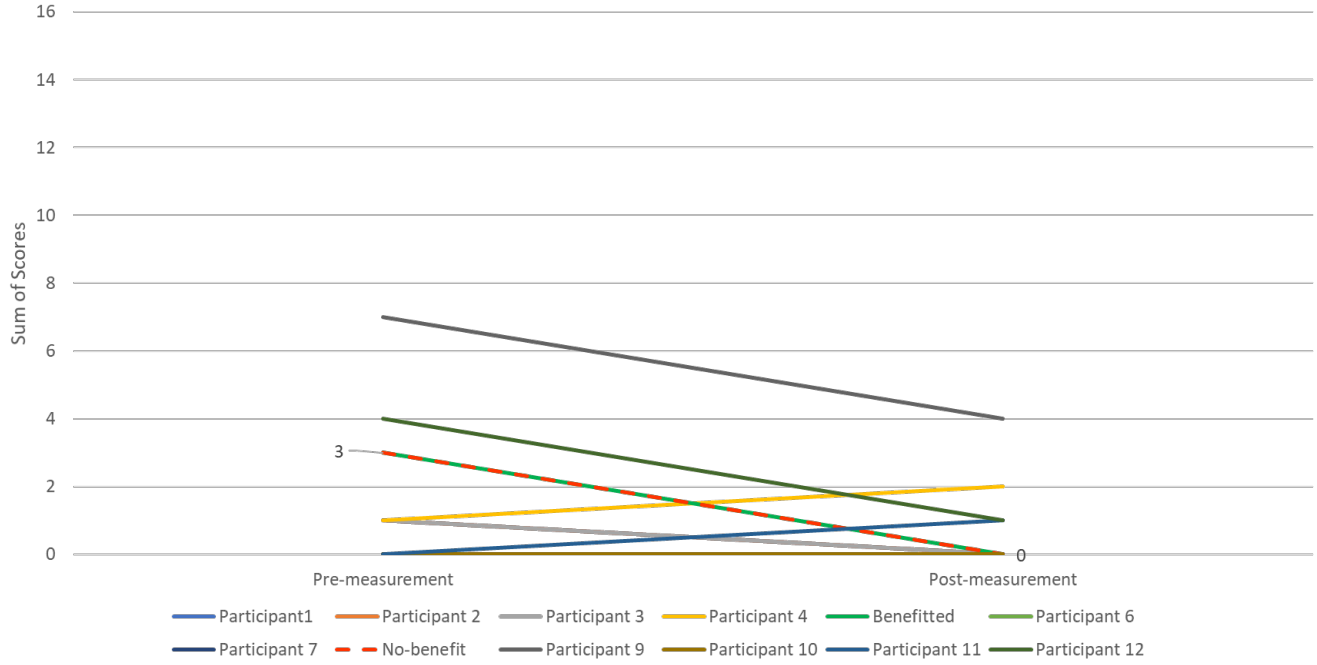


Figure 9. Individual Paths of Anxiety in Intervention Group Categorized by Symptom Severity