Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review

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Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review

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This has meant that the HTA panels can now focus more explicitly on health technologies (‘health technologies’ are broadly defined to include all interventions used to promote health, prevent and treat disease, and improve rehabilitation and long-term care) rather than settings of care. Therefore the panel structure has been redefined and replaced by three new panels: Pharmaceuticals; Therapeutic Procedures (including devices and operations); and Diagnostic Technologies and Screening.

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<th>Description</th>
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<tbody>
<tr>
<td>AI</td>
<td>anchored instruction</td>
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<tr>
<td>CG</td>
<td>control group</td>
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<tr>
<td>CI</td>
<td>confidence interval</td>
</tr>
<tr>
<td>CRD</td>
<td>Centre for Reviews and Dissemination</td>
</tr>
<tr>
<td>CST</td>
<td>coping skills training</td>
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<tr>
<td>DCCT</td>
<td>Diabetes Control and Complications Trial</td>
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<tr>
<td>df</td>
<td>degrees of freedom</td>
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<tr>
<td>DKA</td>
<td>diabetic ketoacidosis</td>
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<tr>
<td>GHb</td>
<td>glycated haemoglobin</td>
</tr>
<tr>
<td>GP</td>
<td>general practitioner</td>
</tr>
<tr>
<td>HbA₁</td>
<td>the normal form of haemoglobin</td>
</tr>
<tr>
<td>HbA₁c</td>
<td>haemoglobin that is attached to glucose</td>
</tr>
<tr>
<td>HDL</td>
<td>high-density lipoprotein</td>
</tr>
<tr>
<td>IDDM</td>
<td>insulin-dependent diabetes mellitus</td>
</tr>
<tr>
<td>IG</td>
<td>intervention group</td>
</tr>
<tr>
<td>LDL</td>
<td>low-density lipoprotein</td>
</tr>
<tr>
<td>MODY</td>
<td>maturity-onset diabetes of the young</td>
</tr>
<tr>
<td>NS</td>
<td>not significant</td>
</tr>
<tr>
<td>RCT</td>
<td>randomised controlled trial</td>
</tr>
<tr>
<td>SD</td>
<td>standard deviation</td>
</tr>
<tr>
<td>SMBG</td>
<td>self-monitoring of blood glucose</td>
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Background

Insulin-dependent diabetes mellitus, also known as type 1 diabetes, is a life-threatening condition and is the third most common chronic illness among young people. As a result of minimal or non-existent insulin production, people with diabetes must take over the normally automatic task of regulation of blood glucose levels. This is achieved by a complex regimen involving multiple, daily administrations of insulin coordinated with dietary intake and energy expenditure and monitored by blood glucose testing.

Objectives

To examine the effectiveness of educational and psychosocial interventions for adolescents with type 1 diabetes designed to improve their diabetes management. Specifically, it addressed the following research questions:

1. Do educational and psychosocial interventions for adolescents with type 1 diabetes have beneficial effects on biological and psychosocial outcomes?
2. Are there types or features of interventions that have been shown to be more effective than others?
3. What evidence is there of the cost-effectiveness of interventions?

Methods

A search strategy was formulated, piloted and refined. Three journals were handsearched, 11 electronic databases were searched and personal contacts, flyers, conferences and websites were used to notify the research community of the review to access further literature. This process generated 10,535 abstracts, which, after screening, resulted in 367 articles identified for retrieval. This number was augmented by hand-searching, personal contact and exploding references, and a final total of 457 articles were scrutinised. Of these, 64 reports describing 62 studies were identified as empirical papers evaluating educational or psychosocial interventions. The relevant data were extracted from the papers and summary tables for each study were prepared. Where possible, effect sizes were computed for outcomes from studies that included a randomised control group (CG) and other relevant information.

Results

A descriptive analysis of the 62 studies was undertaken. Most studies (67.7%) were conducted in the USA and 41% were randomised controlled trials (RCTs), none of which were UK-based. Only 48% of the reports provided an explicit theoretical rationale for the intervention. The mean number of participants was 53.8. The studies took place in various settings, evaluated a variety of interventions, involved various interventionists, addressed various components and assessed the effects by a range of outcomes, including measures of metabolic control and psychological and behavioural outcomes. Follow-up assessments were relatively rare.

The effectiveness of interventions

The 25 RCTs were examined in more detail and three of the most effective were described in depth. Effect sizes could be calculated for 14 studies. The mean (pooled) effect size for psychosocial outcomes was 0.37 and 0.33 for glycated haemoglobin with outliers (0.08 without outliers), indicating that these interventions have small to medium beneficial effects on diabetes management outcomes.

A narrative review of the 21 pre–post studies with no CG was performed, including evaluations of interventions conducted at summer camps, interventions for poorly controlled patients and educational interventions. All studies reported beneficial effects.

Cost-effectiveness

Few studies addressed economic considerations associated with interventions, and the lack of information on costs and the diversity of outcomes included by investigators impeded cost-effectiveness comparisons. Shorter hospitalisation at diagnosis is at least as effective in achieving
control and avoiding complications in adolescence as longer stays. Home care may result in improved outcomes but may not be cheaper than hospital care at diagnosis. Targeting poorly controlled subjects may reduce adverse events and hospitalisations and may be more cost-effective than generic interventions. There is a need for rigorous cost-effectiveness studies of educational and psychosocial interventions for adolescents with type 1 diabetes that include longer-term considerations.

Conclusions
The following conclusions were drawn from this review:

1. Educational and psychosocial interventions have small to medium beneficial effects on various diabetes management outcomes.
2. Well-designed trials of such interventions are needed in the UK (no completed RCTs of educational or psychosocial interventions for adolescents with type 1 diabetes conducted in the UK were found).
3. The evidence, arising primarily from studies in the USA, provides a starting point for the design of interventions in the UK.
4. Quantitative and narrative analysis of the evidence suggested that interventions are more likely to be effective if they demonstrate the inter-relatedness of the various aspects of diabetes management. The effectiveness of interventions should be evaluated by assessing outcomes that the intervention explicitly targets for change, and at the appropriate point in time post-intervention to reflect the impact of the intervention.
5. Interventions need to be evaluated by well-designed studies, such as RCTs, including adequately powered patient-preference trials reporting results in such a way as to enable effect sizes to be calculated.
6. An important gap in the evidence is that there is no systematic understanding of whether interventions should be targeted (e.g. modified for different disease stages, different types of diabetes management problems or the different age groups subsumed by adolescence).
7. To reap economic returns, interventions need to show durable favourable effects on behaviour and metabolic control, but there is a lack of cost-effectiveness studies that fully address the resource implications of educational interventions for adolescents and long-term consequences.

Recommendations for further research
Research to date has proceeded piecemeal instead of cumulatively. Given the absence of high quality UK-based studies, a programme of primary research on adolescent interventions should be developed. This review recommends that a phase of programme development be undertaken involving a consultation process with adolescents with type 1 diabetes, their families, doctors, nurses, health economists and health psychologists. This consultation exercise would enable the establishment of possible interventions that are seen as plausible and potentially effective by patients and their parents, feasible and practical in the context of the NHS diabetes services and understood and accepted by doctors and nurses as key and integral parts of diabetes care. The interventions would also need to have the potential to be cost-effective and be based on sound behavioural principles. Such interventions, if subsequently demonstrated by commissioned research to be effective, would be much more likely to be implemented than ones developed without such a process.
Chapter 1

Background

Research questions

This systematic review examined the effectiveness of educational and psychosocial interventions for adolescents with type 1 diabetes. Specifically, it addressed the following questions:

1. Do educational and psychosocial interventions for adolescents with type 1 diabetes have beneficial effects on biological and psychosocial outcomes?
2. Are there types or features of interventions that have been shown to be more effective than others?
3. What evidence is there of the cost-effectiveness of interventions?

These research questions were examined in the following way:

1. Systematic procedures were adopted to locate the literature
2. The relevant data were extracted from the reports
3. The findings were evaluated using both narrative and quantitative approaches, and effect sizes were calculated where possible and appropriate
4. The results were evaluated from a health–economics perspective.

What is diabetes?

Diabetes mellitus is a relatively common chronic disease for which there is, as yet, no known cure. As a diagnostic category, diabetes includes a number of distinct disorders that all share the common symptom of raised blood glucose levels. The two main forms are insulin-dependent diabetes mellitus (IDDM) or type 1 diabetes and non-insulin-dependent or type 2 diabetes. Although type 1 diabetes can be diagnosed in adulthood, it usually develops in childhood and adolescence, whereas type 2 diabetes is not usually diagnosed before the age of 40 years.

Type 1 diabetes is the result of destruction of the beta cells of the pancreatic islets of Langerhans by the autoimmune system. These cells are progressively destroyed, resulting in a loss of insulin production. Insulin is a hormone that enables glucose that is circulating in the blood to be utilised by muscle and adipose tissue, and is involved in the mobilisation of the glucose stored in the liver. Lack of insulin prevents glucose uptake, which results in high levels of blood glucose (hyperglycaemia). Symptoms of hyperglycaemia include excessive urination (polyuria), thirst (polydipsia), weight loss and a feeling of lassitude.

Insulin deficiency also leads to the excessive breakdown of fats and the production of ketones, which are excreted in urine. This breakdown of adipose tissue also results in weight loss. If hyperglycaemia continues, high ketone levels cause ketoacidosis, manifested by vomiting, dehydration, Kussmaul breathing (air hunger) and finally coma, which can be fatal.

Epidemiology

Type 1 diabetes is the third most common chronic condition in young people after asthma and cerebral palsy. Muntoni and Muntoni showed that there is a wide range in the incidence of diabetes internationally with the lowest rates in Peru at 0.41 per 100,000 per year and the highest at 35.3 per 100,000 per year in Finland, for children aged 0–15. In Great Britain, rates range from a low of 6 in southern England to 19.8 (per 100,000 per year) in Scotland, and other studies report a higher incidence in urban compared to rural populations, particularly where there is a low incidence generally. There is evidence of a rising incidence of type 1 diabetes, particularly in the more developed countries where a doubling of incidence over the past 20 years has been described: in the UK, the incidence of diabetes has doubled in the last two decades from 7.0 to 13.5 per 100,000 per year.

Acute complications of diabetes

There are two acute complications of diabetes: hypoglycaemia and ketoacidosis. The former is a major cause of anxiety and alarm to children, their parents and carers, while the latter may
be life-threatening and is difficult to treat. In hypoglycaemia, blood glucose levels drop to dangerously low levels. Individuals may experience sweating, shaking and palpitations. Left untreated, glucose levels may continue to fall, leading to neuroglycopenia (confusion, lack of coordination, odd behaviour) with cognitive dysfunction, and, in severe hypoglycaemia, unconsciousness and death can result if blood sugars are not elevated. The true prevalence of hypoglycaemia is not known because minor episodes are not usually reported. Studies looking at the prevalence of severe hypoglycaemia in children and adolescents quote ranges of 4–86 episodes per 100 patient years.

Diabetic ketoacidosis (DKA) remains a serious and life-threatening condition. Although most cases of DKA occur at diagnosis (25% of children with diabetes present with DKA, 40% of which are under 4 years of age), readmission rates due to DKA during childhood and adolescence are about 0.2 per 100 patient years. Although there is no agreed definition of DKA, the term, in practice, refers to decompensated diabetes resulting in hyperglycaemia, acidosis and the presence of ketones in urine. Once ketoacidosis is identified, the patient requires hospital admission to correct fluid loss, institute insulin therapy and prevent complications, such as aspiration of gastric contents, hypokalaemia and cerebral oedema.

An isolated admission for DKA can usually be attributed to either a concurrent acute illness, or, in teenage males, to excessive alcohol consumption. However, the single most common cause of ketoacidosis is now widely accepted to be intermittent or non-existent insulin administration. Despite this, there is little accepted knowledge as to the reasoning behind young people’s repeated and dangerous insulin manipulation behaviour.

Diabetic nephropathy is an important cause of morbidity and mortality, with a cumulative incidence of 40–50% after 40 years of type 1 diabetes duration. This condition can degenerate to renal failure, which is 17 times more common in patients with type 1 diabetes than in those without. In the UK, it is estimated that 600 young people with diabetes develop renal failure each year, and these account for 15% of all deaths in people with type 1 diabetes aged less than 50.

Neuropathy (motor nerve conduction) has been shown to be abnormal soon after the onset of type 1 diabetes with prevalence rates of up to 72%. The primary loss of function is sensory, affecting the most distal parts of the longest nerves. This can lead to a range of foot problems, in particular, neuropathic ulcers and Charcot’s foot. The prevalence of clinically defined sensorimotor neuropathy is about 28–29% in the UK, and prevalence increases markedly with age, duration of diabetes and poor blood glucose control.

Impaired function of autonomic nerves is also common in type 1 diabetes. As many as 40% of patients with type 1 diabetes have an abnormality in autonomic nerve function when tested. This autonomic neuropathy is a major component of erectile dysfunction, 85% of cases being attributed to vascular and neuropathic problems. This is a relatively common problem, and has been estimated to occur in 5–6% of 20–24 year olds with type 1 diabetes, increasing to 52–53% by 55–59 years of age, with some studies finding a prevalence of as high as 75%. This compares with prevalence rate estimates of 0.01–18% in the population without diabetes.

The microvascular complications primarily affect the eyes (retinopathy) and kidneys (nephropathy). Prevalence rates vary widely, but long-term follow-up studies show that retinopathy is virtually inevitable in conventionally managed type 1 diabetes. The prevalence of retinopathy has an almost linear relationship with diabetes duration, such that over the subsequent 20 years, prevalence reaches 90%. Proliferative retinopathy is a post-pubertal event, causing blindness through vitreous haemorrhage, fibrosis and retinal detachment. This is rarely seen before 10 years of duration, but threatens visual impairment in up to 50% of type 1 diabetes sufferers after 20 years duration and can lead to blindness, with prevalence estimates ranging from 1–8.5%.

Chronic complications of diabetes

Poor glycaemic control is of concern during adolescence because of its effects on height, weight and puberty. The excess morbidity and mortality in patients with diabetes result from the long-term microvascular, neuropathic and macrovascular complications of diabetes. These are of less immediate relevance to adolescents, but it is likely that better diabetes control from an early age will postpone or even prevent some of these complications.
The predominant macrovascular complication of diabetes is that of atherosclerosis. This results in disorders in three main sites: legs, heart and head. Peripheral artery disease of the lower limb gives rise to a range of disorders that can result in the amputation of all or part of the limb. Although uncommon, premature coronary heart disease may present as young as the mid-twenties, and is certainly detected increasingly during the third and fourth decades of life. Current estimates suggest that, independent of other risk factors, all types of diabetes pose a two- to three-fold increase in the risk of coronary heart disease, and, in pre-menopausal women, this risk may be increased by as much as four- to five-fold. There would appear to be a hyperglycaemic threshold (7 mmol/l) for large vessel disease, with a linearly increasing risk with higher mean blood glucose levels. However, it is unclear to what extent blood glucose levels are a primary factor contributing to susceptibility, or whether it is a marker for other disturbed factors.

The diffuse effect of diabetes in the circulation is also manifested in a greatly increased risk of cerebrovascular disease. Again, independent of other risk factors, all types of diabetes increase the risk of cerebrovascular accidents by two- to three-fold. The most common early manifestation of cerebrovascular problems is that of transient ischaemic attack, with sudden development of weakness or sensory change and temporary disruption to vision. Diabetes may also lead to the more insidious development of dementia, due to progressive reduction in blood flow to the brain. Although there is some evidence that these disorders are associated with higher elevated blood glucose levels, the role of hyperglycaemia in their development remains to be clarified.

The excess in morbidity and mortality due to type 1 diabetes is the topic of a systematic review at the University of Surrey, funded by Diabetes UK under the direction of Iaonnis Vlachonikolis.

**The management of type 1 diabetes**

**Healthcare team**

In childhood and adolescence, patients are managed by a diabetes care team and usually have outpatient appointments every 3 months, reducing to every 6 months in adult clinics. In addition to this outpatient service, nurse specialists and, to a lesser extent, dieticians are available for consultation throughout the week, with many centres also running a 24-hour emergency helpline. The diabetes team normally consists of a medical consultant, a diabetes nurse specialist and a dietician, with a few diabetes centres also employing a clinical psychologist, psychotherapist or counsellor. A few patients with type 1 diabetes are managed by primary care teams, but this remains a substantial minority at present.

The aim of diabetes management is to maintain blood glucose levels as near as possible to the normal range. Glycated haemoglobin (GHB) is now used as the gold standard for estimating average blood glucose control. This laboratory assay estimates the percentage of haemoglobin that has glucose bound to it, and, as such, is an estimate of blood glucose levels over about an 8–12-week period. Regular assessments are recommended and results are used to guide modifications to insulin prescriptions and other management advice.

**Self-management**

Diabetes is a chronic condition and therefore patients and their families are responsible for its day-to-day management. Due to their minimal or non-existent levels of insulin production, a person with diabetes must assume responsibility for the normally automatic regulation of blood glucose levels. This is achieved by a complicated, multi-component treatment regimen. Daily subcutaneous insulin administration is required, either by injection or continuous insulin pump. It is also necessary to coordinate dietary intake (including timing, quantity and content of meals and snacks) and energy expenditure to be compatible with circulating insulin levels. To guide self-regulation, capillary blood glucose tests should be undertaken, which involves pricking the finger to obtain a small amount of blood and testing the level of blood glucose with an automated metering device.

The aim of diabetes management by both the healthcare team and the patient is to prevent, postpone or reduce the severity of the acute and chronic complications of diabetes. The Diabetes Control and Complications Trial (DCCCT) has demonstrated that better blood glucose control is associated with improved microvascular outcomes. Irrespective of the patient’s age, age of onset, baseline GHB values and gender, intensive management of diabetes resulted in improved blood glucose control. Only a small percentage of the sample were adolescents (< 10%) and they were reported to take up a disproportionate amount of staff time and effort. Intensive management consisted of multiple daily insulin injections,
multiple blood glucose tests by the patient and close monitoring and support from the healthcare team. The improvements in blood glucose control achieved by intensive management were linearly associated with delays in the onset and progression of retinopathy, nephropathy and neuropathy. However, intensive management by the healthcare team is time-consuming and costly and there is considerable interest in investigating whether similar beneficial effects on blood glucose control can be achieved by less intense approaches, including psychosocial and educational approaches to improve self-management.

Adolescence and diabetes
Adolescence is a period of rapid change and development. Physical changes are accompanied by continued cognitive development, enabling young people to think in increasingly abstract ways and be less receptive to authority figures. As they compete for jobs or places in higher education, teenagers are establishing their identity and lifestyle, and are making choices that will shape their futures.

As adolescents spend increasing amounts of time away from home, their leisure activities become less structured, with diminishing adult supervision and involvement. Increased experimentation and risk-taking is commonplace during this transitional period. With puberty comes the adjustment to a changing body and interest in sexual relationships, and adolescents are learning how to form and maintain friendships and close intimate and romantic relationships with their peers. In summary, adolescence is a period of rapid and intense development, and the lifestyles adopted during this time may endure through adulthood.

Diabetes in adolescence
Adolescence is a particularly critical time for young people with diabetes. Whether diagnosed in childhood or adolescence, during this transitional period young people learn to take responsibility for and manage their own diabetes. As they integrate self-management of diabetes into their emerging lifestyles, adolescents experience directly the relationship between their actions and their blood glucose levels, which influences their beliefs about diabetes and its treatment. Therefore, these will be formative years in the development of such beliefs. Once fully integrated and accepted, these beliefs will be difficult to change, and are important predictors of self-care and well-being.

Adolescence is also frequently seen as the time to change and intensify insulin regimens, and additional pressure to test blood glucose and adjust insulin can mean that the disease may increasingly intrude on other aspects of the young person’s life.

Metabolic control during adolescence
Research consistently demonstrates that there is a marked worsening of metabolic control during adolescence associated with the onset and progression of complications in this age group. Although this decline is partly attributable to the physiological changes occurring at this time, the decline in self-care behaviour is of at least equal importance. This deterioration is particularly marked and of concern in the area of insulin administration: self-report data have suggested that missed insulin injections are common and the pharmacy record data from the DARTS database demonstrated that about 28% of adolescents and young adults do not even obtain sufficient insulin to fulfil their prescribed regimen. This decline in self-care is also characterised by young people dropping out of the healthcare system and not attending diabetes services. Although this decline in metabolic control seen during adolescence is temporary, with adults and children having better control on average, evidence is accumulating that even brief periods of elevated glucose levels are damaging and accelerate the onset of microvascular and macrovascular complications. Therefore, it is clear that adolescents with type 1 diabetes are in the unique and unenviable position of facing the same developmental tasks and demands as other young people, in addition to learning to manage and live with their diabetes. This poses healthcare professionals with numerous challenges as they seek to improve adolescents’ metabolic control without sacrificing quality of life.

Psychosocial and educational interventions
Psychosocial and educational interventions aim to improve adolescents’ knowledge, skills and management of all aspects of their diabetes. Educational interventions primarily teach diabetes-related knowledge and skills such as testing blood glucose levels and injecting insulin correctly. Psychosocial interventions are diverse and provide training and support in such areas as social skills, diabetes-related problem-solving and coping skills, communication skills, and individual and family-
based counselling. It is widely recommended that such interventions should be an integral part of diabetes care.\textsuperscript{1,46}

No previous review or meta-analysis has been devoted exclusively to evaluating the effects of psychosocial and educational interventions on adolescents. A recently completed survey, commissioned by the charity Diabetes UK, evaluating psychosocial and educational interventions for adults with diabetes concluded that these interventions are beneficial, but that this optimism must be tempered by the methodological weaknesses of many of the studies.\textsuperscript{44} This survey included all published meta-analyses on this topic,\textsuperscript{47–53} which, together, suggested that effect sizes are larger for self-report psychosocial outcomes than for more objective ones, such as metabolic control. In addition, there may be systematic effects of the setting and approach of the intervention. The effects of the intervention may be more short-lived for outcomes such as weight loss and metabolic control, whereas effects on knowledge and skills may increase over time. Older patients may show smaller changes than younger ones. One meta-analysis of correlation studies of both adults and adolescents suggested that the associations between knowledge, skills and individuals’ social environments and their diabetes self-care and metabolic control may be even stronger in adolescents than in adults.\textsuperscript{54}

Based on a consideration of the past research and the unique factors affecting adolescents, we initially posed a number of questions to examine in the current systematic review.

**Education and care at diagnosis**

Increasing numbers of adolescents are diagnosed before reaching a state of DKA. For these individuals, clinical practice, both internationally and nationally, shows wide variation in the delivery of care and education. Some paediatric services require the newly diagnosed adolescent to be admitted into hospital for at least 1–2 nights with education provided in the hospital, whereas others endeavour to keep adolescents out of hospital by providing as much care and education as possible in the community. Even when the two differing approaches teach the same knowledge and skills, the difference in setting (which has significant resource implications) may affect outcomes.

**Individual and group education**

Whether diagnosed in adolescence and needing educating from scratch or diagnosed in childhood and needing re-educating and/or updating, providing the young person with the knowledge and skills for self-management remains a primary goal of patient care. Traditionally, this is done through one-to-one didactic tuition with dieticians and nurse specialists, either at clinics or in the home. Alternatively, clinicians and researchers have utilised group education as the way forward, as it is thought to be more cost-effective with the additional benefit of adolescents being able to learn from each other. Therefore, the relative effectiveness of individual versus group education needs to be evaluated.

**Targeted versus generic approaches**

The intervention research for adolescents with diabetes is marked by the diverse range of approaches that have been used, such as crisis intervention,\textsuperscript{55} stress management training,\textsuperscript{56} family therapy,\textsuperscript{57} parental simulation\textsuperscript{58} and negotiating skills training for parents.\textsuperscript{59} Such diversity raises the questions of which approaches are best used in which situations. Some approaches may be particularly effective at specific times in the diabetes career of young people, such as during the first few months after diagnosis\textsuperscript{60} or when the individual starts to take responsibility for insulin adjustment.\textsuperscript{61} Interventions may need to be modified for younger versus older adolescents. Every young person’s experience of diabetes is unique,\textsuperscript{62} and each will face an idiosyncratic set of challenges. There is evidence in the adult literature that interventions that target individual’s particular management problems are effective,\textsuperscript{63} suggesting that targeting may also be important for adolescents.

**Economic considerations**

Attempts to estimate the economic burden of diabetes for affected individuals or society are beset with data-related problems.\textsuperscript{64} For this reason, most investigators have concentrated on calculating the direct costs of treating the disease and its complications, and have excluded productivity and quality-of-life implications.\textsuperscript{65} Between 1 and 2\% of the British population is diagnosed with diabetes (all types), but studies suggest that they consume some 4–5\% of NHS resources.\textsuperscript{66–68} The excess cost of in-hospital treatment for diabetes has been estimated to be over 80\%, most of which resulted from vascular complications.\textsuperscript{64} When productivity losses associated with type 1 diabetes were calculated, they were found to be at least equal to the direct treatment costs.\textsuperscript{69}

Whereas cost-of-illness studies of this nature indicate the extent of potential savings attainable
Background

through primary and secondary prevention, they do not provide guidelines for decision-makers seeking to invest limited resources in those technologies that offer greatest value for money. To this end, the issue of cost-effectiveness, which appraises the economic worth of particular interventions, must be addressed. The delivery of educational and psychosocial interventions will incur additional expenditures in health services, but these may be offset by productivity gains and utilisation savings elsewhere in the system in both the short and longer term. Furthermore, they may confer private benefits on affected individuals over their lifetimes. Unfortunately, few evaluative studies include economic considerations such as these, and research designs that follow adolescents over decades are difficult to orchestrate. However, modelling approaches can be used to project (within confidence intervals (CIs)) the impact of achieving alternative levels of metabolic control on future morbidity and mortality, and hence on costs. Recent studies of this type associated with the DCCT have illustrated the value of healthcare interventions that result in effective control.70,71

Aims of this review

This systematic review examined studies evaluating the effects of educational and psychosocial interventions for adolescents with type 1 diabetes on a range of outcomes. Evaluations of educational interventions aimed at improving knowledge, diabetes problem solving and management skills, as well as more psychological interventions targeting self-care and psychological outcomes were considered.

Specifically, this review had two purposes: to establish a database of existing research evaluating the effects of psychosocial and educational interventions for adolescents with type 1 diabetes, and to present a narrative and quantitative appraisal of this research to identify what is known from past research and where future research efforts should be directed. The literature was assessed in the light of the research questions outlined above, and in terms of additional questions that arose during the course of the systematic review.
Chapter 2
Methods

The scope of the review
The steps involved in retrieving the literature are outlined in Figure 1. The following sections provide the details of the procedures summarised in the figure.

The search strategy was developed following a preliminary scoping exercise that assessed the extent of the literature on children and adolescents with diabetes. The search was then narrowed to only those studies that had carried out an educational or psychosocial intervention. A broad definition of ‘educational and psychosocial intervention’ was developed, and included one or more of the following: teaching diabetes-related knowledge and skills, providing psychosocial training and support (such as social skills, problem solving, coping skills, communication skills), and giving individual and family-based counselling. Search terms were designed to encompass all the various descriptions used in many different disciplines for ‘adolescents’ and the processes and outcomes of interventions for type 1 diabetes. At each stage of the process from abstract screening onwards, a conservative approach was taken to exclusion decisions to ensure that the maximum number and range of papers were available for the systematic review. For example, although the research questions were specific to adolescents, papers reporting innovative psychosocial and educational interventions in non-adolescent populations were retained on the basis that they may have provided useful background information.

Identifying the literature by electronic searching
Search strategy
The search strategy was formulated, piloted and refined based on guidelines from the UK NHS Centre for Reviews and Dissemination (CRD).72 Foreign language articles were included, and no constraints on date of publication were imposed. The search terms used were synonyms of diabetes, adolescence, types of intervention and varieties of outcomes, and truncated terms were used as appropriate for each database. For example, the synonyms used for adolescence/adolescents were youth, young people/person, child, teen, juvenile or puberty. All terms were used as text-words (i.e. words appearing in the title, abstract or keywords of a database entry). A full list of terms appears in appendix 1.

Electronic databases
All databases were searched from their start date until the end of June 1999. The following databases were chosen because each exemplified a different aspect of the topic (e.g. medical, psychological): Bath Information and Data Services – Science and Social Science, British Nursing Index, CINAHL, Cochrane Library, Dissertation Abstracts International, EMBASE, MEDLINE, National Research Register, PsycLIT, Sociofile and ERIC. The electronic databases provided the vast bulk of the studies: 10,535 references were retrieved from those listed above and entered onto Reference Manager software. Duplicates were identified and removed from the database leaving 4639 remaining references.

Identifying the literature by other search strategies
Handsearches
Three journals (one American and two British) were chosen as representative of the subject area, encompassing a range of audiences and backgrounds: Diabetes Care, Diabetic Medicine and Practical Diabetes International. It was felt particularly important to handsearch Practical Diabetes International because it is not usually referenced on electronic databases. All three were searched from their start date until (and including) June 1999 using the same criteria as for the electronic search, and any relevant articles were dealt with in the same way as those retrieved from the electronic search.

Two additional primary research papers were identified and retrieved through the handsearching process, and a number of background papers were retrieved from Practical Diabetes International and Diabetic Medicine. The capture-recapture figures for the journals handsearched were 100% for Diabetes Care, 67% for Diabetic Medicine and 0% Practical Diabetes International (which is not on any of the electronic databases searched) indicating the sensitivity levels of the electronic searches.
Methods

1. **Search strategy formulated**, piloted and refined
   Synonyms of: diabetes, adolescents, interventions and outcomes

2. **Databases searched:**
   - MEDLINE
   - Bath Information and Data Services
   - Science and Social Science
   - PsycLIT
   - Sociofile
   - CINAHL
   - British Nursing Index
   - National Research Register
   - EMBASE
   - Dissertation Abstracts
   - ERIC
   - EMBASE
   - Dissertation Abstracts
   - ERIC

   10,535 references retrieved
   Duplicates identified and removed – 4,639 remaining
   1,321 references remaining
   403 references remaining
   451 references remaining

3. **Abstracts read** according to defined criteria:
   - Diabetes
   - Age
   - Educational intervention
   Reliability checks done

4. **Criteria redefined**, re-read abstracts in light of this

5. **Non-electronic search**
   - Article retrieval
     a. from results of electronic search
     b. from other sources
     - Handsearching
     - Experts’ recommendations
     - Scanning reference lists
   - Initial paper review
     Papers categorised into:
     - Clinical – details of study design, age of participants
     - Background papers
     - Not relevant – exclude
     Reference lists scanned

   Data synthesis
   1. Data extraction form
   2. Quality checklist

   Data analysis
   - SPSS
   - Summary tables
   - Meta-analysis

   Project write up

   Dissemination

**FIGURE 1** Study methodology
Personal contacts

Personal contacts were considered particularly important to ensure that the systematic review avoided publication bias. Experts in the area were contacted via a number of methods. A wide variety of relevant email discussion groups were targeted with requests for information, ranging from experts on the age group, such as paediatric-nursing-forum, to physicians in general, such as gp-uk, and those specific to evidence-based medicine, such as evidence-based-health (see appendix 2).

A personal letter was sent to the 72 members of the International Conference for Behavioural Research in Diabetes Mellitus informing them about the project and requesting copies of relevant papers. Individuals were also contacted using information obtained from the National Research Register indicating that they were experts in the subject area. Direct contact was made with colleagues known to be active in the field, the UK Cochrane Centre and HTA programme groups to ensure that no experts had been overlooked.

Reference lists

Reference lists of past reviews that included children and adolescents, and of all retrieved articles, were checked for relevant studies and additional studies not already identified (‘exploding’ references).

Notices and flyers

Notices calling for information about past and ongoing studies of educational and psychosocial interventions for adolescents with diabetes were published in the American Diabetes Association Professional Section Quarterly Bulletin and in the Summer 1998 edition of Diabetes UK’s Diabetes Update. A flyer was also distributed with the September 1998 issue of Diabetic Medicine to 5250 Diabetes UK members.

Conferences

The work for the systematic review was publicised (mainly using flyers) at the following conferences (see appendix 3 for a copy of the flyer used):

- Psychosocial Aspects of Diabetes Study Group Annual Conference, Madrid, Spain, April 1998
- Diabetes Workshop & Diabetes Symposium at the 5th International Congress of Behavioural Medicine, Copenhagen, Denmark, 19–22 August 1998
- 8th National Symposium for Paediatric Diabetes, Loughborough, UK, 3–4 September 1998
- 34th Annual Meeting of the European Association for the Study of Diabetes, Barcelona, Spain, September 1998
- British Diabetic Association Conference, Harrogate, UK, October 1998

Appendix 4 lists the individuals who responded to any of the contacts made.

Initial screening: abstract check

The abstracts were read by two of the team members (JH and LS) using the following broad inclusion/exclusion criteria:

1. Was the article primarily about diabetes?
2. Were the participants adolescents?
3. Was there any educational or psychosocial intervention?

In some cases, insufficient information was given in the abstract to allow a decision to be made, and the complete article was retrieved. Reliability checks between the two judges were performed for all the abstracts to be excluded. The disagreement rate was 0.32%. All disagreements were discussed and resolved successfully. This process identified 403 articles found by the electronic searches to be retrieved.

Article retrieval

Articles were retrieved from various sources including inter-library loans, making visits to libraries and personal contacts. Articles with abstracts that had previously been categorised as questionable for inclusion were screened again at this stage for their appropriateness.

Detailed screening: initial paper review

The full articles were subjected to a detailed screening to make a final decision about retaining them in the review. This decision was based on the refined inclusion and exclusion criteria summarised below.
Refined inclusion criteria
The key criteria were that the paper referred to type 1 diabetes, the age range was 9–21 years, and that there was an educational or psychosocial intervention or discussion of such an intervention. For this purpose, education was defined broadly to include any intervention aimed at changing diabetes-related behaviour as well as those related more specifically to knowledge.

Exclusion criteria
The main reasons for excluding papers at both the abstract stage and also when doing the initial paper review were that they focused on gestational diabetes, discussion of epidemiology of diabetes in a given geographical area or non-human subjects, or diabetes was not the primary focus of the paper (e.g. it was discussed only in relation to another condition, such as obesity).

The review team developed an initial paper review form that provided a checklist of the inclusion criteria as well as providing some information about the nature of the study (study design, number of subjects, outcomes, etc). The articles were then subjected to an initial review by two team members (JH and LS). The decisions made at this stage were either to include the article as a clinical paper (i.e. a report of an evaluation of an intervention), as a background paper or to exclude it completely. Each paper excluded by one judge was reviewed by the other judge. The disagreement rate was 0.4% and, in the few cases where there was disagreement, the papers were included to ensure maximum inclusiveness.

At the end of the detailed screening, after excluding 209 papers for failing to meet the criteria, there were 248 articles remaining: 64 clinical and 184 background papers. This included all the articles identified from the electronic searches and also articles obtained from other non-electronic sources.

Background papers
The background papers were those that met some but not all of the inclusion criteria and did not include empirical studies. For example, a background paper could be one that described an educational or psychosocial intervention for children but not adolescents as defined for this review. Each background paper was reviewed by at least one member of the review team. The objective was to select papers that would inform the writing of the review. Of those classified as background papers (but not including economic evaluations), 61% fell into four main categories: reviews or meta-analyses, organisation or delivery of medical services, correlation studies and case studies or descriptive articles. The list of background papers is available upon request from the authors. Those papers that discussed cost and economic issues were referred to the team’s health economist.

Data extraction and critical appraisal for the primary research papers
A data extraction form was developed using CRD guidelines, which were adapted to the current study. The data extraction form was then piloted with members of the team and the steering group at a 1-day workshop, after which the form was refined. The final form was a six-page document (see appendix 5), and is summarised in Figure 2.

There were 64 papers retained for review that described 62 different studies. The findings from the study by Grey and colleagues were reported across three papers. These 64 papers were classified as ‘clinical’ indicating that they met all the inclusion criteria and were evaluations of original empirical research. All these papers were reviewed by one of two members of the review team (SEH or TCS) using the data extraction form, and a data summary table was produced for each paper (see appendix 6).

Critical appraisal followed the principle of a hierarchy of evidence as set out in CRD Report 4. Studies were categorised by type of design, and well-designed randomised controlled trials (RCTs) were regarded as yielding the highest quality of data and have, therefore, been subjected to closer scrutiny in the results section of this review than studies using other types of design. Moreover, the RCTs formed the largest category (41%). The methodological quality of the RCTs was assessed in terms of attrition, randomisation quality and concealment allocation. There was virtually no variation on these variables. Attrition was uniformly low, only one study reported how randomisation was performed, and blinding of patients and interventionists is not possible in this type of study. Blinding of those collecting or analysing the data was not reported. Accordingly, there was no basis for excluding or weighting the RCTs based on their methodological quality. The second largest category of study design was
pre–post intervention with no control group (CG). This design does not permit effects to be attributed unambiguously to the intervention. However, given the frequency of this type of design in the cohort of studies, they are discussed as a separate group in the results section.

Reliability checks
To assess the reliability of the data extraction process, a third team member (DF) reviewed 10% of the papers selected at random and completed data extraction forms. The mean reliability coefficient for the categorical data such as disease stage, theoretical basis of the intervention and nature of the interventionist, setting and study design was 0.85 (Cohen’s Kappa), which shows a high level of agreement given the relatively small sample.

Foreign articles
The articles included 32 foreign language papers in languages ranging from French and German to Polish and Chinese. The abstracts of the foreign language articles were translated and screened for appropriateness. The complete paper was translated for those that were included following initial screening. Four foreign language articles were included as clinical papers and data extraction forms and summary tables were completed for them based on the translations.

Reference and data management
All references retrieved were entered on Reference Manager software. An Excel database was used to keep track of papers being issued for review and also to provide a brief summary of all the background papers. The information from the data extraction forms was entered on to SPSS, and the SPSS file was used to compute descriptive statistics (frequencies and percent of sample for categorical data, and means and standard deviations (SDs) for interval data).

Computation of effect sizes
When integrating findings from several studies, it is sometimes useful to conduct a meta-analysis by computing effect sizes. Effect sizes give a pure number free of the original measurement unit. By converting changes in outcomes to effect sizes, it is possible to combine the effects from several studies using different measurement units of the same outcome (e.g. different GHb assays). The mean size of the effect across several studies can then be examined to draw conclusions about trends across the group of studies included in the review.

However, where there are marked differences among the studies to be combined, the findings from meta-analyses must be treated with caution. There is precedence for conducting meta-analyses...
Methods of effect sizes derived from a wide variety of interventions. Meta-analyses have been conducted on the effects of a range of interventions for adults with diabetes,\textsuperscript{47} and for children and adolescents with a variety of chronic diseases, including diabetes.\textsuperscript{79} Therefore, we undertook such analyses here, but it should be noted that this approach has limitations.

Effect sizes were only computed for studies that included a randomised CG because these are the most rigorous design. Within these studies, effect sizes were computed for all outcomes for which the necessary information was provided. In designs involving a randomised CG, the effect of the intervention is assessed by the interaction between group (intervention versus control) and time (baseline versus follow-up). The intervention group (IG) should show a greater improvement, relative to the CG, in outcomes from baseline to follow-up. The formula used to compute the effect size (d) was:

\[
\text{(Difference between group means at follow-up) – (Difference between group means at baseline) \over \text{Pooled SD at baseline}}
\]

The higher the number, the larger the effect. A negative number indicates an effect in the opposite direction to that expected and a positive number indicates an effect in the expected direction. It is possible for effect sizes to exceed +1.0 and –1.0 although the majority tend to fall within this range. It is conventional in the behavioural sciences to interpret effect sizes of about 0.20 to be small in magnitude, those of about 0.50 to be medium, and those greater than 0.80 to be large.\textsuperscript{77}

For effect-size analyses, outcomes were categorised as psychosocial, GHb, other metabolic measures, self-management behaviour or knowledge. The psychosocial category included outcomes that were self- or parent reports of changes on psychological or inter-personal constructs (e.g. self-efficacy, diabetes-specific stress). The GHb category included haemoglobin A\textsubscript{1c} (HbA\textsubscript{1c}; the normal form of haemoglobin) and haemoglobin A\textsubscript{1c} (HbA\textsubscript{1c}; haemoglobin that is attached to glucose) outcomes, and other metabolic measures were fructosamine, fasting and urinary blood glucose. The self-management category included outcomes that assessed behaviour (e.g. diet choice, frequency of blood glucose testing), and knowledge included measures of diabetes knowledge. The heterogeneity of the outcome categories was assessed with chi-squared tests, and a fixed-effects model was assumed.\textsuperscript{80}

Some studies had more than one measure within a particular category, e.g. it was common for several psychosocial measures to be included. In integrating effect sizes for outcomes across studies, each effect size for all the outcomes in a given study could be used. However, this method would give more weight to those studies with more outcomes. To avoid this problem, the mean effect size was calculated across all the measures within a given category for each study so that each study only contributed one effect size per category.\textsuperscript{37} Similarly, unless otherwise stated, the mean effect size was calculated across all the assessment points (post-test and follow-up).

There were two exceptions to the ‘one effect size per outcome category per study’ principle. Two studies\textsuperscript{58,60} evaluated more than one intervention by assigning participants to one of two groups receiving one of two possible interventions. For these studies, separate effect sizes were retained for each group.
Chapter 3

Results

The search process identified 62 studies reported across 64 papers. The results are organised into six sections: (1) descriptive statistics on the 62 studies, (2) addressing the original questions posed for this review, (3) meta-analyses of a subset of the RCTs, (4) descriptions of selected RCTs, (5) review of the pre-post studies, and (6) economic analyses.

Descriptive results

The key features of each of the 62 studies, including design, details of the intervention and results, are summarised in tables in appendix 6.

Study publication year

The earliest study identified was published in 1978 (see Figure 3). The cut-off date for published studies was June 1999. Two unpublished studies have subsequently been published. The distribution showed that more of the studies identified were published in the 1990s than in the 1980s. This may indicate an increasing interest over time in adolescent interventions or it may simply reflect the general increase in all publications over this period.

Theoretical bases to the intervention

More than half of the studies reviewed (52%) had no theoretical principles that were explicitly stated in the report (see Figure 4). For those that did specify theoretical principles, the largest subgroup used family therapy, the second largest subgroup used behavioural principles and the third largest used social learning theory. The final group was the ‘other’ category, which included any studies with specified theoretical principles that could not be categorised as family therapy, behavioural therapy or social learning theory, such as anchored instruction (AI) or social support.

Design characteristics

RCTs accounted for the largest subgroup of studies (41.9%), followed by pre-post designs with no CG (33.9%). There were several studies that used a non-randomised CG (9.1%) and the remainder...
Results

were post-intervention only, waiting list CG, case studies or some other type of design (see Figure 5). Studies typically had one IG (see Figure 6), either with no CG (38.7%) or one CG (41.9%). A small number had two IGs with one CG (11.3%) or no CG (6.5%).

The total number of participants in these studies is shown in Figure 7. The mean number of participants was 53.8, but more than half of the studies involved fewer than 40 participants. Given that most of the studies involved an IG and a CG, subject numbers per condition tended to be small.

**Sample characteristics**

The mean age of participants across all the studies was 12.7 years and the mean duration of diabetes was 4.9 years. The majority of the studies were conducted on adolescents who had been diagnosed with type 1 diabetes for more than 1 year (67%). There were seven studies (11%) in which the participants were selected because their diabetes was poorly controlled, and there were seven studies (11%) in which participants were a mixture of newly diagnosed or those in the first year after a diagnosis of type 1 diabetes. The time since diagnosis was not provided in the remaining studies (11%).

The majority of studies were conducted in the USA (67.7%), and the UK was the second most likely location (see Figure 8). Two evaluation studies were identified that are currently being run in the UK (by Lesley Howells at Ninewells Medical School, Dundee and by Sue Chanon at the University of...
Wales College of Medicine, Cardiff), but results are not yet available.

**Nature of the intervention**

Reports were frequently unclear about where the intervention had been conducted (17.7%). Where this information was provided, hospital outpatients (35.5%) and other community settings (29%) were the most likely settings for interventions, followed by inpatient, home and general practitioner (GP) clinics (see Figure 9). In a small number of studies, the setting altered for different aspects of the intervention or for different groups within the study. The most typical community setting was the diabetes summer camp. The studies illustrate a wide variety of interventions (see Figure 10), the
most common of which was some form of skills training (38.7%), followed by dietary interventions (19.4%) and emotional/psychological interventions (17.7%). Most commonly, only one interventionist was involved in delivering the intervention (43.5% of studies). The interventionists, when described, were most likely to be nurses (32.3%), psychologists (32.3%) or doctors (27.4%), but the type of interventionist was also frequently unclear from the reports (see Figure 11).

**Outcomes**

A large variety of outcomes were assessed across the 62 studies (see Figure 12). The most common was GHb in 62.9% of studies, measured by one of a variety of assays. Psychosocial measures for indi-
individual functioning were the next most commonly assessed outcomes (33.3%), which included constructs such as self-efficacy for diabetes management, measures of family functioning, social skills and quality of life. Diabetes self-management behaviours such as adherence to diet (12.9%) and, most markedly, exercise (1.6%) were less commonly assessed.

Follow-ups were defined as assessments that took place some period in time after the post-intervention assessment. As it can be seen from Figure 13, most studies did not have a follow-up assessment (59.7%). Of those that did, follow-ups were most likely to occur less than 6 months after the post-intervention assessment (17.7%), although some studies (11.3%) included a follow-up at more than 1 year.

In summary, the descriptive data indicate that evaluations of educational and psychosocial interventions for adolescents have mostly been conducted in the USA. The interventions often had no explicit guiding theoretical principles and there was an enormous variety in the aspects of diabetes management addressed by the interventions. Similarly, there was great variety in the outcomes used to evaluate the effectiveness of the interventions, although GHb was measured in over half of the studies. Although there was a high proportion of RCTs, the typical number of participants per condition was low.

Addressing the questions posed prior to conducting the review

Three issues related to intervention (other than economic aspects) were identified prior to conducting this review: education and care at diagnosis, delivery of interventions to individuals versus groups, and targeted interventions versus generic ones. The studies identified did not permit definitive answers to these questions, however, the relevant evidence is reviewed below.
Education and care at diagnosis
The majority of studies were conducted on patients who had been diagnosed with diabetes for longer than 3 months. However, in five studies, participants were limited to the newly diagnosed.\textsuperscript{55,60,125,129,130} Three of these studies were RCTs,\textsuperscript{60,125,129} one used a non-randomised CG,\textsuperscript{55} and one was a post-intervention assessment only design in which medical records were examined for those who were hospitalised at diagnosis versus those who were not.\textsuperscript{130} The interventions used in these five studies varied, and included one or more of the following: skills training \((n = 3)\), social support \((n = 2)\), diet \((n = 1)\), emotional/psychological \((n = 1)\), problem solving \((n = 1)\), stress reduction \((n = 1)\), family-related \((n = 1)\) and other components \((n = 2)\).

One RCT evaluated length of hospital stay,\textsuperscript{125} one assessed the arrangements for the family to live at the hospital,\textsuperscript{120} and one examined a self-management intervention.\textsuperscript{60} The length of stay for initial hospitalisation \((i.e.\ 1\ \text{week versus 4 weeks})\) did not affect subsequent metabolic control,\textsuperscript{125} where both groups received the same 20-hour education programme. Having the family live in an apartment at the hospital and receive a multi-component intervention did not result in more positive outcomes than usual care that permitted the family to stay at the hospital although not in their own apartment.\textsuperscript{129} However, the findings of Delamater and colleagues\textsuperscript{60} suggest that the deterioration in control often seen at the end of the so-called ‘honeymoon’ period \((i.e.\ \text{when residual insulin production ceases})\), can be avoided by self-management training as outpatients in the early months following diagnosis.

The study of newly diagnosed patients using a non-randomised CG\textsuperscript{55} indicated that intensive psychosocial support at diagnosis has long-term \((5–15\ \text{years of follow-up})\) beneficial effects, but this study used non-validated measures. Only one study examined the specific question of home care versus hospitalisation at diagnosis,\textsuperscript{130} which had a retrospective design using medical records. The findings suggested that home care resulted in fewer subsequent hospitalisations, however, there are many confounds associated with this type of study design.

In summary, these five studies did not provide sufficient evidence to reach conclusions about the choice between education and care at home versus hospitalisation, or the best components of intervention at diagnosis. However, there is evidence that a longer hospital stay at diagnosis confers no advantage over a shorter stay,\textsuperscript{125} and that psychosocial and educational intervention in the months immediately following diagnosis can be effective in preventing deterioration of control when residual insulin production ceases.\textsuperscript{60}
Individual versus group education

There were 13 studies in which the interventionist primarily worked one-to-one with the adolescent,55,82,85,86,88,90,99,100,110,122,123,125,132 and 33 studies in which the intervention mostly took place in a group setting.56,58,59,73,81,83,84,87,92,93,95,96,98,102–109,111–113,117–121,126,127,131,133 Of the remaining studies, the interventions took place in family units,59,60,97,124,129,134 in a mixture of group and individual settings,94,114–116,150 in some other arrangement or the details were not provided.57,89,91,101,128

Of the 13 individual-based interventions, eight studies included a CG (five were RCTs and three involved a non-randomised CG). Of the 33 group-based interventions, 16 studies included a CG (14 were RCTs and two involved a non-randomised or waiting-list CG). Individual-based interventions showed no emphasis on a particular component with at least one study including one or more of all the various component types. Group-based interventions tended to include components on skills (16 of 33 studies, 48%), such as self-monitoring of blood glucose (SMBG), but otherwise showed no tendency to favour any particular component.

Individual-based interventions may be more costly in terms of staff involvement than group-based interventions, but they permit a more targeted approach that meets the individual’s particular needs, which may be more cost-effective in the long term. However, adolescents may benefit from the interactions generated in group-based interventions. Beneficial effects were reported for both types of interventions, but no studies were identified that had compared delivery of comparable interventions to individuals versus groups.

Targeted versus generic approaches

There were no studies that compared targeted (i.e. assessment of each participant’s specific diabetes management problems and intervention only on those problems) versus generic (i.e. use of the same intervention in all participants) approaches. Moreover, there were no studies that evaluated a targeted intervention at all. In the adult literature, there is evidence that targeted approaches are effective in improving dietary outcomes,43 but this type of approach remains to be evaluated in adolescents.

Revision of the review

Given that the original questions posed for this review could not be addressed in depth, a revised approach was developed. In the hierarchy of evidence, the RCT is regarded as the most superior design. RCTs also included the largest number of studies identified, and a quantitative review of these was conducted, computing effect sizes for many of them. The next largest design category was the pre–post studies with no CG, and a narrative review of these findings is given.

RCTs

A review of the 25 RCTs identified yielded 16 interventions for which sufficient detail was provided to enable effect sizes to be calculated, and the representativeness of these studies was evaluated by comparing them with the remaining studies. There were no significant differences in the following variables: study country, theoretical principles, age of participants, duration of diabetes, interventionist, disease stage of participants, no follow-up versus any follow-up, individual versus group interventions, and number of participants. The only significant difference was that the effect-size studies were likely to have been published more recently (mean year 1993) than the non-effect-size studies (mean year 1989). The studies for which effect sizes could be calculated, therefore, appeared to be reasonably representative of the entire corpus of 62 studies.

Effect sizes could be computed for GHb in 12 of 18 interventions. There was considerable diversity in the other outcomes studied. For eight of the interventions, effect sizes could be computed on outcomes coded as psychosocial. The psychosocial category was diverse and included measures such as self-efficacy for diabetes management,56,85 measures of family climate97,129 or conflict,59,61,134,135 diabetes-specific stress56 and quality of life.56 For each of the remaining categories of outcomes (self-management, knowledge, and other metabolic outcomes) effect sizes could be computed for fewer than four of the interventions. The effect sizes for GHb and psychosocial outcomes are shown in Table 1.

The mean of the 12 effect sizes for GHb was 0.33 (95% CI, –0.04 to 0.70). However, the effect sizes for GHb were significantly heterogenous ($\chi^2 = 28.45$, degrees of freedom (df) = 11, $p < 0.05$). This was due to the two large effects from the interventions evaluated by Satin and colleagues.54 When these two effect sizes were removed, the category was homogenous ($\chi^2 = 9.9$, df = 9, $p = not significant (NS)$), and the mean was reduced to 0.08 (95% CI, –0.10 to 0.26).
The median (0.18) may be a more reliable indicator of the typical effect on GHb in these studies. To give an indication of their clinical relevance, these effect sizes can be converted into change in percentage HbA1c using the mean and SD for HbA1c reported by Mortenson and Hougaard136 in their study of 2873 children and adolescents from 18 different countries (mean 8.6%, SD 1.7%). Using these data, an effect size of 0.33 is equivalent to a change of just over one half of a percentage point (0.60%), and an effect size of 0.18 is equivalent to a change of just less than one-third of a percentage point (0.31%).

Large effect sizes in the study by Satin and colleagues58 suggest that there was something unusual about these two interventions, and, therefore, they have been singled out for description in a later section.

The mean of the eight effect sizes for psychosocial outcomes was 0.37 (95% CI, 0.19 to 0.55). Despite being derived from a diversity of measures, this category was not significantly heterogeneous ($\chi^2 = 4.42$, df = 7, $p = \text{NS}$), and the median was similar to the mean (0.36).

There are a number of reasons to predict that the effects of these interventions on psychosocial outcomes will be larger than on GHb. The former are typically assessed by self-report or, much less commonly, by reports from other family members. As such, they are vulnerable to demand effects (to report more beneficial change than actually occurred). Measures of metabolic control, particularly measures of GHb (which assesses control over the preceding 8–12 weeks), are less open to such bias. However, due to the fact that changes in metabolic control are expected to result from changes in intervening variables assessed by psychosocial outcomes, it is to be expected that changes on these intervening variables may be more substantial than changes on GHb measured concurrently. In addition, the effects on GHb may be expected to occur at later follow-ups after the behavioural and psychological changes have, in turn, affected metabolic sequelae.

Psychosocial interventions are usually designed to have direct, short-term impacts on psychosocial variables and indirect, long-term impacts on metabolic control. Accordingly, the effect sizes for psychosocial variables should be larger than those for GHb (as seen in Table 1). The mean effect size for the psychosocial outcomes (0.37) was significantly larger than for GHb (0.08) when the outliers were removed ($t = 2.34$, df = 16, $p < 0.05$). For all four studies where both GHb and psychosocial effect sizes were available, the psychosocial effect sizes were larger. This pattern of effect sizes suggests that the interventions may have larger impacts on psychosocial outcomes than on GHb.

Of the 12 effect sizes for GHb, seven were derived from studies with an explicit theoretical basis for the intervention and five were derived from studies without an explicit theoretical basis. The mean effect sizes for the theoretically based (0.09) and non-theoretically based (0.06) interventions were virtually identical when the outliers from the Satin study were not included in the theoretically based group. When these are included, the theoretically based interventions resulted in substantially larger effect sizes (0.52) than the non-theoretically based interventions (0.06). This pattern of results suggests that theoretically based interventions may be more beneficial, but the nature of the interventions evaluated by Satin and colleagues needs to be carefully examined (see below).
In conclusion, the RCTs demonstrated small to medium effects on GHb and psychosocial outcomes, with stronger effects more likely for psychosocial outcomes than for GHb. The meta-analysis must be treated with caution given the variation among studies in terms of the nature of the interventions evaluated. Moreover, the category of psychosocial outcomes was very diverse (although not statistically heterogeneous). With these caveats, the meta-analysis provides confirmation that psychosocial and educational interventions for adolescents with type 1 diabetes are moderately effective.

Descriptions of particular RCTs

Anderson and colleagues\(^61\) conducted the RCT that produced the largest effect size on psychosocial outcomes. The largest effect on GHb was produced by the two interventions in the study by Satin and co-workers.\(^58\) The intervention developed by Grey and colleagues\(^73–75\) produced consistent effects on both psychosocial outcomes and GHb. These RCTs were thus singled out for description in order to suggest the features of the relatively more effective interventions for adolescents.

Anderson and colleagues\(^61\)

This study addressed the issue of declining parental involvement in the management of diabetes, which may be associated with the decline in control observed among adolescents. The participants (\(n = 85\)) were younger adolescents (mean age 12 years), and the intervention focused on parent–teen responsibility for sharing diabetes tasks and ways to avoid conflicts that would undermine such teamwork. Families met individually with a research assistant for four sessions at the usual time of routine clinic appointments over a 1-year period. An attention CG met with the research assistant for an equivalent amount of time and received traditional didactic education with no emphasis on parental involvement, and a standard care group had no intervention sessions. At the end of the 1-year intervention period, the teamwork group (IG1) showed no major deterioration in parent involvement in insulin administration or blood glucose monitoring compared to either the attention CG or standard care group. The IG1 also reported less family conflict. The effects of teamwork intervention on GHb were marginally significant when compared to the combination of the attention CG and the standard care group and using the measure of number of patients (frequency) in either an ‘improved’ or a ‘not improved’ category, rather than using a continuous measure of GHb. However, the results of the effect size calculations reported in the present review do not reflect this beneficial effect on GHb: when the mean GHb of the IG1 is compared with that of the CG, the IG1 appears to have deteriorated compared to the CG. Thus, the beneficial effects of this intervention on GHb are not robust.

Satin and colleagues\(^58\)

The study by Satin and colleagues\(^58\) evaluated a multi-family group intervention in 32 adolescents (mean age 14 years) with or without parental simulation of diabetes and compared this to usual care (CG). The groups were composed of three to five families (limited later in the study to a maximum of four families) that met with professional group leaders who used principles of group therapy once a week for 6 weeks. The first 2 weeks focused on feelings about diabetes and how it affected family members (‘grieving’), and subsequent weeks focused more on diabetes management, specifically what the family could do to improve treatment adherence. In the parental simulation arm of the study only, adolescents taught their parents how to manage their ‘diabetes’ at the third session. This involved administration of two ‘insulin’ (saline) injections daily, measurement of urinary glucose and ketones four times daily, recording the results, following a meal plan, following an exercise prescription, recording late or missed meals and snacks, and submitting to a blood test for GHb. The simulation lasted 1 week, and parents discussed their experience at subsequent meetings.

At 3-month follow-up, GHb had decreased (improved) for the parental simulation group but increased (deteriorated) for the other two groups, particularly for the CG. The difference between the parental simulation condition and the CG, but not between the two group therapy conditions, was statistically significant. When only participants in the later stages of the study were considered (when the group leaders were more experienced and when group size was restricted to no more than four families), both group interventions produced significant improvements in GHb compared to the CG at both 3- and 6-month follow-ups, and these improvements were of clinically important magnitude (a 2.5–3% change in HbA1c). The largest effect size (2.03) for GHb in the Satin study was produced by the parental simulation condition. No other intervention in any study included in the present review used parental
simulation, yet it appeared to be dramatically effective in producing beneficial changes in GHb in adolescents.

Grey and colleagues

Grey and colleagues were reported across three publications. It evaluated the effects of providing coping skills training (CST) as an adjunct to intensive insulin therapy in adolescents of a mean age of 16 years \( (n = 77) \). Grey’s intervention was designed to address the particular challenges faced by adolescents on intensive therapy. The aim of CST was to increase the teenager’s sense of competence and mastery by giving training in positive coping skills for the stresses arising from intensive management. Specifically, CST taught social problem solving, social skills, cognitive-behavioural modification, and conflict resolution using scenarios depicting problematic social situations for adolescents. Adolescents role-played the situations with a trainer (master’s prepared nurse practitioner), and scenarios included managing food choices with friends, decision-making about drugs and alcohol and independence conflicts. Training occurred in groups of two to three adolescents with the nurse trainer, followed by three to five peer-led sessions. A handbook is available describing the CST protocol in depth.

The results indicated that CST had beneficial effects on both GHb and psychosocial outcomes, with effect sizes of 0.34 and 0.48, respectively. Adolescents receiving CST had better diabetes control, greater self-efficacy, were less upset by their diabetes, found it easier to cope with their diabetes and experienced less negative impact on their quality of life than those receiving intensive management only. These effects were maintained at both 6- and 12-month follow-ups.

Pre–post studies

The second largest group of studies were ones without a CG that assessed participants pre- and post-intervention. This design does not permit results to be attributed unambiguously to the intervention and findings from these studies must, therefore, be interpreted cautiously. Seven studies in this category evaluated the effects of interventions conducted at diabetes summer camps, six studies were conducted on participants in poor control of their diabetes and eight studies evaluated education programmes.

Evaluations of interventions conducted at diabetes camps

Summer camps for children and adolescents with diabetes are more common practice in the USA than Europe, although two of these seven studies were conducted in Italy. Diabetes camps provide all the usual recreational activities as well as diabetes support and education. These studies demonstrated the effectiveness of diabetes interventions delivered at camps within the limitations of the pre–post design.

One advantage of evaluating interventions at diabetes camp is that all participants undergo similar life experiences.

Camps typically included diabetes education and the four studies that assessed diabetes knowledge all reported that children were significantly more knowledgeable at the end of camp than at the beginning. A wide range of other beneficial outcomes was also reported in these studies. The experience of the Outward Bound course resulted in significantly fewer self-reports of behavioural problems. Skills training produced significant increases in independence in insulin administration and urine testing assessed by parents and camp staff. A life-skills curriculum, which addressed assertive communication, decision-making and stress management, was evaluated in two consecutive camp years by Smith and colleagues. They observed an increase both in reports of intentions to use more adaptive stress management techniques and in self-perceptions of assertiveness. Camps can have a beneficial impact on metabolic control that can be maintained after the camp: Misuraca and colleagues reported that camp participants required lower doses of insulin and had reduced GHb and that these benefits were sustained at 3-month follow-up.

These studies suggest that diabetes camps have beneficial effects on objectively measured outcomes, such as metabolic control, knowledge and skills as well as more subjective outcomes (e.g. self-perceived assertiveness). However, it is not possible to attribute these improvements specifically to the interventions described in these studies or to the experience of attending diabetes camps since the two are confounded in these studies.

Approaches to poor control

There were six pre–post studies that were conducted with adolescents selected specifically because their blood glucose was poorly controlled. A variety of interventions for these young people
are represented in these studies, but all were intended to improve blood glucose control. Arguably, these adolescents are the ones most in need of intervention, and the ones who should show the most improvement in GHb.

Ratner and co-workers\textsuperscript{122} used self-hypnosis as a means to increase adherence to the diabetes regimen and thus achieve better control. All participants ($n = 7$) showed improved GHb during the self-hypnosis phase (6–12 months) compared with the previous 6 months. Rose and co-workers\textsuperscript{123} reported the effects of an anxiety management programme applied to five poorly controlled girls. During the 5-month intervention, participants showed improvements in their urinary glucose values over baseline. Carney and colleagues\textsuperscript{86} reported the effects of training parents to use contingent praise to increase their children’s SMBG ($n = 3$). All three children monitored themselves more during the intervention and at 4-month follow-up, and all had better GHb at follow-up. Chase and colleagues\textsuperscript{88} used as many as necessary of a sequence of eight interventions to improve blood glucose control for 38 children and adolescents, beginning with increasing insulin and ending with parents taking over management for the most challenging cases. Improvement was defined in terms of improved GHb. Of the 21 participants who improved, 10 responded to changes in insulin regimen, six to a family conference, and four to a parent temporarily taking over responsibility. Orr and colleagues\textsuperscript{116} described the results of detailed psychosocial assessments of 15 adolescents with poor metabolic control and recurrent hospitalisation. Participants received standard care (diabetes education and a revision of their insulin regimen) plus the necessary psychosocial intervention, depending on the results of the assessment: 10 were referred to counselling, with five attending a support group. There were no further hospitalisations for participants over the 12–18-month follow-up period, but there were no improvements in GHb. A beneficial effect on hospitalisations, but not on GHb, was also found in a study of 52 youngsters in residential treatment by Geffken and co-workers.\textsuperscript{94} While in the residential programme, each young person received a variety of interventions, and at discharge, after a mean of 138 days, participants had gained weight and were more knowledgeable about diabetes.

A common feature of all these studies of adolescents with poorly controlled diabetes is the small sample size and lack of specificity of the intervention. It is not possible to conclude from these studies what interventions are effective for poor diabetes control, although all of the approaches produced beneficial effects.

**Education programmes**

Diabetes education is commonly evaluated using pre–post designs, possibly because it is considered essential for children and adolescents and, therefore, unethical to deprive some individuals of education in an RCT. Eight studies were identified in this review that used a pre–post design to evaluate the effects of various education programmes.

General education sessions were evaluated in four studies,\textsuperscript{84,106,107,131} and although the length (12 hours to 5 days) and the duration (2 weeks to 18 months) of these programmes varied substantially, they all showed benefits. Lucey and co-workers\textsuperscript{106} and Brandt and colleagues\textsuperscript{84} reported gains in knowledge and problem-solving skills that were sustained at 3-month follow-up. Both Magrath\textsuperscript{107} and Warren-Boulten and colleagues\textsuperscript{131} reported beneficial effects of group education on metabolic control, and Warren-Boulten and co-workers\textsuperscript{131} also showed improvements in cholesterol. However, the intervention for these latter two studies did not only involve diabetes education but also included various psychosocial elements.

Two studies focused on providing dietary education.\textsuperscript{93,105} Both interventions resulted in significant beneficial effects on total caloric intake and fat intake, and Lorini and co-workers\textsuperscript{105} also reported reductions in low-density lipoprotein (LDL) and increases in high-density lipoprotein (HDL).

The effects of instruction in aerobic exercise were evaluated by Marrero and colleagues.\textsuperscript{109} Adolescents ($n = 10$) attended three group sessions and were also given a take-home video. After 12 weeks, participants showed significant improvements in objective measures of fitness and in GHb.

Challener and co-workers\textsuperscript{87} described the effects of provision of memory blood glucose meters on 16 adolescents. They reported increased frequency of testing and modest improvements in GHb, although no tests of significance were conducted.

In summary, these various education programmes were all described as having beneficial effects on various outcomes including knowledge.
Conclusions from pre–post studies
These studies illustrate the variety of interventions that have been used for adolescents, and the range of outcomes that have been examined. The studies all reported some beneficial effects. However, the quality of these pre–post studies was, by definition, lower than that of the RCTs and, in addition, tended to be conducted on small sample sizes. Accordingly, the findings should be viewed as provisional until evaluated in more rigorous designs.

Economic analysis
Objective
The aim of the economic analysis was to establish, if possible, the incremental cost per unit of outcome for individual interventions and for groupings of similar interventions, so that value-for-money relativities could be investigated. To this end, all included papers were reviewed and details of the resource use and consequences of interventions recorded.

Economic evidence
The search process resulted in the identification of a wide variety of interventions, ranging from multi-faceted education and self-management programmes to initiatives that focused on specific issues such as diet, exercise, sick days and family relations. There was equal diversity in study populations, settings, interventionists, outcomes, research designs and methodological quality. It was consequently impossible to make pure groupings of interventions from which meaningful comparisons could be made, and studies were appraised on an individual basis.

Across the studies as a whole there was scanty treatment of economic considerations. Just one study included costings of professional time involved in the intervention. Some more recent American studies acknowledged economic constraints by designing their interventions to be ‘low cost’ or ‘office-based’. No cost-effectiveness ratios were calculated by any of the investigators. Although many papers included descriptions of the human resource implications of the interventions, this could not be adequately ascertained from other accounts, and the magnitude of the full economic costs could rarely be estimated due to non-existent reporting of capital equipment and overhead costs.

Utilisation outcomes
Eight studies reported the effect of interventions on subsequent service utilisation or adverse events. Two studies targeting poorly controlled individuals recorded significantly reduced hospitalisation following in-depth psychosocial counselling and a lengthy period of residential treatment. Due to the short follow-up periods, it is not possible to determine whether the discounted benefits would exceed the costs of the interventions in these two studies. It is more difficult to show significant short-term utilisation effects due to interventions in already moderately or well-controlled subjects because of the infrequency of adverse events amongst such adolescents. Weak positive effects were, however, shown by three such studies. Another study demonstrated that the distribution of a diabetes-related video game was associated with a reduced number of urgent doctor visits. Two studies that investigated the 10-year impact of not hospitalising patients at diagnosis showed very different results. One showed that this had no effect on complications and hospitalisation, whilst the other found that it reduced subsequent hospital admissions.

Hospitalisation at diagnosis
The effect of length of hospital stay at diagnosis on subsequent metabolic control has also been investigated, and no additional benefits have been revealed from a longer hospital stay suggesting that hospital savings might be effected by quicker discharge, although an economic evaluation in Canada found no overall cost-savings associated with home care at diagnosis. Despite significantly better health outcomes after 2 years for the home care group compared with those that received routine hospital care at diagnosis, the healthcare delivery costs were higher at home and exceeded the savings in familial expenses. However, significant savings in hospital costs at diagnosis have already been achieved in the UK through home management by paediatric diabetes nurse specialists.

Poorly controlled adolescents
Since many of the costs associated with diabetes arise from complications induced by poor metabolic control, the potential benefits of assisting poorly controlled individuals are above average. Therefore, interventions that target hard-to-manage adolescents are of special interest. Effective initiatives could have higher cost-savings but may be more difficult to achieve with this patient group and thus require a higher commitment of resources.

Twelve studies focused on poorly controlled subjects and mostly used interventions
involving family therapy and individual or group counselling. Although seven studies reported improved metabolic control,\textsuperscript{57,88,94,122–124,131} and the other five recorded improvements in a variety of behavioural or psychosocial outcomes,\textsuperscript{56,80,97,116,134} only two of these studies showed significantly reduced hospitalisations following intervention.\textsuperscript{94,116} Collectively, these studies illustrate that poorly controlled subjects can be assisted by tailored interventions, but they do not provide robust evidence of the cost-effectiveness of such approaches.

**Conclusion**

Studies lacked the information required to undertake a detailed economic analysis and the diversity of the interventions and outcomes further impeded cost-effectiveness comparisons. In line with the conclusions of a review of educational interventions for adults with diabetes,\textsuperscript{139} no evidence was found to show that similar interventions for adolescents saved money. Furthermore, the small to medium-sized beneficial effects recorded across such a range of interventions and outcomes for adolescents with diabetes as in this review is consistent with the findings of reviews of similar interventions for childhood asthma.\textsuperscript{140,141} Future appraisals of educational or psychosocial interventions for adolescents with diabetes need to include a full economic evaluation of the costs and benefits. This should take into account the potential future social and private cost-savings associated with achieving better metabolic control, which could be substantial.\textsuperscript{11,142}
Obstacles to evaluating educational and psychosocial interventions for diabetes

In discussing the findings of this review, it is important to consider the obstacles to the conduction of appropriate controlled clinical trials of educational and psychosocial interventions for diabetes. As type 1 diabetes is a life-threatening disease, basic education and skills training at diagnosis are essential for survival. Therefore, all adolescents with diabetes (and/or their parents) will have received some basic education. For obvious ethical reasons, education at diagnosis cannot be evaluated against no education. Subsequent interventions must, therefore, show an effect over and above the effects of the intervention administered at diagnosis. Consequently, such effects may be relatively modest.

Theoretical models relating educational and psychosocial interventions to outcomes through mediating variables remain to be fully developed. As a result, there is debate over the appropriate outcomes to assess when evaluating the impact of interventions. Although metabolic control has been viewed by many as the primary outcome, educational and psychosocial interventions are concerned with changing self-management behaviours, attitudes and beliefs, which are viewed as mediating improved health status. Therefore, assessing changes in these behavioural and psychological outcomes is a fairer evaluation of the intervention than assessing changes in metabolic control.

Moreover, changes in metabolic control are the result of numerous factors beyond the interventionist’s control. Typically, educational and psychosocial interventions are conducted as a supplement to standard medical care. In a drug trial, it can be required that participants are not taking other medications, and that they do not start another medication during the course of the trial. In a trial of educational or psychosocial interventions for diabetes, it is not considered ethical for such restrictions to be placed upon participants. Therefore, their medical treatment may be changed during the intervention or follow-up period, with resulting consequences for metabolic control that may obscure intervention effects. Ideally, medical care and education should be integrated, as in the DCCT. However, under these circumstances, it is not possible to isolate the effects of the non-medical aspects of care.

The ultimate goal of diabetes care is to increase patients’ quality of life by reducing the morbidity and mortality associated with the disease. Therefore, evaluating the effectiveness of interventions is a long-term enterprise in which patients should be followed-up sufficiently for any impact on chronic complications to be observed. However, follow-up over several years is problematic, because numerous other uncontrolled factors intervene making it impossible to attribute changes in disease status to an educational or psychosocial intervention some years earlier.

Despite these obstacles, there is a considerable body of research on interventions for adolescents. This review identified 62 studies evaluating 64 different educational and psychosocial interventions for adolescents with type 1 diabetes. A meta-analyses of 16 of these interventions indicated that small to medium beneficial effects were observed in psychosocial outcomes and GHb.

Shortcomings of past research

Although the largest proportion of studies (41%) were RCTs, 59% of the studies were of a less powerful design that prevented evaluation of the intervention with potential bias minimised as much as possible. Sample sizes were not based on power calculations and the power of the study was rarely discussed. It is unlikely, however, that studies in which fewer than 40 participants (i.e. the majority of studies in this review) were allocated to one of two groups would yield significant results when only small to medium effect sizes can be anticipated. Specifically, to achieve a significant effect size of 0.20 with power of 0.90, a total of 270 participants is required, and to achieve a significant effect size of 0.35 with power of 0.90, 90 participants are required. Most studies (67%) have been conducted in the USA, and the generalisability of these finding to
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the UK setting is undetermined. Interventions developed in the USA require modification and re-evaluation for application in the UK.\textsuperscript{147}

This review exposed the enormous variety of interventions that have been developed for adolescents with type 1 diabetes. These interventions have taken place in a variety of settings (e.g. from medical offices to summer camps), focused on various combinations of aspects of diabetes management, involved a range of interventionists and been evaluated by assessing widely differing outcomes (e.g. from ‘romantic appeal’ to fructosamine). Even where different studies have assessed comparable outcomes, they have not necessarily used the same measure or even ones of known reliability and validity. Given this heterogeneity, the existing research is piecemeal rather than cumulative, which makes it difficult to identify what progress has been made.

More than half the studies reviewed (55\%) had no explicit theoretical basis underlying the intervention. A theoretical basis determines not only the contents of the intervention but the most appropriate outcomes to measure and when to measure them. A theoretical basis also permits predictions to be made for outcomes that are not expected to change versus ones that are expected to change, which provides a powerful test of the intervention’s effects.

This review found that outcomes were not likely to be assessed at follow-up; only 40\% of studies had a post-test assessment and the majority of these took place within less than 6 months. However, outcomes range along a continuum from proximal to distal. An intervention designed to change proximal outcomes (e.g. skill at injecting insulin) should produce larger effects on proximal outcomes (e.g. observed injecting skill) than on more distal ones (e.g. GHb), which is probably partially mediated by injecting skill but might also be subject to other influences. The length of appropriate follow-up should be based on the theoretical model underlying the assumed intervention effects on different outcomes. Long-term effects are unlikely for interventions that do not address long-term maintenance issues.

**Findings from the 25 RCTs**

None of the RCTs identified in this review were conducted in the UK, thus the generalisability of any of the findings to the UK setting remains unknown. However, the work conducted in the USA provides valuable information about likely effective components of interventions and is, therefore, a good starting point for designing a UK intervention.

The importance of integrating medical care and educational and psychosocial interventions was underscored by at least three of the RCTs. The interventions evaluated by Anderson and colleagues,\textsuperscript{59} Delamater and colleagues\textsuperscript{60} and Marrero and colleagues\textsuperscript{108} focused on SMBG and related it to other aspects of diabetes management (e.g. insulin adjustment, lifestyle aspects). By demonstrating how this information can be used to guide other management behaviours, SMBG becomes meaningful and more likely to be performed. The results from integrating medical and non-medical aspects of diabetes management suggest that multicomponent interventions may be more successful for adolescents than ones that just focus on one aspect. These interventions, such as those used by Grey and co-workers,\textsuperscript{73–75} address all aspects of diabetes management and the complex interrelationships between management activities are considered. Grey’s intervention was also integrated with medical care because all participants were on intensive insulin therapy.

One important issue for adolescents is the question of parental involvement. In the studies identified here that addressed the issue of parental involvement, the evidence supports the widely held clinical view that developmentally appropriate, negotiated responsibility has beneficial outcomes. Anderson and colleagues\textsuperscript{59,61} hypothesised that the increasing decline in control observed in adolescents is the result of declining parental involvement during this period. In one intervention,\textsuperscript{59} they maintained parental involvement by intervening with both adolescents and their parents, although this was through separate groups. This intervention had significant positive effects on GHb. In their more recent study,\textsuperscript{61} the intervention was designed explicitly to maintain parental involvement through family counselling sessions and although the effects on psychosocial outcomes were positive, the effects on GHb were not. (However, when a different analytic approach was used, the report indicated a marginal beneficial effect on GHb.) In one of the interventions used by Satin and colleagues,\textsuperscript{58} parents became intensely involved by simulating the experience of having diabetes for 1 week under the tutorship of their child. This intervention presumably resulted in the parents having a better understanding of their child’s experience of diabetes,
which may have helped them negotiate the responsibility issues. Finally, the intervention used by McNabb and colleagues aimed to increase developmentally appropriate responsibility for management tasks by younger adolescents. All of these interventions had beneficial effects on diabetes management, and the parental simulation used by Satin and colleagues resulted in a large beneficial effect on GHB.

An unresolved issue is the extent to which targeted interventions are more effective than generic ones. There are a number of ways in which interventions can be targeted. A particular stage in the disease can be selected, e.g. results from intervention in the first few months after diagnosis suggested that this is effective. Interventions for adolescents who have had diabetes for several years or who are in poor control may need to focus on different issues. The period of adolescence, as defined for this review, includes a wide age-range and different approaches need to be considered for younger versus older adolescents. Each adolescent experiences diabetes in a unique way and faces idiosyncratic challenges, suggesting that interventions might need to address specific concerns of the individual adolescent patient in addition to those issues common to most, if not all, patients. However, no studies have examined the effects of this type of targeting.

The meta-analysis only included a subset of findings from the RCTs, nevertheless it generated some suggestions for future interventions. Although effects of educational and psychosocial interventions at diagnosis cannot be fully evaluated, given ethical constraints, it appears that length of hospital stay is not a critical factor in subsequent diabetes management. However, the provision of such an intervention in the early months after diagnosis was found to be effective in slowing the subsequent decline in GHB, suggesting that this may be an optimal time to intervene. There was no strong evidence to favour individual, group or family-based interventions, suggesting that the choice of unit of intervention can be governed by other factors such as cost and convenience. There was no evidence to support targeted approaches over more generic ones because this issue had not been explicitly addressed.

Psychosocial and educational interventions are expected to have a larger impact on corresponding psychosocial and educational outcomes than on metabolic control. In line with this expectation, the meta-analysis indicated that these interventions had larger effects on psychosocial outcomes than on metabolic control. A significant difference in mean effect sizes (0.37 for psychosocial outcomes versus 0.08 for GHB) was observed when the two large effect sizes in the GHB group were removed to achieve homogeneity.

In summary, the RCTs demonstrated that these interventions have beneficial impacts on a range of outcomes, and the effect sizes are typically in the small to medium range.

Pre–post studies

There were 21 studies in which a pre–post design with no CG had been used. This design does not permit results to be attributed unambiguously to the intervention, so the findings from these studies should be treated with caution. A narrative review of these studies revealed that they all reported beneficial effects of the various interventions examined, but there is a danger here of publication bias. Studies with this type of weak design are possibly less likely to be published if they report the absence of beneficial effects.

Limitations of this review

Extensive electronic searching and soliciting of reports was undertaken and many abstracts were screened. The eventual corpus of clinical studies consisted exclusively of journal articles or reports destined for journals, suggesting that the ‘grey’ literature may not have been accessed successfully.

Not all the RCTs were included in the meta-analysis and effect sizes could not be calculated for all the outcomes reported in those studies that were included, thus the effect sizes used in the meta-analysis may have been unrepresentative. Given the limited number of effect sizes in this review, it was decided not to weight them differentially. Only one type of effect size was used based on means and SDs because the large majority of outcomes were continuous variables. However, this decision meant that no effect sizes for categorical variables were included and it remains a possibility that the findings of a meta-analysis including this type of outcome would be different.

However, these limitations of the meta-analytic component should be considered in the light of its strengths. The studies for which effect sizes were available were not unrepresentative of the whole set of studies, except in so far as they
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included studies with a CG and ones published more recently. They were, therefore, higher quality studies to which more weight should be given. The quantitative integration of findings across several studies can be a more rigorous approach than a qualitative, narrative review. On balance, the effect size analyses generated useful indicators of the impact of these interventions, but should be viewed with caution.

Conclusions

Based on the process of location, analysis and discussion of the research identified by this review, the following conclusions may be drawn.

1. Educational and psychosocial interventions have small to medium-sized beneficial effects on a variety of diabetes management outcomes.
2. There is a need for well-designed clinical trials of these interventions in the UK. (No completed RCTs of educational or psychosocial interventions for adolescents with type 1 diabetes conducted in the UK were located although two studies are currently underway).
3. The evidence-base, arising primarily from studies in the USA, provides a starting point for the design of interventions for the UK.
4. Quantitative and narrative analysis of the evidence-base suggests that interventions are more likely to be effective if they demonstrate the inter-relatedness of the various aspects of diabetes management, assess outcomes that the intervention explicitly targets for change, and assess outcomes at the appropriate point in time post-intervention to reflect the impact of the intervention.
5. The evaluation of interventions needs to be by well-designed studies such as RCTs including patient-preference arms with adequate power and which report results in such a way that effect sizes can be calculated.
6. An important gap in the evidence is that there is no systematic understanding of whether interventions should be targeted (e.g. modified for the different age groups subsumed by adolescence, for the different disease stages, or for adolescents with different types of diabetes management problems).

This review was based on a systematic literature search up to June 1999. As research has tended to be piecemeal rather than programmatic, it is very unlikely that more recently published papers will substantially change the conclusions arrived at here. Moreover, our contacts with active researchers in the field have not identified any major new studies underway in the USA, and only two in the UK (see chapter 3).

Recommendations for future research

Research to date has proceeded piecemeal instead of cumulatively and this limits the extent to which firm conclusions can be drawn about what is already known of the effectiveness of education and psychosocial intervention for adolescents with type 1 diabetes. In order for more cumulative research to be conducted, studies need to be based on explicit theoretical principles in which the design of the intervention and the selection of the outcomes are theoretically guided. Outcomes need to be assessed using reliable and valid measures, preferably ones that are widely used so that evidence across studies can be combined. However, even if these principles are followed, there will still be an enormous number of possible interventions that could be developed and evaluated. There is a tendency, perhaps a preference, for researchers to develop their own interventions independently, which adds to the non-cumulative nature of this field.

The lack of UK-based studies highlights a gap in the evidence. To fill this gap, this review recommends that a programme of primary research on adolescent interventions be developed. Past research conducted elsewhere will assist to some extent in the development of what are expected to be effective interventions. However, there is insufficient evidence to narrow the possibilities significantly. Instead of further encouraging the piecemeal development of research in this area, this review recommends that a phase of programme development is undertaken involving a consultation process with stakeholders (i.e. adolescents with diabetes, their families, doctors, nurses, health economists and health psychologists). The aim of such a consultation exercise would be to arrive at the outline of interventions that are seen as plausible and potentially effective by patients and their parents, feasible and practical in the context of NHS diabetes services and understood and accepted by doctors and nurses as key and integral parts of diabetes care. The interventions should also have the potential to be cost-effective and be based on sound behavioural principles. Such interventions, if demonstrated to be effective, would be much more likely to be implemented than ones established outside of such a developmental phase.
The types of issues to address during such a consultation process could include, but not be limited to, the following.

1. Establishing the intervention topics viewed by each stakeholder group as most important for inclusion.
2. Individual- versus group- versus family-based interventions.
3. Targeting by disease stage and age of adolescent.
4. The use of information technology (e.g. videos, video games, glucometers, palm-top computers) both for delivering interventions and as aids to self-management.
5. The location of the intervention (e.g. hospital outpatients, GP clinics, some other community setting) to facilitate maximum attendance.
6. Parental involvement.
7. Integration of the intervention with medical care.
8. The practicalities of running RCTs of these interventions in NHS settings.
9. The views of adolescents and their parents about participating in RCTs and patient-preference trials.
10. What constitutes an acceptable CG from both the researchers’ and participants’ perspectives.

At the conclusion of this developmental phase, the information obtained would be documented and used to shape the interventions to be developed and evaluated by commissioned research. In this way, UK-based research on education and psychosocial interventions for adolescents with type 1 diabetes would proceed in a cumulative and consensual manner with implementation in mind from the outset.
Acknowledgements

The authors thank Sue Cradock, RGN, MSc, DipN, FETC and E Adele McEvilly, RGN, RSCN, FETC for assisting the review team at their two workshops by commenting on the approach and results of the review, and by providing expertise on aspects of care and management of diabetes in adolescents. In addition, they thank them and Professor Rosemary Crow for commenting on the draft report.

The authors are indebted to the referees for their attention to the report and the quality of their comments. The views expressed are those of the authors, who are also responsible for any errors.
References


Appendix 1

Search terms

**Section 1 (age)**
adolescen*
youth*
young people
young person*
child*
adult [and type 1 and/, ages 16, 17, 18]
teen*
juvenile
pube*

**Section 2 (condition)**
diabet*

**Section 3 (intervention/process)**
program*
educat*
teach*
inform*
train*
skill*
learn*
famil*
parent*

**Section 4 (outcomes)**
adher*
manage*
control*
empower*
knowledge*
diet*
skill*
exerci*
nutrition
eating and * [f, behaviour/dis,der/pattern]
weight control
regime
insulin sensitivity
behiav*
outcome*
diabet* and (adolescen* or youth* or young people or young person* or child* or teen* or juvenile or pube*) and (program* or educat* or interven* or inform* or teach* or train* or skill* or learn* or famil* or parent*) and (adher* or manage* or control* or empower* or knowledge* or diet* or skill* or exerci* or nutrition or eating or weight control or regime or insulin sensitivity or behavi* or outcome*)
### Appendix 2

List of Mailbase discussion groups contacted

<table>
<thead>
<tr>
<th>podiatry</th>
<th>adol-npra</th>
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<tr>
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<td>comp-med-trials</td>
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Appendix 3

Example of a flyer used to publicise the work of the review

A review of educational interventions for adolescents with diabetes

We are currently carrying out a systematic review of the

“Effectiveness of diabetes education interventions for adolescents”

If you have any relevant information (e.g. knowledge of / involvement with recent or ongoing projects, in any country) then we would be very pleased to hear from you.

Please could you contact Jo Hart or Lesley Storey at the address below, with details.

Jo Hart / Lesley Storey
Department of Psychology
University of Surrey
Guildford
GU2 5XH
UK

Tel: +44 (0)1483 876927
Fax: +44 (0)1483 259553
Email: Jo.Hart@surrey.ac.uk or L.Storey@surrey.ac.uk
# Appendix 4

List of those who responded to any request for information

| Ralf Ackerman | Ray Jones          |
| B J Anderson  | Fran Kaufman       |
| Sue Baughan   | Celia Keenaghan    |
| Mary Boyle    | Z Laron            |
| C Bradley     | Rod Lorenz         |
| Julie-Anne Burgess | Johnny Ludvigsson |
| B Carter      | P J Lustman        |
| Sandy Cook    | A Macklin          |
| Jennifer Couper | Terry Maguire    |
| Sally Croft   | Ian Moody          |
| Ian Crook     | Andrea Nelson      |
| Mark Duman    | Ray Newton         |
| Trisha Dunning | Arie Nouwen       |
| Deborah Eeidin | Maryanne Quinn    |
| Kathryn Ehrich | Dan Remley        |
| P Fonagy      | Rajna Rimac        |
| Hilary Gray   | L Ruggiero         |
| T Greenhalgh  | C M Ryan           |
| Margaret Grey | K E Smith          |
| Brian Haynes  | E de Sousa         |
| Ronald Hillson| R Surwit           |
| R G Hiss      | Tim Wysocki        |
| Pat Hughes    | M Zwi              |
## Appendix 5

### Data extraction proforma

<table>
<thead>
<tr>
<th>ID reference number</th>
<th>Reviewer</th>
</tr>
</thead>
</table>

### 1. Bibliographic details

Author (1st only) ______________
Publication year _______
References to same study? Y/N
ID number _______

### 2. Details of study

#### General details

- Total number of subjects ________________
- Number of groups ________________
- Number in each group ________________
- Country ________________

#### Study population – intervention group 1 (IG1)

- **IDDM**
- **MODY** (maturity-onset diabetes of the young)

<table>
<thead>
<tr>
<th>Age range</th>
<th>Mean age</th>
<th>SD</th>
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<th>Racial/ethnic group membership?</th>
<th>% of total?</th>
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#### Study population – intervention group 2 (IG2)

- **IDDM**
- **MODY**

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<th>% of total?</th>
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#### Study population – control group (CG)

- **IDDM**
- **MODY**

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<th>Racial/ethnic group membership?</th>
<th>% of total?</th>
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<tbody>
<tr>
<td>Y/N</td>
<td></td>
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3. Intervention

Theoretical principles – must be overtly stated (tick as many as apply and please specify author)

- [ ] None
- [ ] Social learning theory
- [ ] Cognitive behavioural therapy
- [ ] Behavioural
- [ ] Family-therapy
- [ ] Other (please specify)

Nature of intervention (tick as many as apply)

- [ ] Skills-training (e.g. insulin pump)
- [ ] Exercise-related
- [ ] Emotional/psychological
- [ ] Stress reduction
- [ ] Other (please specify)

Brief overview of intervention:

Interventionist (please tick as many as apply)

- [ ] Doctor
- [ ] Nurse
- [ ] Psychologist
- [ ] Nutritionist/dietician
- [ ] Peer group
- [ ] Not clear/not specified

Disease stage

- [ ] Onset
- [ ] Poorly controlled
- [ ] First year
- [ ] Subsequent years
- [ ] Not stated

Mode of delivery – IG1 (please tick as many as apply)

- [ ] Lecture
- [ ] Interactive discussion
- [ ] Video
- [ ] Printed information/leaflet
- [ ] Computer
- [ ] Motivational/patient empowerment
- [ ] Not clear
- [ ] Other (please specify)

Mode of delivery – IG2 (please tick as many as apply)

- [ ] Lecture
- [ ] Interactive discussion
- [ ] Video
- [ ] Printed information/leaflet
- [ ] Computer
- [ ] Motivational/patient empowerment
- [ ] Not clear
- [ ] Other (please specify)
### Mode of delivery – CG (please tick as many as apply)

- Lecture
- Interactive discussion
- Video
- Printed information/leaflet
- Computer
- Motivational/patient empowerment
- Not clear
- Other (please specify) _______________________

### Setting (please indicate only one unless different settings for different groups – if so, please specify)

- Hospital clinic (outpatient)
- Hospital (inpatient)
- GP clinic
- Home
- Other community setting (e.g. camp) ______________
- Not clear

### Type of setting (please tick only one)

- Group
- Individual
- Family unit
- Mixture
- Not clear

### Timing (upper limit)

- Total time spent on intervention _________ hours
- Number of sessions _________
- Over what time period did the intervention take place? __________

### 4. Study design

#### Type of study – please tick as appropriate

- RCT
- Case study
- Pre–post (no CG*)
- Post-intervention only
- Waiting list CG*
- Non-randomised CG
- Meta-analysis – quantitative
- Meta-analysis – qualitative
- Other (please specify) ____________________________

(* CG includes any group used for comparative purposes)

### 5. Assessments

- Baseline
- Post-test
- No follow-up, post-intervention
- Less than 6 months
- 6 months
- 1 year
- More than 1 year (please state how long) __________
Appendix 5

Measurement of C-peptides (residual insulin production) Y/N?

<table>
<thead>
<tr>
<th>OUTCOME (please specify outcome in each case)</th>
<th>Please state specific outcome and source of report</th>
<th>Baseline (mean and SD)</th>
<th>Post-intervention (mean and SD)</th>
<th>Follow-up (mean and SD)</th>
<th>Significant results</th>
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<td>Outcome 1</td>
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<td>Outcome 2</td>
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<td>Outcome 3</td>
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<tr>
<td>Outcome 4</td>
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</tbody>
</table>

Please use key: IG1, IG2, IG3 and CG for groups
Please give details of other relevant findings including interaction effects

6. Methodological quality

Power of study _______
Participation rate (% of those contacted recruited) _______
Attrition rate (% of those recruited completing study) _______
Randomisation quality, scale 0–5 (please tick grade that applies)
   0 = not mentioned
   1 = very poor (no randomisation)
   2 = poor (e.g. cluster randomisation at some sites but not others, allocation by alternate weeks of attendance)
   3 = adequate (individual patients randomised but method not described)
   4 = good (individual patients randomised using random number tables)
   5 = excellent (patients randomised using independent randomisation system determined by person independent of intervention team)

Concealment of allocation? Y/N
   0 – Not stated
   1 – Single-blind (patient only)
   2 – Double-blind (patient and care team)
   3 – Treble-blind (patient, care team and analyst)
Baseline comparability tested for
   □ Yes      □ No      □ Not stated
Reliable measures used?
   □ Yes      □ No      □ Not stated      □ Not clear
Do the statistics used seem reasonable?
   □ Yes      □ No      □ Not sure
7. Cost data supplied? Y/N

8. Conclusions and implications

9. References to be chased
## Appendix 6

Data summary tables (in reference order)

<table>
<thead>
<tr>
<th>Reference details</th>
<th>Sample characteristics</th>
<th>Intervention</th>
<th>Study design and assessments</th>
<th>Measures and results</th>
<th>Conclusions and implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galatzer et al., 1982&lt;sup&gt;55&lt;/sup&gt;</td>
<td>N = 223 (107 IG1, 116 CG)</td>
<td>IG1 – intensive psychosocial support for first month after diagnosis</td>
<td>Non-randomised CG with 3–15 years follow-up</td>
<td>IG1 had significantly better compliance (p &lt; 0.001), family relations (p &lt; 0.02) and sociability (p &lt; 0.025), but the difference in school/work was not significant. Effects were specific to higher socio-economic groups.</td>
<td>Very intensive psychosocial support at diagnosis had benefits at extended follow-up, but assessment not validated.</td>
</tr>
<tr>
<td></td>
<td>Mean age = 15.52% males</td>
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<tr>
<td></td>
<td>Intervention at diagnosis</td>
<td>CG – usual care</td>
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<tr>
<td></td>
<td>Israel</td>
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<tr>
<td></td>
<td>Poorly controlled adolescents (N = 19)</td>
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<tr>
<td></td>
<td>IG1 (n = 9)</td>
<td>IG1 – 13 group-based behavioural intervention sessions over 6 months for SMBG, stress management and adherence training using learning, discussion, role-play, modelling and behavioural contracting</td>
<td>RCT Assessments at baseline and 3, 6 and 9 months</td>
<td>IG1 improved relative to CG on diabetes-specific stress levels (p &lt; 0.05) No significant differences in metabolic measures (GHb and fructosamine), maladaptive coping, diabetes self-efficacy, adherence measured by 24-hour recall interview or number of life events</td>
<td>Intervention did reduce reported stress but had no other effects, including metabolic control. Relaxation training was not included and this may be necessary to affect metabolic control</td>
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<tr>
<td></td>
<td>Mean age = 15.44 ± 1.19; mean duration = 6.92 ± 5.79 years; 22% males</td>
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<tr>
<td></td>
<td>CG (n = 10)</td>
<td>CG – usual care</td>
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<tr>
<td></td>
<td>Mean age = 14.32 ± 1.71; mean duration = 6.34 ± 2.61 years</td>
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<tr>
<td></td>
<td>USA</td>
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<td></td>
<td>Patients with type 1 diabetes for at least 1 year in poor metabolic control (N = 25)</td>
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<tr>
<td></td>
<td>IG1 (n = 9)</td>
<td>IG1 – family therapy (Minuchin) with child psychiatrist (seven 1–2-hour sessions over 6 months)</td>
<td>IG2 12-, 22- and 32-month follow-ups depending on measure</td>
<td>Diabetic control (combination of HbA&lt;sub&gt;1c&lt;/sub&gt; and doctor ratings); eight of nine IG1 and two of nine CG patients improved (p &lt; 0.05) at 12 months No effect on behavioural symptoms and self-evaluation. Self-evaluation in relation to behavioural symptoms: five of nine IG1 compared to two of 10 CG patients showed healthier pattern</td>
<td>IG1 retained more participants than IG2, and had ‘integrated and enduring positive effects’, i.e. effects on self-evaluation, control and symptoms</td>
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<tr>
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<td>Mean age = 12.8 (four &gt; 12 years); 33% males</td>
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<tr>
<td></td>
<td>IG2 (n = 6)</td>
<td>IG2 – practical instruction with paediatrician (only two families attended all seven 1–2-hour sessions over 6 months)</td>
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<tr>
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<td>Mean age = 14.0 (four &gt; 12 years); 33% males</td>
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<tr>
<td></td>
<td>CG (n = 10)</td>
<td>CG – usual care</td>
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</tr>
<tr>
<td></td>
<td>Mean age = 12.6; 30% males</td>
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<tr>
<td></td>
<td>Sweden</td>
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*continued*
## Reference Sample Intervention Study design Measures and Conclusions and implications

<table>
<thead>
<tr>
<th>Reference details</th>
<th>Sample characteristics</th>
<th>Intervention</th>
<th>Study design and assessments</th>
<th>Measures and results</th>
<th>Conclusions and implications</th>
</tr>
</thead>
</table>
| Satin et al., 1989<sup>36</sup> | N = 32  
Mean age = 14.6 ± 2.6; mean duration = 5.9 ± 4.3 years  
IG1  
Mean age = 15 ± 2.4; mean duration = 6.3 ± 5.1 years; 36% males  
IG2  
Mean age = 14.9 ± 2.8; mean duration = 5.2 ± 3.8 years; 25% males  
CG  
Mean age = 13.7 ± 2.7; mean duration = 6.3 ± 4.3 years; 55% males  
USA | IG1 and IG2 – multi-family group therapy of adolescents and parents to discuss diabetes management for six sessions over 6 weeks  
Parents in IG2 simulated having diabetes  
IG – no intervention | RCT  
HbA<sub>1c</sub> assessed at baseline and 3 and 6 months after enrolment  
Parents’ and teenagers’ perceptions of diabetes assessed at pre- and post-intervention  
Parents’ ratings of child’s self-care on carefulness scale assessed at pre- and post-intervention | IG2 showed significant decrease in HbA<sub>1c</sub> at 3 months compared with CG (p < 0.05), but no difference between IG1 and CG  
The families that met in smaller groups in both IG1 and IG2 differed significantly from CG at 3 and 6 months  
Adolescents’ attitudes toward ‘a teenager with diabetes’ in both IG1 and IG2 improved relative to CG (p < 0.01), but there were no other significant differences  
Mothers in smaller groups rated that self-care increased in both IG1 and IG2 (p < 0.07) but reduced in CG (p < 0.05) | Multifamily group therapy with parental simulation (IG2) shows some improved control  
Subgroup analyses should be interpreted with caution due to the small number of participants |
| Anderson et al., 1989<sup>37</sup> | N = 70  
Age range 11–14  
IG1  
Mean age = 12.9; 47% males  
CG  
Mean age = 12.5; 47% males  
USA | IG1 – adolescents (taught SMBG and adjustment skills) and parents (taught skills for negotiating management responsibility) had separate concurrent 3-hour meetings every 3–4 months for 18 months at usual outpatient appointments | RCT  
Pre- and post-intervention assessments | IG1 made more use of blood glucose results to make adjustments  
CG showed a significantly greater decline in metabolic control over the 18 months (p < 0.04) | Intervention had a significant impact on GHB and was clear and replicable, and may be used in usual outpatient clinics |
| Delamater et al., 1990<sup>38</sup> | N = 36 newly diagnosed  
Age range 3–16, plus parents  
IG1  
Mean age = 9.3 ± 3.9; 58% males; 92% white  
IG2  
Mean age = 8.6 ± 4.1; 50% males; 75% white  
CG  
Age = 9.8 ± 2.6; 50% males; 92% white  
USA | IG1 – within first 4 months of diagnosis, seven sessions of SMBG training given to adjust diet, exercise and insulin  
IG2 – attention placebo control  
CG – usual care | RCT  
Follow-up assessments over 2 years | IG1 had a lower HbA<sub>1c</sub> at 1 year (p < 0.01) and at 2 years (p < 0.05) than CG after controlling for C-peptides, but not lower than IG2  
No effects for SMBG  
Fewer dietary deviations for IG1 than for CG (p < 0.05) | Interventions in the first few months after diagnosis may be beneficial for diabetes control over the next 2 years |
<table>
<thead>
<tr>
<th>Reference details</th>
<th>Sample characteristics</th>
<th>Intervention</th>
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<th>Measures and results</th>
<th>Conclusions and implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grey et al., 1998</td>
<td>N = 65</td>
<td>IG1 – coping skills training plus intensive diabetes management, IG1 (n = 34) Mean age = 15.8 ± 2.1; 44% males</td>
<td>RCT Baseline and 3-month assessment for all variables except HbA1c, which was assessed monthly</td>
<td>HbA1c improved over time in both groups (p &lt; 0.001) but more so for IG1 (p &lt; 0.04) Incidence of hypoglycaemia, ketoacidosis and being overweight at 3 months was similar in both groups Diabetes self-efficacy improved more in IG1 (p &lt; 0.05), and IG1 patients were less upset with coping (p &lt; 0.001), finding coping less hard (p &lt; 0.01) and diabetes had less impact on their quality of life (p &lt; 0.04)</td>
<td>CST plus intensive diabetes management was better than intensive management only Excellent high-quality study so these results are likely to be generalisable, although not necessarily to non-white youths of a lower socio-economic status However, long-term follow-up needed</td>
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<td>Age range 12–20</td>
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<td>USA</td>
<td>CG – intensive management only Social skills training, cognitive-behaviour modification and conflict resolution taught in small groups using scenarios and role play in four–eight 1–1.5-hour sessions over 4–6 weeks</td>
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<td>Ayarri, 1994</td>
<td>N = 106</td>
<td>Knowledge and skills training at summer camp IG1 – intensive, multi-component treatment given by nurse or doctor over 4 months consisting of an initial visit and assessment, clinic visits every 2 weeks, daily telephone calls providing medical care, teaching, clarification and support for self-management plus one group session</td>
<td>Pre–post camp Knowledge test of self-injection and SMBG techniques</td>
<td>Knowledge increased, particularly for first-timers (p &lt; 0.05), and injecting and SMBG skills were improved for all</td>
<td>Camp was effective at increasing knowledge and skills</td>
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<td>Age range 6.7–16.75; mean duration = 4.5 ± 3.0 years; 62% males Three cohorts studied Spain</td>
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<td>Barglow et al., 1983</td>
<td>N = 42</td>
<td>IG1 (n = 21) Mean age = 13.4 ± 3.3; mean duration = 59 ± 45.4 months; 43% males; 62% black</td>
<td>Non-randomised CG Assessed psychological characteristics at baseline and HbA1c at baseline, 6–8 and 14–16 weeks</td>
<td>HbA1c, comparable in both IG1 and CG at baseline and the Coddington Social Readjustment Scale was the only measure to enable prediction of initial HbA1c (p &lt; 0.01)</td>
<td>Intensive treatment had a significant effect on HbA1c. Those with greater ego control showed more improvement and those with more life events were in poorer control at the start of study</td>
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<td>IG1 (n = 21) Mean age = 12.2 ± 2.50; mean duration = 38.6 ± 35.4 months; 24% males; 43% black USA</td>
<td>CG – standard medical care</td>
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continued
## Reference details | Sample characteristics | Intervention | Study design and assessments | Measures and results | Conclusions and implications
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Bloomfield et al., 1990[1] | N = 92  
IG1 (n = 24)  
Mean age = 9.1 ± 3.1; mean duration = 2.8 ± 2.4 years; 50% males  
IG2 (n = 24)  
Mean age = 8.9 ± 2.9; mean duration = 2.7 ± 1.9 years; 38% males  
CG (n = 44)  
Mean age = 10.4 ± 2.4; mean duration = 2.7 ± 1.9 years; 41% males  
UK | Diabetes club (informal meetings held in house (part of medical school) where meals prepared and semi-structured discussion groups held) replaced routine clinic on 10 afternoons over 1 year | Crossover RCT with two IGs and non-participants also acting as CG  
Baseline, post-intervention and 1-year follow-up | Some improvement in knowledge (p < 0.01), dietary intake (p < 0.05 for fat intake), social contacts (p < 0.001) and metabolic control (p < 0.01) whilst attending diabetes club, but effects did not last through follow-up | Novel alternative to traditional diabetes clinics, which seemed to have some benefits but the effects did not last when traditional methods of treatment were resumed
Brandt et al., 1993[2] | N = 17  
Age range 8–13, median = 11.5; mean duration = 2.25; 53% males  
USA | 11 Group education sessions for young person and mother held over 5 days with the primary goal of improving knowledge and management skills of parents and children and the secondary goal of improving the child’s feeling of competence and mother’s social support | Baseline, post-intervention and follow-up assessment with no CG | Significant improvements in diabetes knowledge (p < 0.003), problem solving (p < 0.002) and management skills (insulin injection) (p < 0.02), which were maintained a follow-up | Knowledge and skills were gained following intervention, but this had no impact on secondary goals
Brown et al., 1997[3] | N = 59 (31 IG1, 28 CG)  
Age range 8–16; duration = at least 3 months  
USA | Packy & Marlon video game in which characters have diabetes and engage in self-care  
CG given another game to play with no health connections  
Both groups had games for 6 months | RCT  
Baseline, 3- and 6-month assessments | Enjoyment of and amount of time spent playing games was same in both groups  
Parent reports of child’s communication about diabetes (p = 0.025) and levels of self-care (p = 0.003) both increased significantly, but self-efficacy, knowledge, urgent medical visits and HbA1c showed no significant differences | Video game provided a new approach to teaching diabetes self-management skills that is acceptable to this age group, but these results only showed some effectiveness on parental ratings only
Carney et al., 1983[4] | N = 3 poorly controlled  
Age range 10–14, mean = 11.6; mean duration = 6.6 years; 60% males; 100% white  
USA | Family taught to use praise and a point reinforcement system to increase SMBG | Pre–post  
All three patients had lower GHb and increased frequency of SMBG follow-up, but no significance tests or p-values reported | Families reported using reinforcement strategies 70% of time, thus behavioural modification techniques can be used to improve specific outcomes; however, effects may have been due to increased parental involvement, as there was no CG to compare with | continued
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<tr>
<td>Challener et al., 1989&lt;sup&gt;17&lt;/sup&gt;</td>
<td>IG1 (n = 16)&lt;br&gt;Age range 13–17, mean = 14.8; mean duration = 5.8 years&lt;br&gt;UK</td>
<td>Two brief education sessions on SMBG, followed by the use of a meter with a memory facility for 6 weeks</td>
<td>Pre–post and 12- and 24-week follow-ups&lt;br&gt;No CG, although IG1 split into two with crossover design for 6-week memory period</td>
<td>Improvement in glycaemic control and frequency of SMBG seen over study period, but no significance tests or p-values reported despite collection of detailed data</td>
<td>Apparent evidence of change in a positive direction</td>
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<td>Chase et al., 1985&lt;sup&gt;18&lt;/sup&gt;</td>
<td>N = 38&lt;br&gt;Age range 10–19&lt;br&gt;IG1 40% males; 21% black&lt;br&gt;Participants in poor control&lt;br&gt;HbA&lt;sub&gt;1c&lt;/sub&gt; &gt; 16%&lt;br&gt;USA</td>
<td>Eight stages of increasing intervention:&lt;br&gt;1. increase insulin dosage &gt; 10% therapy&lt;br&gt;2. change in injection regimen&lt;br&gt;3. emphasis on SMBG&lt;br&gt;4. frequent telephone contact&lt;br&gt;5. frequent clinic visits&lt;br&gt;6. psychological help&lt;br&gt;7. family conference&lt;br&gt;8. parents take responsibility</td>
<td>Pre–post</td>
<td>At follow-up (mean = 3 years), 40% showed consistently improved HbA&lt;sub&gt;1c&lt;/sub&gt;, 47% showed inconsistent improvement and rest showed no improvement, thus the uptake of different methods and their success varied</td>
<td>Most success resulted from change in insulin dosage, change in injection regimen, family conference and parental responsibility Little impact seen from other elements</td>
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<td>Kluczowe, 1992&lt;sup&gt;19&lt;/sup&gt;</td>
<td>N = 162&lt;br&gt;IG1 (n = 114)&lt;br&gt;Age range 3.5–19, mean = 13, mean duration = 4.2 years, range 0.2–17.9&lt;br&gt;CG (n = 48)&lt;br&gt;Age range 5.3–19.9, mean = 13.6&lt;br&gt;Poland</td>
<td>IG1 – 2-week knowledge and skills training programme, including diet&lt;br&gt;CG – usual care, with no training programme</td>
<td>No random assignment to groups&lt;br&gt;Post-test only at unspecified time</td>
<td>HbA&lt;sub&gt;1c&lt;/sub&gt; was better in IG1 than CG (p &lt; 0.001) No gender differences Older children had poorer HbA&lt;sub&gt;1c&lt;/sub&gt; than younger children</td>
<td>Cannot attribute improved control to intervention because of other confounding differences between IG1 and CG in diabetes care and composition of the groups</td>
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<td>Elamin et al., 1993&lt;sup&gt;20&lt;/sup&gt;</td>
<td>N = 67&lt;br&gt;Age range 9–18&lt;br&gt;IG1 (n = 34)&lt;br&gt;Median age = 14; mean duration 4.4 ± 1.6 years; 50% males&lt;br&gt;CG (n = 33)&lt;br&gt;Median age = 14; mean duration = 4.2 ± 1.4 years; 52% males&lt;br&gt;Sudan</td>
<td>Patients and mothers were given eight sessions over 3 months and a booklet on diet. Emphasis was placed on the effect of diet on control and prevention of complications and encouragement of parent and patient communication</td>
<td>RCT&lt;br&gt;Baseline and post-test</td>
<td>Significant improvements in reported calories (p &lt; 0.01), fasting glucose insulin dose (p &lt; 0.01), cholesterol (p &lt; 0.01) and GHb (p &lt; 0.01)</td>
<td>In-depth dietary education improved diet and biomedical outcomes</td>
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<tr>
<td>Epstein et al., 1981&lt;sup&gt;10&lt;/sup&gt;</td>
<td>N = 19</td>
<td>Eight 1–1.5-hour separate parent and child group sessions over 12 weeks, with behavioural intervention for urine testing skills, insulin adjustment, diet and exercise using a contracting and point rewards system</td>
<td>Multiple baseline with three waves of subjects</td>
<td>The proportion of negative (improved) urine tests increased ($p &lt; 0.01$) from pre- to post-intervention and maintained at follow-up, and triglicerides improved from pre- to post-intervention ($p &lt; 0.05$)</td>
<td>This behavioural approach achieved the goal of increasing negative urine tests, but only a pre-post design with no CG</td>
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<td>IG1 (n = 6)</td>
<td>Mean age = 10.1, range 9–11; 16% males; mean duration = 2.68 years</td>
<td>No CG</td>
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<td></td>
<td>IG2 (n = 7)</td>
<td>Mean age = 10.2, range 8–12; 28% males; mean duration = 3.80 years</td>
<td>Assessments at pre- and post-intervention and 2 months</td>
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<td>IG3 (n = 6)</td>
<td>Mean age = 9.8, range 6–11; 33% males; mean duration = 4.33 years</td>
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<td>Esquivel-Herrera et al., 1984&lt;sup&gt;11&lt;/sup&gt;</td>
<td>N = 22</td>
<td>Workshop-style nutritional education</td>
<td>Pre-post with no CG</td>
<td>Significantly improved knowledge ($p &lt; 0.02$) and reductions in self-reported calories ($p &lt; 0.005$), fat ($p &lt; 0.005$), protein ($p &lt; 0.005$) and carbohydrate intake ($p &lt; 0.005$)</td>
<td>Intervention improved knowledge and reduced food consumption over extended follow-up Changes in knowledge not associated with change in diet</td>
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<td>Age range 9–16; duration range 0.5–13 years; 50% males</td>
<td>Baseline, post-intervention and 6-month and &gt; 1-year follow-up</td>
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<td>Mexico</td>
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<tr>
<td>Gefken et al., 1997&lt;sup&gt;12&lt;/sup&gt;</td>
<td>N = 52 poorly controlled</td>
<td>Residential unit using highly structured combination of individual, group and family therapy</td>
<td>Pre-post 1-year follow-up</td>
<td>Lower GHb on discharge ($p = NS$), and significant reduction in hospitalisations at follow-up ($p &lt; 0.0009$) compared to pre-admission year</td>
<td>Improved control seen whilst in residential unit and reduced hospitalisations at follow-up, but this was a very intensive intervention, and may not be necessary to achieve the level of results achieved</td>
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<td>Age range 9–18; 40% males; 27% minority</td>
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<td>USA</td>
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<tr>
<td>Gross et al., 1983&lt;sup&gt;13&lt;/sup&gt;</td>
<td>N = 11 (6 IG1, 5 CG)</td>
<td>IG1 – social skills training to enable more appropriate verbal and non-verbal responses to difficult diabetes-related situations</td>
<td>Multiple baseline with randomisation to IG1 or CG</td>
<td>Increase in eye contact and appropriate verbalisation during training in IG1, which was maintained at follow-up (no statistics reported), but no change seen in CG</td>
<td>Social skills training seemed to be effective for specific behaviours, but changing these behaviours may have no impact on metabolic control</td>
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<td>Age range 9–12</td>
<td>CG – no training</td>
<td>No changes in HbA1c ($t = 0.5, p &gt; 0.05$)</td>
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<tr>
<td>Gross, 1985&lt;sup&gt;96&lt;/sup&gt;</td>
<td><strong>N</strong> = 14</td>
<td>Parents and children met concurrently but separately for discussion and role playing (both IG1 and CG)</td>
<td>RCT</td>
<td>Children learnt principles of behaviour modification</td>
<td>This study was based on previous work in a sound theoretical way, however, both groups improved</td>
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<td>Age range 9–13; mean duration = 4.8 years</td>
<td>IG1</td>
<td>Mean age = 11.4</td>
<td>IG1 also had behaviour modification training and a written lesson prior to this</td>
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<td>CG</td>
<td>Mean age = 11.5</td>
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<td>Hansson et al., 1994&lt;sup&gt;97&lt;/sup&gt;</td>
<td><strong>N</strong> = 25</td>
<td>IG1 (n = 15)</td>
<td>Two subgroups: one traditional family therapy group led by a psychiatrist, one paediatric support group, but there was no difference in outcomes between them so results amalgamated in the report</td>
<td>Non-randomised CG</td>
<td>Interventions had positive effect on measures of family climate (p = 0.15) and closeness (p = 0.004)</td>
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<td>Age range 8–18</td>
<td>CG</td>
<td>Mean age = 13.3; all poorly controlled</td>
<td>Baseline and 1-year follow-up assessments</td>
<td>Differences in other measures, e.g. expressiveness were not significant</td>
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<td></td>
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<td>IG1</td>
<td>Mean age = 11.5</td>
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<td>Study amalgamated results of IG1 subgroups, but these two groups were very different so effects can only be attributed to provision of support</td>
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<td>CG</td>
<td>Mean age = 11.3</td>
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<td></td>
<td>All in optimal control</td>
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<td>Sweden</td>
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<td>Herskowitz, 1990&lt;sup&gt;98&lt;/sup&gt;</td>
<td><strong>N</strong> = 8 on Outward Bound course</td>
<td>Involved challenging physical activities (e.g., sailing, rock climbing), insulin self-adjustment, meal planning and preparation With medically trained instructors</td>
<td>Informal evaluation of the course in general before and 7–11 months after Psychological measures available for six participants, with three adolescent case histories</td>
<td>Observation suggested that the course improved self-confidence, inner strength, determination to take charge and management skills (illustrated by three case histories)</td>
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<td></td>
<td>Age range 15–19; duration range 2–10 years</td>
<td>IG1</td>
<td></td>
<td>Improvement between baseline and follow-up on Achenbach Youth Self-Report for IG1 (p &lt; 0.05), compared with no change in random selection of comparable adolescents</td>
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<tr>
<td></td>
<td>USA</td>
<td>CG</td>
<td></td>
<td>No changes in other measures: Diabetes Adjustment Scale, Locus of Control and Coopersmith Self-Esteem</td>
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<tr>
<td>Heston, 1980&lt;sup&gt;99&lt;/sup&gt;</td>
<td><strong>N</strong> = 37</td>
<td>IG1 – read OK Insulin and completed assessment game three times</td>
<td>Non-randomised assignment to groups</td>
<td>No differences between groups on knowledge at baseline, but average gain in knowledge higher for IG1 than IG2 and CG (no statistics provided), and there was a significant increase in knowledge for IG1 from pre- to post-intervention (p &lt; 0.001)</td>
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<td>Age range 7–12</td>
<td>CG</td>
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<td>Older children (11–12) in early adolescence were more knowledgeable about diabetes than younger children, but still acquired further knowledge by this intervention</td>
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<td>IG1</td>
<td>Mean age = 10.3; 46% males</td>
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<td>IG2</td>
<td>Mean age = 10; 40% males</td>
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<td>CG</td>
<td>Mean age = 10; 50% males</td>
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<td>Horan et al., 1990</td>
<td>N = 20</td>
<td>IG1 – computer-assisted learning of Diabetes in Self-Control, including data management and review, factual and applied diabetes education, problem solving and goal setting</td>
<td>Subjects formed matched pairs and were then randomised to IG1 or CG</td>
<td>No change in HbA1c, or applied knowledge; 60% of IG1 and 50% of CG improved on factual knowledge (no statistical test)</td>
<td>Some indication of modest benefits of Diabetes in Self-Control, but sample size was too small for definitive results</td>
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<tr>
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<td>Duration = at least 1 year</td>
<td>CG – equivalent written materials</td>
<td>Baseline and post-intervention</td>
<td>Compared to CG, IG1 had improved pre-lunch (p &lt; 0.02) and pre-dinner (p &lt; 0.025) blood glucose levels, and performed more tests (p &lt; 0.089), particularly in phases 2 and 3</td>
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<td>IG1 (n = 10)</td>
<td>Phase 1 = baseline assessments of both IG1 and CG</td>
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<td>Age range 12–19; 30% males; 30% black</td>
<td>Phase 2 = diabetes education of both IG1 and CG</td>
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<td>CG (n = 10)</td>
<td>Phase 3 = goal setting and problem solving for IG1 only</td>
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<td>Age range 12–19; 30% males; 10% black</td>
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<tr>
<td>Huttunen et al., 1989</td>
<td>N = 32</td>
<td>IG1 – 13 weekly 1-hour exercise sessions</td>
<td>RCT</td>
<td>Significant improvements in aerobic fitness (p &lt; 0.01), but significant deterioration in GHB (p &lt; 0.01)</td>
<td>Not clear why aerobic fitness improved but metabolic control deteriorated</td>
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<tr>
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<td>Mean age = 11.9, range 8–17</td>
<td>CG – usual care</td>
<td>Baseline and post-intervention</td>
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<td>IG1</td>
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<td>Mean duration = 4.7 years; 59% males</td>
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<td>CG</td>
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<td>Mean duration = 5.6 years; 59% males</td>
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<td>Finland</td>
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<tr>
<td>Kaplan, 1985</td>
<td>N = 21</td>
<td>IG1 – social skills training based on social learning theory (Bandura): role play and discussions of difficult social situations involving peers, and made a video of enacted solutions</td>
<td>RCT</td>
<td>No differences between groups at baseline in HbA1c, diabetes knowledge, attitudes, self-care behaviour, social support satisfaction, means–ends problem solving and lie scale</td>
<td>Described as a pilot study, the small patient number precludes strong conclusions, but suggested that social skills with peers play a role in self-management and better glycaemic control</td>
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<td></td>
<td>Age range 13–18; all middle class and white</td>
<td>CG – discussed medical information about diabetes, watched videos and made a video about diabetes</td>
<td>Baseline and post-test</td>
<td>HbA1c improved for IG1 compared with CG at post-test (p &lt; 0.05), but no other pre–post comparisons</td>
<td>Knowledge did not correlate with control, but improved self-management, attitudes, problem solving and more desirable responses associated with better control</td>
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<td>IG1</td>
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<td></td>
<td>Mean age = 14.9 ± 1.6; 54% males</td>
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<td>CG</td>
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<td></td>
<td>Mean age = 14 ± 1.4; 47% males</td>
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<tr>
<td>Kemp et al., 1986</td>
<td>N = 42</td>
<td>Summer camp for 2 weeks in 1983 and 1984 with intensive management of diabetes plus 8 hours of education</td>
<td>RCT</td>
<td>No differences between groups at baseline in HbA1c, diabetes knowledge, attitudes, self-care behaviour, social support satisfaction, means–ends problem solving and lie scale</td>
<td>The camp seemed to be effective in improving diabetes control in the short but not the long term</td>
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<tr>
<td></td>
<td>Mean age = 10, range 8–16</td>
<td>Subjects studied over two annual camps, no CG</td>
<td>Baseline and post-test</td>
<td>HbA1c, assessed at start of each camp, glycated albumin (measure of control over 2–4 weeks) assessed at start and end of camp</td>
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<tr>
<td>Lebovitz et al., 1978</td>
<td>N = 111</td>
<td>Summer camp for 2 weeks that included skills training to increase independence in diabetes management</td>
<td>Pre-post</td>
<td>Increased independence in insulin administration at camp (p &lt; 0.001) and follow-up (p &lt; 0.05) (previous campers were more independent prior to camp and maintained this), increased knowledge at camp that was maintained at follow-up (p &lt; 0.001) and increased independence of performing urine tests at camp (p &lt; 0.001) that was maintained at follow-up (p &lt; 0.001)</td>
<td>Educational experience of camp contributed to skills/behaviour changes that were maintained, although at lower level, at follow-up This demonstrates the importance of combining knowledge with skills training</td>
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<td>Mean age = 11.7 ± 2.4, range 7–17; 47% males</td>
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<tbody>
<tr>
<td>Lorini, 1990</td>
<td>N = 36</td>
<td>Weekly meetings on dietary education held by doctor and dietitian, followed by further fortnightly meetings for 2 months</td>
<td>Pre-post</td>
<td>Significant improvements in self-reported diet diaries, e.g. reduction in total calorie intake (p &lt; 0.001), and some changes in HDL, LDL, serum nitric acid and nitrogen; but no effect on blood glucose control, triglycerides, apolipoproteins and creatinine</td>
<td>Simple dietary education improved patients’ self-reported food diaries, with concurrent changes in some biochemical parameters</td>
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<tr>
<td></td>
<td>IG1</td>
<td>Mean age = 14.2, range 9–21; 47% males</td>
<td>No CG</td>
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<td>Italy</td>
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<tr>
<td>Lucey, 1985</td>
<td>N = 18</td>
<td>Two 6-hour small group educational sessions using videoing and dramatisations leading to problem-solving discussions</td>
<td>Pre-post</td>
<td>Significant improvement in diabetes knowledge (p = 0.025) and problem solving (p ≤ 0.005)</td>
<td>Improved knowledge and problem solving in children &gt; 12 years of age Study highlighted knowledge deficits in adolescents</td>
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<tr>
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<td>Mean age = 11.67, range 8–15; duration range 0.5–9 years</td>
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<tr>
<td>Magrath, 1985</td>
<td>N = not specified</td>
<td>Four monthly small-group study days to improve group HbA1c, emphasis on diet and SMBG</td>
<td>Pre-post</td>
<td>Improvement in HbA1c, but significance tests not reported</td>
<td>Little detail of intervention, sample characteristics and no inferential statistics</td>
</tr>
<tr>
<td></td>
<td>Age range 11–13</td>
<td></td>
<td>No CG</td>
<td>Baseline, post-intervention and 6-month follow-up</td>
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<tr>
<td>Marrero et al., 1982</td>
<td>N = 23</td>
<td>Bi-monthly social support group meetings over 8 months focusing on coping strategies for stressful events developed and rehearsed</td>
<td>RCT with waiting list CG</td>
<td>Trend of positive change from pre- to post-test on all outcomes for IG1, including being significantly less depressed than CG at post-test (p &lt; 0.02)</td>
<td>This small pilot study suggested beneficial effects of increasing social support through a group</td>
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<tr>
<td></td>
<td>IG1 (n = 10)</td>
<td>CG – usual care</td>
<td>Pre- and post-test</td>
<td>Differences in self-esteem were non-significant</td>
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<td></td>
<td>Mean age = 15.2; mean duration = 4.9 years; 40% males</td>
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<tr>
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<td>CG (n = 13)</td>
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<td></td>
<td>Mean age = 14.7; 46% males</td>
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### Reference details

| Marrero et al., 1988<sup>109</sup> | N = 10  
Mean age = 13.3, range 12–14; mean duration = 3.6 years; 60% males  
USA | Two sessions: one on managing exercise and one group exercise  
Participants sent home with exercise video to be used three times a week for 12 weeks | Pre–post  
Assessments at baseline and post-intervention | Significant improvement in aerobic fitness (p = 0.045) and GHb post-intervention (p = 0.03) | Brief and simple intervention that improved fitness and control  
If exercise maintained, this could be a useful tool |
| Marrero et al., 1995<sup>110</sup> | N = 106  
IG1 (n = 52)  
Mean age = 13.4 ± 4.5; 60% males; 2% minority  
CG (n = 54)  
Mean age = 13.3 ± 4.9; 59% males; 6% minority  
USA | Fortnightly transmission of blood glucose meter data to clinic, which was interpreted by management system and then nurses used algorithm to adjust insulin dosage  
RCT  
Baseline and post-test (intervention lasted over 1 year) | There were no significant differences between groups in HbA1c (p = 0.544), although it declined in both groups, hospitalisations (p = 0.787), emergency room visits (p = 0.614) and self-image (no p-value reported), but IG1 less negative on necessity of keeping blood glucose diaries and sticking finger (p < 0.001) | Intervention had no impact on diabetes control, however negative perceptions of testing reduced, presumably because these records were put to use |
| Massouh et al., 1989<sup>111</sup> | N = 33  
Age range 12–15 | IG1  
Mean age = 12.6 ± 0.7; mean duration = 3.9 ± 3.2; 41% males  
CG  
Mean age = 13.1 ± 1; mean duration = 4.7 ± 3.5; 50% males  
USA | IG1 – 8-day diabetes camp with social learning for managing peer pressure  
CG – reviewed educational programme by writing questions and answers for a game show  
RCT  
Baseline and follow-up assessments | No significant difference between CG and IG1, and both groups had a decline in metabolic control; pre–post change in HbA1c, level for both groups was in the wrong direction (IG1, p = 0.008; CG, p = 0.141) | No effect of intervention, if anything, data suggest IG1 had worse outcomes |
| McNabb et al., 1994<sup>112</sup> | N = 24  
Age range 8–12; 54% males | IG1 (n = 12)  
Mean age = 9.7; two drop-outs  
CG (n = 12)  
Mean age = 10  
USA | IG1 – parents (taught to promote child’s responsibility for self-care) and children (taught skills and to take responsibility) met separately in small groups (six 1-hour sessions over 6 weeks)  
CG – usual care  
RCT  
Assessments at baseline and at 12 weeks | Children’s Diabetes Inventory assessed frequency and degree of child’s responsibility for 35 self-care behaviours completed by parents  
No effects on frequency but mean responsibility increased for IG1 compared with CG at post-test (p < 0.01), and no effects on GHb when baseline levels controlled for | Child’s responsibility for self-care increased without detrimental effects on metabolic control or frequency of performance, which supports a structured approach to developmentally appropriate transfer of self-care responsibility |

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<sup>1</sup> Reference continued
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<tr>
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<tr>
<td>Mendez, 1997&lt;sup&gt;113&lt;/sup&gt;</td>
<td>N = 37</td>
<td>IG1 (n = 18)</td>
<td>Mean age = 13.83 ± 2.0; 50% males; mean duration = 3.73 ± 3.93 years</td>
<td>IG1 – 10 group sessions for adolescents over 4 months plus two sessions for parents to teach several behavioural procedures (e.g., social skills training, stress management, SMBG)</td>
<td>Quasi-experimental design with non-equivalent CG Pre-post and 13-month follow-up</td>
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<td>Misuraca et al., 1996&lt;sup&gt;114&lt;/sup&gt;</td>
<td>N = 256 (87)</td>
<td>Mean age = 10, range 8–16; 47% males</td>
<td>Summer camps (mean duration = 10 days) with 3-monthly meetings post-camp</td>
<td>Quasi-experimental design with non-equivalent CG Pre-post</td>
<td>Significant increase in knowledge (p &lt; 0.01) and significant reduction in GHb (p &lt; 0.01)</td>
</tr>
<tr>
<td>Nurick, 1991&lt;sup&gt;115&lt;/sup&gt;</td>
<td>N = 15</td>
<td>IG1</td>
<td>Mean age = 14.5; 50% males; 33% black</td>
<td>IG1 – blood glucose awareness training with period of estimating blood sugars and testing, using three 45-60-minute education sessions</td>
<td>Non-RCT Baseline and post-test</td>
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<td>Orr et al., 1998&lt;sup&gt;116&lt;/sup&gt;</td>
<td>N = 15</td>
<td>Mean age = 15.3, range 11–20; 40% males; mean duration = 5.1 years, range 1.5–11.5; lower middle-middle class I Hispanic Poor control</td>
<td>Medical, educational and counselling provided based on each patient’s needs Counselling was one or more of the following: group therapy, family treatment based on Minuchin, and individual psychotherapy</td>
<td>Pre-post with no CG Assessments at baseline and 12–18 months later HbA&lt;sub&gt;1c&lt;/sub&gt; at baseline and follow-up Other outcomes were subjective judgements of improvement</td>
<td>Nine of 15 patients were judged as having improved on medical, psychological and compliance outcomes (no p-values reported) HbA&lt;sub&gt;1c&lt;/sub&gt; changes were not significant</td>
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<td>Petrolini et al., 1994&lt;sup&gt;11&lt;/sup&gt;</td>
<td>N = 53</td>
<td>8-day summer camp</td>
<td>Pre–post with no CG, baseline and post-intervention assessments</td>
<td>Significant improvement in knowledge (p &lt; 0.05), and camps seen as recreational</td>
<td>Unclear description of camp content with poor evaluation that was more about perception of camp</td>
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<td></td>
<td>Mean age = 14.4 ± 2, range 8–15; 58% males; mean duration = 4 ± 2.9 years</td>
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<tr>
<td>Pichert et al., 1993&lt;sup&gt;18&lt;/sup&gt;</td>
<td>N = 70</td>
<td>AI using video to enhance exercise-related diabetes management</td>
<td>RCT, pre–post</td>
<td>Significant impact on knowledge (p &lt; 0.01), and approaching longer follow-up, good CG</td>
<td>Sound theory to intervention, but needs longer follow-up, good CG</td>
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<td></td>
<td>56% males</td>
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<td></td>
<td>IG1 Age range 10–15</td>
<td>CG Age range 10–15</td>
<td>Baseline and post-intervention assessments</td>
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<td>Pichert et al., 1994&lt;sup&gt;15&lt;/sup&gt;</td>
<td>N = 69</td>
<td>IG1 – AI using video story to prompt a problem-solving task</td>
<td>RCT, pre–post</td>
<td>Both IG and CG showed improvements in knowledge and meal choice (p &lt; 0.01 for all skills) but no difference between groups</td>
<td>Al did not produce increased benefits over normal education</td>
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<td></td>
<td>Age range 9–15</td>
<td>CG – non-AI education programme</td>
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<td></td>
<td>Mean age = 11.5; mean duration = 6.1 years</td>
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<tr>
<td>Pichert et al., 1994&lt;sup&gt;12&lt;/sup&gt;</td>
<td>N = 84 at diabetes camp</td>
<td>IG1 – groups of 10–12 campers for two 45-minute sessions for AI on sick day guidelines, which involved watching a videodisk of person facing diabetes-related management problems and discussing solutions</td>
<td>RCT</td>
<td>Older group had higher knowledge scores than younger group, and both IG1 and CG had higher post- than pre-test scores (p &lt; 0.01)</td>
<td>Only mixed support for AI, which did not have different effects for older age group</td>
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<td>Age range 9–15; mean duration = 6.9 years, range 3–14; 36% males</td>
<td>CG – watched video on sick day guidelines and discussed</td>
<td>Sick day knowledge test pre- and post-intervention, sick day problem-solving test post-intervention and at 8-months, and assessment of recall, number of explanations, and conditional probability of recalling a guideline and explanation for its use</td>
<td>No effect on recall or explanations post-test, but conditional probability score better for IG1 (p &lt; 0.01)</td>
<td>At 8 months, older group better than younger on all measures, and explanations (p &lt; 0.03) and conditional probability score (p &lt; 0.02) better for IG1 than CG. More IG1 than CG parents reported shared responsibility with child for sick day management (p &lt; 0.05)</td>
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<td>Age range 9–15; mean duration = 6.9 years, range 3–14; 36% males</td>
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<td>12–15 year olds were compared with 9–11 year olds</td>
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<td>Pichert et al., 1994</td>
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N = 16  
Age range 14–15;  
mean duration = 6.8 years, range 1.5–10; 50% males  
USA | All received AI in problem-solving strategies for dietary problems using video and discussion in small groups led by dietician for two 50-minute sessions over 1–3 days at summer camp | Half the participants were chosen randomly to be tested a few days before the intervention and half within 24 hours after | In a role-playing/problem-solving test, more of those tested after AI gave appropriate solutions to a problem particularly less all-or-none and more adjustment (p < 0.02) | This pilot study had several limitations, but suggests that AI may result in new knowledge that can be generalised to new situations |
| Ratner et al., 1990 |  
N = 7 long-term non-adherent recruited from poor deprived neighbourhood  
Mean age = 15.4, range 11–19; mean duration = 7.4 years; 43% males  
USA | Three initial training sessions on self-hypnosis, taught to practice twice daily. Follow-up sessions for a further 6–12 months | Pre–post | Significant improvements in fasting blood sugar (p < 0.001) and GHb over the intervention period (p < 0.001) | Intervention seems to have some utility in this lower socio-economic class, low self-care group, but study poorly designed with no follow-up data |
| Rose et al., 1983 |  
N = 6  
Age range 15–18; duration > 3 years; 0% males  
Canada | Psychological testing on personality and intelligence with feedback, followed by anxiety management training over 6 months | Pre–post  
Baseline and post-test assessments | Significant (p < 0.01) reductions in % of glucose in urine (using test strips) and in amount of urine in 24-hour collections. No reduction in measures of anxiety | Although some indices of control improved, these are not accepted as reliable indicators of blood sugar levels, and there was no effect on anxiety with a low participation rate |
| Schafer et al., 1982 |  
Three case studies:  
Kathy: age = 18, duration = 7 years  
Tom: age = 16, duration = 4 years  
Kim: age = 18, duration = 11 years  
USA | Social learning theory, involving self-monitoring, goal setting, and behavioural contracting if needed with therapist working with patient and parent  
Three case studies using a multiple baseline, across behaviours design  
Assessments of behaviours daily during baseline and intervention period and at 2-month follow-up  
Metabolic control assessed by urine and blood glucose tests at pre- and post-intervention and follow-up | Kathy improved on wearing diabetic identification, exercise, frequency of urine testing and metabolic control  
Tom improved on timing of morning insulin injection (but this was not maintained), frequency of urine testing, exercise and metabolic control  
Kim’s SMBG was unreliable so data not reported | Intervention successful with two of three patients across a range of self-management behaviours |
| Simell et al., 1991 |  
N = 61 newly diagnosed  
Age range 0–14  
IG1 (n = 31)  
IG2 (n = 30)  
Finland | Both groups received diabetes education from a multidisciplinary team over the first month  
IG1 – short hospital stay (mean = 9 days) so both inpatient and outpatient education  
IG2 – long hospital stay (mean = 23 days) so all inpatient education  
RCT  
Baseline and regular testing over 1 month and up to 2 years of follow-up | Metabolic control (HbA1c) improved similarly in both groups over first month (p = 0.01) and increased slightly over follow-up (p = 0.001). Insulin dose was lower in IG1 than IG2 (p = NS)  
Short and long hospital stays seem to be equally effective in managing newly diagnosed diabetes in the first month and for up to 2 years. This has implications for cost-effective treatment at diabetes onset | No p-values reported |
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<tr>
<td>Smith et al., 1991</td>
<td>N = 108&lt;br&gt;Mean age = 14.5 ± 1.4; mean duration = 53.7 ± 42.5 months; 44% males; 96% white&lt;br&gt;USA</td>
<td>Stress management intervention delivered in small groups for 1 hour per day during camp</td>
<td>Pre-post, no CG</td>
<td>Ways of coping measured from pre- to post-intervention&lt;br&gt;Mean age = 14.5 ± 1.4; mean duration = 53.7 ± 42.5 months; 44% males; 96% white&lt;br&gt;USA</td>
<td>Intervention may have led to improvements in intended coping strategies at end of camp compared to those reported to have been used before, but study design weak</td>
</tr>
<tr>
<td>Smith et al., 1993</td>
<td>N = 86&lt;br&gt;Mean age = 4.9 ± 3.4, range 13–17; mean duration = 4.1 ± 3.4 years; 57% males&lt;br&gt;USA</td>
<td>Assertiveness training built into summer camp programme through didactic information, sharing of personal experiences and role-playing</td>
<td>Pre-post with no CG&lt;br&gt;Assessments at baseline, post-intervention and 3 months</td>
<td>Assertiveness scores improved at follow-up (p &lt; 0.001) and adolescents reported improved communication with father (p &lt; 0.05) and mother (p = 0.06), but parents did not report any such change following intervention</td>
<td>Significant effect only seen in self-report of behaviour but changes not validated by parents, thus adolescents at least know what assertiveness is and how to do it, but may not be implementing skill</td>
</tr>
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<td>Stratton, 1987</td>
<td>N = 16 white&lt;br&gt;IG1 Mean age = 15.1; 50% males&lt;br&gt;CG Mean age = 15.5; 50% males&lt;br&gt;USA</td>
<td>IG1 – 30–45 minutes of exercise training at hospital gym three times a week for 8 weeks&lt;br&gt;CG – exercise recommendations</td>
<td>RCT&lt;br&gt;Baseline and post-test assessments</td>
<td>Improved cardiovascular fitness (p &lt; 0.05), and reduced glycosylated serum albumin (p &lt; 0.01) and blood glucose values (NS)</td>
<td>Indicates benefits from making exercise part of diabetes management, but this cannot be used to inform how to achieve increased exercise in adolescents</td>
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<td>Sundelin, 1996</td>
<td>N = 36 families of those newly diagnosed with diabetes&lt;br&gt;IG1 Mean age = 8, range 3–13.1 (12 aged 8–15); 37% males&lt;br&gt;CG Mean age = 8.8, range 4–14; 37% males&lt;br&gt;Sweden</td>
<td>IG1 – family spent up to 2 weeks in apartment at hospital receiving family therapy from psychotraffestherapist as well as multidisciplinary team support (seven sessions over 6 months)&lt;br&gt;CG – family stayed in hospital and met same amount with pediatrician and received multidisciplinary team support</td>
<td>RCT&lt;br&gt;HbA1c (at baseline, 1 and 2 years), intelligence tests (at diagnosis, 6, 12 and 24 months), self-esteem (at diagnosis, 6, 12 and 24 months), children’s behaviour checklist (at 6 and 24 months), family climate (at diagnosis, 6, 12 and 24 months) and family relations (at diagnosis, 6, 12 and 24 months)</td>
<td>HbA1c in the subgroup of children aged 8–15 years appeared to be worse in IG1 (p &lt; 0.05) at 2 years, but this was attributed to three extreme scores&lt;br&gt;No other effects for older group reported</td>
<td>There seems to be no clear benefit from the intervention</td>
</tr>
<tr>
<td>Swift et al., 1993</td>
<td>N = 236&lt;br&gt;(138 IG1, 98 CG)&lt;br&gt;UK</td>
<td>IG1 – cared for at home at diagnosis&lt;br&gt;CG – admitted to hospital at diagnosis</td>
<td>Post-intervention review of medical notes</td>
<td>No significant differences in metabolic control (p = 0.37) but fewer hospitalisations in IG1 (p = 0.001)</td>
<td>Although fewer hospitalisations in IG1, there are too many confounds to draw conclusions</td>
</tr>
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</table>
### Reference Sample

<table>
<thead>
<tr>
<th>Reference details</th>
<th>Sample characteristics</th>
<th>Intervention</th>
<th>Study design and assessments</th>
<th>Measures and results</th>
<th>Conclusions and implications</th>
</tr>
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<tbody>
<tr>
<td>Warren-Boulton et al., 1981</td>
<td>$N = 5$&lt;br&gt;Age range 17–23; 0% males; 100% black&lt;br&gt;USA</td>
<td>Intensive group setting with multidisciplinary healthcare team&lt;br&gt;Baseline assessments for 5 days in hospital followed by 18 monthly group meetings</td>
<td>Pre–post, no CG</td>
<td>Improved metabolic control during study (fasting glucose, $p &lt; 0.01$; HbA$_{1c}$, $p &lt; 0.05$; lower cholesterol, $p &lt; 0.05$; and reduced insulin dose, $p &lt; 0.05$) Sample described as having increased personal responsibility for and openness about diabetes, and better school attendance and concentration</td>
<td>Authors concluded that intensive group setting was effective in producing better diabetes control and psychosocial outcomes. Cost of intervention was US$520 per patient</td>
</tr>
<tr>
<td>Warzak, 1982</td>
<td>$N = 20$&lt;br&gt;Age range 9–15&lt;br&gt;USA</td>
<td>Peer intervention of SMBG during 2-week summer camp</td>
<td>Assessed SMBG frequency by naïve users during the camp</td>
<td>96% practiced SMBG at least once, no $p$-values reported</td>
<td>Peer instruction of SMBG is effective</td>
</tr>
<tr>
<td>Wolanski et al., 1996</td>
<td>$N = 41$&lt;br&gt;(20 IG1, 19 CG, two drop-outs)&lt;br&gt;Age range 8–16; duration range 4 months–12 years; 51% males&lt;br&gt;USA</td>
<td>IG1 – SMBG skills training in a single one-to-one session plus one small group session during camp&lt;br&gt;CG – no SMBG training</td>
<td>RCT, pre–post&lt;br&gt;Baseline and in final week of camp</td>
<td>IG1 improved slightly in the absolute systematic error in blood glucose test, and CG got slightly worse ($p = NS$)&lt;br&gt;Both groups improved slightly in the random error in blood glucose test ($p = NS$)</td>
<td>SMBG training not effective, probably because skills were already reasonable. Problem may be more one of attitude to diabetes care than skills deficit</td>
</tr>
<tr>
<td>Wysocki et al., 1997</td>
<td>$N = 119$&lt;br&gt;All had at least moderate levels of general or type 1 diabetes-specific conflict.&lt;br&gt;Age range 12–17&lt;br&gt;USA</td>
<td>IG1 – behaviour family systems therapy; problem solving, communication skills training, and functional and structural family therapy&lt;br&gt;IG2 – family educational support groups&lt;br&gt;CG – usual care</td>
<td>RCT&lt;br&gt;Baseline and post-test</td>
<td>Adolescents ($p &lt; 0.004$) and mothers ($p &lt; 0.002$) rated therapy better than education group on treatment evaluation questionnaire&lt;br&gt;Other outcomes reported elsewhere</td>
<td>Well-designed and reported study, but only treatment evaluation questionnaire reported here, which has not been validated as only designed for this study</td>
</tr>
</tbody>
</table>
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We look forward to hearing from you.