World Journal of Diabetes

Submit a Manuscript: http://www.wjgnet.com/esps/
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
DOI: 10.4239/wjd.v5.i6.877

World J Diabetes 2014 December 15; 5(6): 877-881
ISSN 1948-9358 (online)

Intensive diabetes management and goal setting are key aspects of improving metabolic control in children and young people with type 1 diabetes mellitus

Astha Soni, Sze May Ng

Astha Soni, Sze May Ng, Department of Paediatrics, Southport and Ormskirk NHS Trust, L39 2AZ Ormskirk, United Kingdom
Sze May Ng, Department of Women's and Children's Health, Institute of Translational Medicine, University of Liverpool, L8 7SS Liverpool, United Kingdom
Author contributions: Soni A and Ng SM equally contributed to this work.
Correspondence to: Sze May Ng, FRCPCH, MSc, PhD, Department of Paediatrics, Southport and Ormskirk NHS Trust, Wigan Road, Ormskirk, L39 2AZ Lancashire, United Kingdom. may.ng@nhs.net
Telephone: +44-169-5656163 Fax: +44-169-5656282
Received: August 5, 2014 Revised: October 5, 2014
Accepted: October 23, 2014
Published online: December 15, 2014

Abstract

Diabetes control in children remains poor in spite of advances in treatment for last 10 years. The aim of this review was to look at various aspects of intensive therapy in the management of type 1 diabetes such as insulin regimes, role of target setting, psycho-educational approaches and self-management. To achieve good metabolic control, clear goal setting with adequate support for self-management are essential. Psycho-educational and behavioural interventions aimed at specific areas of management have shown significant improvement in quality of life and diabetes control.

Key words: Type 1 diabetes; Children; Metabolic control; Intensive; Management; Goal setting

Core tip: The aim of diabetes treatment is to maintain normoglycaemia in order to prevent long term complications. Insulin is the mainstay of diabetes treatment and is delivered by various regimens. Superiority of one regimen over the other is not established. Newer techniques with sensor augmented pumps have shown improvement in the diabetes control. Other aspects of intensive treatment are goal setting and adequate multidisciplinary support for self-management. Self-management is necessary to achieve the goals of diabetes treatment. Interventions based on clear psycho-educational principles are shown to be effective in improving outcomes.

Soni A, Ng SM. Intensive diabetes management and goal setting are key aspects of improving metabolic control in children and young people with type 1 diabetes mellitus. *World J Diabetes* 2014; 5(6): 877-881 Available from: URL: http://www.wjgnet.com/1948-9358/full/v5/i6/877.htm DOI: http://dx.doi.org/10.4239/wjd.v5.i6.877

INTRODUCTION

Type 1 diabetes is characterised by autoimmune destruction of the β cells leading to insulin deficiency. It accounts for 90% of childhood diabetes in the western world. The incidence has been increasing over past 2 decades and poses a global challenge[1]. The aim of diabetes management in children is to achieve near normoglycaemia without major hypoglycaemic episodes and to prevent long term complications associated with hyperglycaemia[2].

Early normalisation of blood sugars with intensive insulin therapy might lead to improved long term control and higher endogenous insulin production 1 year after the diagnosis[3]. Good glycaemic control in patients with Insulin Dependent Diabetes mellitus delays the onset and slows the progression of long term complications. Several approaches are taken when aiming for low glucose targets. The Diabetes Control and Complication trial

Table 1 Review of studies comparing different insulin regimens

Ref.	Method/population	Outcome
de Beaufort *et al*[10]	Observational cross-sectional international study/2036 patients(11-18 yr)	No improvement in glycaemic control over a decade Those on twice daily free mix had significantly better control and the ones on twice daily injections had the worst HbA1c
Holl *et al*[11]	Multicentre Observational study/872 patients (11-18 yr)	Deterioration in metabolic control in all three groups over 3 yr period One group had moved from twice daily to multiple injections
Haller *et al*[12]	Observational Study (enrolled patients were on preferred regimes from 12 paediatric endocrinologists)/229 patients (9-15 yr)	Increased number of insulin types correlated with increased HbA1c
Nordly *et al*[13]	Multicentre cross sectional sudy/874 (< 16 yr)	Children with 2 injections a day had significantly better control than children on 3 or four injections a day
Paris *et al*[14]	Multicentre cross-sectional study/2743 patients (< 20 yr)	Insulin pump users had better control. No difference between MDI or 2-3 injections a day
Jakisch *et al*[15]	Multicentre matched pair cohort analysis, comparing CSII to MDI/434 matched pairs	Significantly better HbA1c in CSII group after 1 yr but subsequently no difference at 3 yr

MDI: Multiple daily insulin; CSII: Continuous subcutaneous insulin infusion; HbA1c: Hemoglobin A1c.

(DCCT) clearly showed that intensive therapy aiming for lower target blood sugars measured by lower mean glycosylated haemoglobin A1c (HbA1c) reduced the risk for onset and progression of diabetes complications[4]. However, intensive treatment does not just include intensive insulin regimes but patient education, counselling and effective diabetes self-management[5]. It can best be provided with well-sourced multidisciplinary team with focus on treatment goals and regimes, self-management, patient education and frequent clinic visits[6]. There is considerable diversity in delivery of these interventions and it has been a challenge to find practical, clinic based interventions that can provide improvement in HbA1c similar to those achieved in DCCT. Hvidoere study group have demonstrated that the clinical and metabolic goals or targets are more important in determining the outcomes than the therapeutic regimen on its own. Self management, structured education for the patient and family, and close telephone contact with the diabetes team are also associated with reduced hospitalisations and emergency room visits[7].

The purpose of this review is to examine the key aspects of improving metabolic control in children and young people with diabetes who have characteristics and needs that dictate different standards of care. We will look specifically at the impact insulin delivery and regime, self-management of diabetes which includes psychological intervention, self-education programmes and goal setting in improving outcomes.

INSULIN DELIVERY AND REGIME

Treatment with insulin is the mainstay of therapy in type 1 diabetes mellitus. Many formulations are available but with the advent of newer analogues, they are mainly used in treatment in children. There is no data on the long term benefits of these analogues but they provide more flexibility and some improvement in the care of diabetes[8,9].

The choice of insulin regime depends on the individuals The basal bolus therapy or multiple daily insulin (MDI) regimes consists of long or intermediate acting insulin is given once or twice a day with boluses of rapid acting insulin analogue with meals. Insulin pump or continuous subcutaneous insulin infusion (CSII) works on similar principles but delivers short acting analogue continuously with boluses at meal times. After DCCT trial, these modalities have become the norm of diabetes treatment. Other methods include use of pre-mixed insulin which contain fixed ratio mixtures of short and intermediate acting insulins. They are given as two injections a day. Currently, there is no clear evidence that one insulin regime is superior to other on its own[10].

There are various cross-sectional studies looking at different insulin regimes (Table 1) but none of them have found any clear evidence that one is superior over the others.

Insulin pumps

There are several systemic reviews and meta-analysis including a Cochrane review comparing CSII to MDI[16]. Most of them have favoured CSII for better control but recent meta-analysis comparing CSII to MDI showed no significant change in HbA1c from baseline level after 16 wk or more of follow up in children. Overall CSII has been found to yield better quality of life compared to MDI, however benefit to glycaemic control is variable[16,17].

Sensor augmented pump therapy (SAP) which integrated CSII with a continuous glucose sensor. In a comparative meta-analysis sensor-augmented insulin pump use resulted in a statistically and clinically significant greater reduction in HbA1C levels than with MDI or self-monitoring of blood glucose (SMBG) in persons with type 1 diabetes mellitus[17]. Sensor-Augmented Pump Therapy for A1C reduction. STAR 3 study has shown that compared to MDI, SAP offers rapid glycemic advantage in children and adolescents which lasted for the entire year of study phase[18,19].

SMBG is the key to achieving main goals of insulin therapy. Several studies have established that frequency

of SMBG is directly proportional to improved HbA1c levels[12,20].

More recently continuous glucose monitoring (CGM) has been used and can provide information on trends of blood glucose levels. It is considered to be useful for children with poorly controlled diabetes. Recent Cochrane review has shown that there is limited evidence of improved glycaemic control in patients with poorly controlled diabetes. But the review found larger decline which was statistically significant in HbA1c for real-time CGM users starting on insulin pump therapy(sensor augmented pumps) compared to patients using MDI and SMBG (conventional therapy)[21].

GOAL SETTING AND PSYCHOLOGICAL INTERVENTIONS TOWARDS SELF MANAGEMENT

Specific goal setting is an encouraging way of improving adherence to diabetes management in young people[22]. As parental support and involvement is associated with better management of diabetes in children and adolescents, their perception of goals for optimal management of diabetes is associated with actual control achieved in children[23]. Hvidoere study group has documented persistent inter-centre differences in the mean HbA1c over 10-year period in spite of changes to the insulin regimes[10]. They concluded that target setting might me the most influential factor in lowering the HbA1c[24]. Key findings from their work suggests that best metabolic results are obtained by physicians who target driven and teams and families have unanimity of purpose[7].

It is important to have necessary self-management skills in order to achieve goals of diabetes therapy. Diabetes self-management is the process of providing the person with diabetes education, knowledge and skills needed to successfully manage diabetes[25]. It is multi-dimensional and refers to the young persons or/and parents sharing responsibility and decision making for achieving optimal control[26]. Goals for self management varies considerably by age, development, family characteristics, duration of diabetes and lifestyle[27,28]. Adolescence could be a challenging time in control of diabetes. It has been recognised that diabetes control tend to decline during this period[29]. As young people strive for autonomy, social influence and peer pressure with desire to fit in can be higher priority than diabetes management for some young people[30,31]. Various psychological and educational interventions are used to empower the young person with necessary self-management skills but efficacy of one over another is not established. Wysocki *et al*[32] found that youths with suboptimal pre-treatment status with high autonomy to maturity (AMR) did better with intensive treatment over 18 mo period compared to the ones who had low AMR and better HbA1c. An integrated review in 2011 demonstrated that there is a clear relationship between self-management and metabolic control but there is multitude of factors playing part[28].

Research has also shown that there is an association between psychosocial factors and metabolic control in a large international cohort of adolescents with type 1 diabetes mellitus[33] Good metabolic control is associated with better quality of life in adolescents[34,35]. It is also associated with families of children with better control reporting lower disease burden. Behavioural interventions for young people with diabetes and their parents have demonstrated improvement in adherence of treatment[36]. Interventions based on clear psycho-educational principles are most effective[37]. In a systematic review of psychological interventions for improving diabetes control, psychological therapies led to significant improvement in glycaemic control in children and adolescent compared to adults[38]. A case study of 9 adolescents with consistently poor control previously has shown has shown marked improvement with coaching[39]. These findings show that assessment of psychosocial factors should be an integral part of the paediatric diabetes care in this population[33,40].

There are various structural education programmes for adults with type 1diabetes which have shown improvement in their control as well as quality of life[41,42]. However, there is need for practical, clinic based educational interventions for children and adolescents. Various trials have reported disappointing outcomes in improving control when applied to families and children in a real life setting[43,44]. The Kids in control of food is a structured education course based on Dose Adjustment for Normal Eating course which is a current adult education programme. The pilot showed significant improvement in quality of life and self-efficacy at 3 and 6 mo. There was no change in glycaemic control overall but improvement trend in those with poorest control[45]. Results of the randomised trial will hopefully give us more information on the effect of highly structured group education on a population with wide range of glycemic control[46].

In a systematic review by Hampson *et al*[37], it was concluded that educational and psychological interventions are most likely to be effective if demonstrate an interrelatedness of various aspects of diabetes management. There is a gap in evidence as no complete understanding of where these interventions to be targeted.

CONCLUSION

Good metabolic control is needed to prevent long term complications of diabetes. It is challenging in the paediatric population to achieve optimal control due to various developmental and psychological factors[47]. Psycho-educational and behavioural interventions play an important role in the diabetes management. However, there is need for practical, cost effective interventions which could be applied to the diabetes population in a clinic setting such as goal setting and psychosocial interventions. Svensson *et al*[48] have reported significant improvement in diabetes control independent of number of injections per day or insulin regimens but thought to be due to increased focus

on treatment goals, glucose monitoring and optimising care in their population over 10 years period. Overall, this review concludes that clear goal setting with good multidisciplinary team effort working together with families and children towards specific targets may be the key to good diabetes control.

REFERENCES

1 **Craig ME**, Hattersley A, Donaghue KC. Definition, epidemiology and classification of diabetes in children and adolescents. *Pediatr Diabetes* 2009; **10** Suppl 12: 3-12 [PMID: 19754613 DOI: 10.1111/j.1399-5448.2009.00568.x]

2 **Nathan DM**, Zinman B, Cleary PA, Backlund JY, Genuth S, Miller R, Orchard TJ. Modern-day clinical course of type 1 diabetes mellitus after 30 years' duration: the diabetes control and complications trial/epidemiology of diabetes interventions and complications and Pittsburgh epidemiology of diabetes complications experience (1983-2005). *Arch Intern Med* 2009; **169**: 1307-1316 [PMID: 19636033 DOI: 10.1001/archinternmed.2009.193]

3 **Shah SC**, Malone JI, Simpson NE. A randomized trial of intensive insulin therapy in newly diagnosed insulin-dependent diabetes mellitus. *N Engl J Med* 1989; **320**: 550-554 [PMID: 2644534 DOI: 10.1056/nejm198903023200902]

4 The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. The Diabetes Control and Complications Trial Research Group. *N Engl J Med* 1993; **329**: 977-986 [PMID: 8366922 DOI: 10.1056/nejm199309303291401]

5 **Swift PG**. Diabetes education in children and adolescents. *Pediatr Diabetes* 2009; **10** Suppl 12: 51-57 [PMID: 19754618 DOI: 10.1111/j.1399-5448.2009.00570.x]

6 **Dunbar JA**. The RCPE UK Consensus Statement on Diabetes. *J R Coll Physicians Edinb* 2010; **40**: 283; author reply 283 [PMID: 21127772 DOI: 10.4997/jrcpe.2010.321]

7 **Cameron FJ**, de Beaufort C, Aanstoot HJ, Hoey H, Lange K, Castano L, Mortensen HB. Lessons from the Hvidoere International Study Group on childhood diabetes: be dogmatic about outcome and flexible in approach. *Pediatr Diabetes* 2013; **14**: 473-480 [PMID: 23627895 DOI: 10.1111/pedi.12036]

8 **Siebenhofer A**, Plank J, Berghold A, Jeitler K, Horvath K, Narath M, Gfrerer R, Pieber TR. Short acting insulin analogues versus regular human insulin in patients with diabetes mellitus. *Cochrane Database Syst Rev* 2006; (**2**): CD003287 [PMID: 16625575 DOI: 10.1002/14651858.CD003287.pub4]

9 **Bangstad HJ**, Danne T, Deeb L, Jarosz-Chobot P, Urakami T, Hanas R. Insulin treatment in children and adolescents with diabetes. *Pediatr Diabetes* 2009; **10** Suppl 12: 82-99 [PMID: 19754621 DOI: 10.1111/j.1399-5448.2009.00578.x]

10 **de Beaufort CE**, Swift PG, Skinner CT, Aanstoot HJ, Aman J, Cameron F, Martul P, Chiarelli F, Daneman D, Danne T, Dorchy H, Hoey H, Kaprio EA, Kaufman F, Kocova M, Mortensen HB, Njølstad PR, Phillip M, Robertson KJ, Schoenle EJ, Urakami T, Vanelli M. Continuing stability of center differences in pediatric diabetes care: do advances in diabetes treatment improve outcome? The Hvidoere Study Group on Childhood Diabetes. *Diabetes Care* 2007; **30**: 2245-2250 [PMID: 17540955 DOI: 10.2337/dc07-0475]

11 **Holl RW**, Swift PG, Mortensen HB, Lynggaard H, Hougaard P, Aanstoot HJ, Chiarelli F, Daneman D, Danne T, Dorchy H, Garandeau P, Greene S, Hoey HM, Kaprio EA, Kocova M, Martul P, Matsuura N, Robertson KJ, Schoenle EJ, Sovik O, Tsou RM, Vanelli M, Aman J. Insulin injection regimens and metabolic control in an international survey of adolescents with type 1 diabetes over 3 years: results from the Hvidore study group. *Eur J Pediatr* 2003; **162**: 22-29 [PMID: 12486503 DOI: 10.1007/s00431-002-1037-2]

12 **Haller MJ**, Stalvey MS, Silverstein JH. Predictors of control of diabetes: monitoring may be the key. *J Pediatr* 2004; **144**: 660-661 [PMID: 15127007 DOI: 10.1016/j.jpeds.2003.12.042]

13 **Nordly S**, Mortensen HB, Andreasen AH, Hermann N, Jørgensen T. Factors associated with glycaemic outcome of childhood diabetes care in Denmark. *Diabet Med* 2005; **22**: 1566-1573 [PMID: 16241923 DOI: 10.1111/j.1464-5491.2005.01692.x]

14 **Paris CA**, Imperatore G, Klingensmith G, Petitti D, Rodriguez B, Anderson AM, Schwartz ID, Standiford DA, Pihoker C. Predictors of insulin regimens and impact on outcomes in youth with type 1 diabetes: the SEARCH for Diabetes in Youth study. *J Pediatr* 2009; **155**: 183-189.e1 [PMID: 19394043 DOI: 10.1016/j.jpeds.2009.01.063]

15 **Jakisch BI**, Wagner VM, Heidtmann B, Lepler R, Holterhus PM, Kapellen TM, Vogel C, Rosenbauer J, Holl RW. Comparison of continuous subcutaneous insulin infusion (CSII) and multiple daily injections (MDI) in paediatric Type 1 diabetes: a multicentre matched-pair cohort analysis over 3 years. *Diabet Med* 2008; **25**: 80-85 [PMID: 18199134 DOI: 10.1111/j.1464-5491.2007.02311.x]

16 **Misso ML**, Egberts KJ, Page M, O'Connor D, Shaw J. Continuous subcutaneous insulin infusion (CSII) versus multiple insulin injections for type 1 diabetes mellitus. *Cochrane Database Syst Rev* 2010; (**1**): CD005103 [PMID: 20091571 DOI: 10.1002/14651858.CD005103.pub2]

17 **Yeh HC**, Brown TT, Maruthur N, Ranasinghe P, Berger Z, Suh YD, Wilson LM, Haberl EB, Brick J, Bass EB, Golden SH. Comparative effectiveness and safety of methods of insulin delivery and glucose monitoring for diabetes mellitus: a systematic review and meta-analysis. *Ann Intern Med* 2012; **157**: 336-347 [PMID: 22777524 DOI: 10.7326/0003-4819-157-5-201209040-00508]

18 **Slover RH**, Welsh JB, Criego A, Weinzimer SA, Willi SM, Wood MA, Tamborlane WV. Effectiveness of sensor-augmented pump therapy in children and adolescents with type 1 diabetes in the STAR 3 study. *Pediatr Diabetes* 2012; **13**: 6-11 [PMID: 21722284 DOI: 10.1111/j.1399-5448.2011.00793.x]

19 **Bergenstal RM**, Tamborlane WV, Ahmann A, Buse JB, Dailey G, Davis SN, Joyce C, Peoples T, Perkins BA, Welsh JB, Willi SM, Wood MA. Effectiveness of sensor-augmented insulin-pump therapy in type 1 diabetes. *N Engl J Med* 2010; **363**: 311-320 [PMID: 20587585 DOI: 10.1056/NEJMoa1002853]

20 **Evans JM**, Newton RW, Ruta DA, MacDonald TM, Stevenson RJ, Morris AD. Frequency of blood glucose monitoring in relation to glycaemic control: observational study with diabetes database. *BMJ* 1999; **319**: 83-86 [PMID: 10398627 DOI: 10.1136/bmj.319.7202.83]

21 **Langendam M**, Luijf YM, Hooft L, Devries JH, Mudde AH, Scholten RJ. Continuous glucose monitoring systems for type 1 diabetes mellitus. *Cochrane Database Syst Rev* 2012; **1**: CD008101 [PMID: 22258980 DOI: 10.1002/14651858.CD008101.pub2]

22 **Schafer LC**, Glasgow RE, McCaul KD. Increasing the adherence of diabetic adolescents. *J Behav Med* 1982; **5**: 353-362 [PMID: 7131549]

23 **Boot M**, Volkening LK, Butler DA, Laffel LM. The impact of blood glucose and HbA(1c) goals on glycaemic control in children and adolescents with Type 1 diabetes. *Diabet Med* 2013; **30**: 333-337 [PMID: 23190135 DOI: 10.1111/dme.12083]

24 **Swift PG**, Skinner TC, de Beaufort CE, Cameron FJ, Aman J, Aanstoot HJ, Castaño L, Chiarelli F, Daneman D, Danne T, Dorchy H, Hoey H, Kaprio EA, Kaufman F, Kocova M, Mortensen HB, Njølstad PR, Phillip M, Robertson KJ, Schoenle EJ, Urakami T, Vanelli M, Ackermann RW, Skovlund SE. Target setting in intensive insulin management is associated with metabolic control: the Hvidoere childhood diabetes study group centre differences study 2005. *Pediatr Diabetes* 2010; **11**: 271-278 [PMID: 19895567 DOI: 10.1111/

j.1399-5448.2009.00596.x]
25 **Clement S**. Diabetes self-management education. *Diabetes Care* 1995; **18**: 1204-1214 [PMID: 7587866]
26 **Schilling LS**, Grey M, Knafl KA. The concept of self-management of type 1 diabetes in children and adolescents: an evolutionary concept analysis. *J Adv Nurs* 2002; **37**: 87-99 [PMID: 11784402 DOI: 10.1046/j.1365-2648.2002.02061.x]
27 **Chao A**, Whittemore R, Minges KE, Murphy KM, Grey M. Self-management in early adolescence and differences by age at diagnosis and duration of type 1 diabetes. *Diabetes Educ* 2014; **40**: 167-177 [PMID: 24470042 DOI: 10.1177/0145721713520567]
28 **Guo J**, Whittemore R, He GP. The relationship between diabetes self-management and metabolic control in youth with type 1 diabetes: an integrative review. *J Adv Nurs* 2011; **67**: 2294-2310 [PMID: 21615460 DOI: 10.1111/j.1365-2648.2011.05697.x]
29 **Amiel SA**, Sherwin RS, Simonson DC, Lauritano AA, Tamborlane WV. Impaired insulin action in puberty. A contributing factor to poor glycemic control in adolescents with diabetes. *N Engl J Med* 1986; **315**: 215-219 [PMID: 3523245 DOI: 10.1056/nejm198607243150402]
30 **Silverstein J**, Klingensmith G, Copeland K, Plotnick L, Kaufman F, Laffel L, Deeb L, Grey M, Anderson B, Holzmeister LA, Clark N. Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. *Diabetes Care* 2005; **28**: 186-212 [PMID: 15616254 DOI: 10.2337/diacare.28.1.186]
31 **Wysocki T**, Taylor A, Hough BS, Linscheid TR, Yeates KO, Naglieri JA. Deviation from developmentally appropriate self-care autonomy. Association with diabetes outcomes. *Diabetes Care* 1996; **19**: 119-125 [PMID: 8718430]
32 **Wysocki T**, Harris MA, Buckloh LM, Wilkinson K, Sadler M, Mauras N, White NH. Self-care autonomy and outcomes of intensive therapy or usual care in youth with type 1 diabetes. *J Pediatr Psychol* 2006; **31**: 1036-1045 [PMID: 15772362 DOI: 10.1093/jpepsy/jsj017]
33 **Hoey H**. Psychosocial factors are associated with metabolic control in adolescents: research from the Hvidoere Study Group on Childhood Diabetes. *Pediatr Diabetes* 2009; **10** Suppl 13: 9-14 [PMID: 19930221 DOI: 10.1111/j.1399-5448.2009.00609.x]
34 **Ingersoll GM**, Marrero DG. A modified quality-of-life measure for youths: psychometric properties. *Diabetes Educ* 1991; **17**: 114-118 [PMID: 1995281]
35 **Frøisland DH**, Graue M, Markestad T, Skrivarhaug T, Wentzel-Larsen T, Dahl-Jørgensen K. Health-related quality of life among Norwegian children and adolescents with type 1 diabetes on intensive insulin treatment: a population-based study. *Acta Paediatr* 2013; **102**: 889-895 [PMID: 23738648 DOI: 10.1111/apa.12312]
36 **Anderson B**, Ho J, Brackett J, Finkelstein D, Laffel L. Parental involvement in diabetes management tasks: relationships to blood glucose monitoring adherence and metabolic control in young adolescents with insulin-dependent diabetes mellitus. *J Pediatr* 1997; **130**: 257-265 [PMID: 9042129 DOI: 10.1016/S0022-3476(97)70352-4]
37 **Hampson SE**, Skinner TC, Hart J, Storey L, Gage H, Foxcroft D, Kimber A, Shaw K, Walker J. Effects of educational and psychosocial interventions for adolescents with diabetes mellitus: a systematic review. *Health Technol Assess* 2001; **5**: 1-79 [PMID: 11319990 DOI: 10.3310/hta5100]
38 **Winkley K**, Ismail K, Landau S, Eisler I. Psychological interventions to improve glycaemic control in patients with type 1 diabetes: systematic review and meta-analysis of randomised controlled trials. *BMJ* 2006; **333**: 65 [PMID: 16803942 DOI: 10.1136/bmj.38874.652569.55]
39 **Ammentorp J**, Thomsen J, Kofoed PE. Adolescents with poorly controlled type 1 diabetes can benefit from coaching: a case report and discussion. *J Clin Psychol Med Settings* 2013; **20**: 343-350 [PMID: 23900748 DOI: 10.1007/s10880-013-9374-z]
40 **Viner RM**, Christie D, Taylor V, Hey S. Motivational/solution-focused intervention improves HbA1c in adolescents with Type 1 diabetes: a pilot study. *Diabet Med* 2003; **20**: 739-742 [PMID: 12925054 DOI: 10.1046/j.1464-5491.2003.00995.x]
41 **Jordan LV**, Robertson M, Grant L, Peters RE, Cameron JT, Chisholm S, Voigt DJ, Matheson L, Kerr EJ, Maclean K, Macalpine RR, Wilson E, Mackie AD, Summers NM, Vadiveloo T, Leese GP. The Tayside insulin management course: an effective education programme in type 1 diabetes. *Int J Clin Pract* 2013; **67**: 462-468 [PMID: 23510057 DOI: 10.1111/ijcp.12107]
42 **DAFNE Study Group**. Training in flexible, intensive insulin management to enable dietary freedom in people with type 1 diabetes: dose adjustment for normal eating (DAFNE) randomised controlled trial. *BMJ* 2002; **325**: 746 [PMID: 12364302 DOI: 10.1136/bmj.325.7367.746]
43 **Murphy HR**, Wadham C, Hassler-Hurst J, Rayman G, Skinner TC. Randomized trial of a diabetes self-management education and family teamwork intervention in adolescents with Type 1 diabetes. *Diabet Med* 2012; **29**: e249-e254 [PMID: 22507080 DOI: 10.1111/j.1464-5491.2012.03683.x]
44 **Gregory J**, Robling M, Bennert K, Channon S, Cohen D, Crowne E, Hambly H, Hawthorne K, Hood K, Longo M, Lowes L, McNamara R, Pickles T, Playle R, Rollnick S, Thomas-Jones E. Development and evaluation by a cluster randomised trial of a psychosocial intervention in children and teenagers experiencing diabetes: the DEPICTED study. *Health Technol Assess* 2011; **15**: 1-202 [PMID: 21851764 DOI: 10.3310/hta15290]
45 **Waller H**, Eiser C, Knowles J, Rogers N, Wharmby S, Heller S, Hall C, Greenhalgh S, Tinklin T, Metcalfe C, Millard E, Parkin V, Denial M, Price K. Pilot study of a novel educational programme for 11-16 year olds with type 1 diabetes mellitus: the KICk-OFF course. *Arch Dis Child* 2008; **93**: 927-931 [PMID: 18676435 DOI: 10.1136/adc.2007.132126]
46 **Price KJ**, Wales J, Eiser C, Knowles J, Heller S, Freeman J, Brennan A, McPherson A, Wellington J. Does an intensive self-management structured education course improve outcomes for children and young people with type 1 diabetes? The Kids In Control OF Food (KICk-OFF) cluster-randomised controlled trial protocol. *BMJ Open* 2013; **3**: pii: e002429 [PMID: 23355675 DOI: 10.1136/bmjopen-2012-002429]
47 **Anderson BJ**, McKay SV. Barriers to glycemic control in youth with type 1 diabetes and type 2 diabetes. *Pediatr Diabetes* 2011; **12**: 197-205 [PMID: 20561243 DOI: 10.1111/j.1399-5448.2010.00667.x]
48 **Svensson J**, Johannesen J, Mortensen HB, Nordly S. Improved metabolic outcome in a Danish diabetic paediatric population aged 0-18 yr: results from a nationwide continuous Registration. *Pediatr Diabetes* 2009; **10**: 461-467 [PMID: 19175901 DOI: 10.1111/j.1399-5448.2008.00460.x]

P- Reviewer: Chen SS, Dumitrascu DL, Das UN
S- Editor: Tian YL **L- Editor**: A **E- Editor**: Liu SQ

Published by **Baishideng Publishing Group Inc**
8226 Regency Drive, Pleasanton, CA 94588, USA
Telephone: +1-925-223-8242
Fax: +1-925-223-8243
E-mail: bpgoffice@wjgnet.com
Help Desk: http://www.wjgnet.com/esps/helpdesk.aspx
http://www.wjgnet.com