

Research Article

Factors Affecting Glycemic Control in Adolescents and Emerging Adults Living with Type 1 Diabetes: An Integrative Literature Review

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ABSTRACT

Title: Factors Affecting Glycemic Control in Adolescents and Emerging Adults Living with Type 1 Diabetes: An Integrative Literature Review

Aim: This paper presents an integrative review of findings from studies about factors affecting glycemic control in adolescents and emerging adults living with Type 1 Diabetes.

Background: A diagnosis of Type 1 Diabetes requires optimal glycemic control to avoid future complications associated with the disease. For adolescents and emerging adults living with Type 1 Diabetes, the challenges of glycemic control can be challenging during times of transition.

Data sources: An electronic search of original research studies focusing on factors affecting glycemic control in adolescents and emerging adults, ages 10 to 24, published between during January 2009 and December 2014 was done. Databases searched include: Academic Search Premier, CINAHL, Cochrane Library, OVID, and PubMed.

Review methods: Studies were reviewed for problem identification, data were evaluated and analyzed. Following these steps data were displayed and compared leading to drawing of verified conclusions.

Results: Nineteen studies were found in this search and include cross-sectional (n=5) longitudinal (n=11), intervention (n=2) and qualitative (n=1). The literature identified three major areas affecting glycemic control in adolescents and emerging adults. These areas include psychological and social support, cardiovascular fitness and transition of type 1 diabetes care from pediatric to adult services.

Conclusion: Knowledge gained from integrative review of the research aimed at examining factors affecting glycemic control in adolescents and emerging adults living with Type 1 Diabetes is critical. Development of interventions aimed toward improvement in glycemic control should focus on individual perceptions, impulse control, parental relationships and transitions from pediatric to adult health care.

Keywords: Adolescents; Emerging adults; Glycemic control

Introduction

The transition from adolescence to emerging adulthood can be a difficult time. It is a time when internal struggles occur in relation to peer acceptance and the search for one's own identity [1]. The term emerging adulthood is used to describe the period from late teens through the early twenties [2]. Many adolescents and young

adults leave the comfort and safety of parental control and guidance to become more independent while venturing out into the world on their own [3].

Until this time, adolescents and emerging adults thought of themselves as extensions of their parents. Decisions were made for them and when given the opportunity to make a decision on their

own, it often had to be approved by a parent prior to acting upon it. Contemplation about individual value systems occurs during these transition periods. The individual reflects on the values he or she grew up with and compares them to those he or she currently believes.

The American Academy of Pediatrics ([AAP], 2014) identifies late adolescence and emerging adulthood as a time when many individuals focus on finding employment or making the decision to pursue a college education. They must build a social support system while acclimating to a different environment. The transition to college and independent living is challenging for adolescents and young adults. It requires significant adjustments to prior practice, even with the simplest tasks of daily living.

According to the National Diabetes Education Program ([NDEP], 2014) and the American Diabetes Association ([ADA], 2014), 215,000 Americans younger than age 20 live with diabetes. Type 1 Diabetes (T1D) is considered to be one of the most common chronic illnesses in childhood, along with asthma and cerebral palsy [4]. Although cases of diagnosed type 2 diabetes are rising due to increased obesity in this population (ADA, 2014), the rate of T1D remains the higher of the two in this population (CDC, 2014). In 2009, 19.3 children per 10,000 were living with T1D (mostly white), compared with 4.6 per 10,000 living with type 2 diabetes (mostly Native American and Blacks) [5].

The diagnoses of T1D and type 2 diabetes (T2D) possess similarities, as well as major differences, in disease management protocol [6]. The lifestyle changes required for management of T2D include diet monitoring, exercise, oral hypoglycemic agents, and occasional blood glucose monitoring (BGM). These changes are often hidden from others. On the other hand, the insulin dependence of T1D through self-injection, require the need for frequent BGM. Other varied symptoms associated with hypo and hyperglycemic reactions are also invisible to others until they become critically symptomatic.

With the focus of T1D management on optimal control [6,7], adolescents and emerging adults must consider making independent decisions when venturing into the world on their own. Some of these decisions include food choices and independent living, while balancing the demands of exercise, sleep, work or school, and social obligations. The hormonal fluctuations unique to adolescence, regardless of a T1D diagnosis, often diminish the body's ability to respond to insulin [8]. Psychosocial challenges in this population also contribute to complications in glycemic control for individuals living with T1D. Both hormonal fluctuations and psychosocial issues make T1D management difficult [8,9].

The purpose of this integrative review is to explore, review, and synthesize existing research focused on T1D management during the years of 2009 to 2014. This is done to more clearly understand effects on glycemic control in the adolescent and emerging adult population. The knowledge gained from this integrative review will enhance current knowledge and contribute to focusing future research in T1D management.

Methods

This integrative review includes an electronic search of studies focusing on factors affecting glycemic control in adolescents and emerging adults, ages 10 to 24, living with T1D and published between January 2009 and December 2014. Databases used in the search

include: Academic Search Premier, CINAHL, Cochrane Library, OVID, and PubMed. Each database was searched separately using the keywords: Type 1 diabetes and adolescents, Type 1 diabetes and emerging adults, and glycemic control in adolescents and emerging adults. The inclusion criteria for the review includes original, published, peer-reviewed research studies done in the United States, focusing on factors affecting glycemic control in adolescents and emerging adults (ages 10-24) who are living with T1D.

Four of the studies included in the search had participants outside of the inclusion criteria for age, one included participants as young as 8 years [10] and three included participants as old as 30 years [11-13]. During the search, a review article by Lyons, et al. [14] was found. The focus in this review examines the effects of transfer from pediatric to adult health care on the patients' diabetes outcomes. Of the eight research articles analyzed in this review, all but one originated from outside the United States. The one remaining article is excluded from this integrative review due to its publication date of 1999. Measurement tools used in the studies include the Children's Depression Inventory (CDI), the Diabetes-Related Quality of Life (DQOL), the Pediatric Quality of Life Inventory (PedsQL), and the State-Trait Anxiety Inventory for children (STAIC).

Steps in this integrative literature review process include problem identification, comprehensive search, data evaluation, data analysis, data reduction, data display, data comparison, and conclusion drawing and verification. As recommended, a table summarizing studies used in the integrative review is included (Table 1). This integrative review includes quantitative (cross-sectional, longitudinal, and intervention studies) and qualitative studies, focusing on factors affecting glycemic control in adolescents and emerging adults living with T1D. The most common study type is the longitudinal study. All studies meeting the criteria were organized into subgroups following data evaluation, analysis, displayed and compared. Study design and conclusions were reviewed and studies were regrouped [15]. A combined total of 7,590 participants is reflected in this review. One of the longitudinal studies includes 5,004 of these participants [6].

Research examining the factors affecting glycemic control in adolescents and emerging adults living with T1D was found in 19 published studies from the United States during the years of 2009 to 2014. Six studies were found from other countries, including Australia [16], Belgium [17], Egypt [18], Germany [19], Grenada [20], and Iran [21]. Due to differing cultural, financial, and health care practices within these countries, those studies are not included in this integrative literature review.

The literature in this review identifies three major areas which incorporate factors affecting glycemic control in adolescents and emerging adults. These areas include psychological and social support (family function and support, educational interventions, depression and anxiety, perceived quality of life (QoL) and support groups), exercise and nutrition, and transition of T1D care from pediatric to adult services.

Results

Psychological and social support

Examples of psychological and social support affecting glycemic control in adolescents and emerging adults vary. Among these are educational interventions [21], family function and support [10,23-

Table 1: Summary of Research Studies.

Author/year	Purpose	Sample	Method	Findings
Fortenberry, et al. [27]	Examined how daily affect related fluctuations in experience of diabetes problems, and whether perceptions of control moderated daily associations.	n=209 adolescents, ages 10.5 to 15.5, kept for a 3 year period.	Longitudinal Study	Findings show that perceived treatment control helps to buffer detrimental associations between negative affect and adolescents' ability to successfully manage their diabetes.
Garvey, et al. [11]	Experiences of health care transition voiced by young adults with type 1 diabetes: a qualitative study	n=26 ages 22-30	Qualitative Study using focus groups	Four key themes identified. Findings show modifiable deficiencies in the T1D transition process and underscore the importance of a planned transition with enhanced preparation by pediatric clinics .
Garvey, et al. [12]	Examined characteristics of the transition from pediatric to adult care in emerging adults with type 1 diabetes and evaluate associations between transition characteristics and glycemic control (gc).	n=258 ages 23-30	Cross-sectional Study	Transition practices may help prevent gaps between pediatric and adult care but did not promote improvement in A1C lab results.
Grabill, et al. [10]	To determine the direct impact of family variables on gc.	n=224 ages 8-18	Longitudinal Study	Results suggest that youth perception of parental involvements in their diabetes management is critical to glycemic control.
Hanna, et al. [32]	Roles of gc, diabetes management, diabetes care responsibility, living independently of parents, and time since high school graduation in predicting diabetes-related quality of life were examined.	n=184 ages 17-19	Longitudinal Study	Findings showed relatively good diabetes related quality of life in emerging results during the transition period from pediatric to adult health care.
Hanna, et al. [35]	As part of a longitudinal, purpose was to 1. Examine how diabetes care responsibility changed in relation to time and living situation and 2. To examine the association of diabetes self-efficacy and glycemic control	n=113 ages 17-19 years	Longitudinal Study (subgroup)	Findings show that this group had increased levels of responsibility for daily diabetes care essential for glycemic control.
Helgeson, et al. [29]	To examine the impact of parent and peer relationships on health behaviors and psychological well-being of those with and without T1D over the transition to emerging adulthood.	n=117 (with T1D) n=122 (without T1D) ages 16-20	Longitudinal Study	Supportive relationships predicted better health care behaviors.
Helgeson, et al. [22]	To determine the relation of stressful life events to metabolic control.	n=132 ages 11-13	Longitudinal Study (4 years)	Stressful events are associated with poor metabolic control especially with older adolescents.
Herzer, et al. [24]	To examine whether individual psychological variables mediate the family conflict-gc relationship.	n=147 ages 13-18	Longitudinal Study (9 months)	Anxiety is triggered by negative family conflict adversely affecting glycemic control.
Herzer and Hood [30]	To examine the prevalence of anxiety symptoms and their association with blood glucose monitoring and gc in adolescents with T1D.	n=276 ages 13-18	Cross-sectional Study	Multidisciplinary teams need to consider the association between anxiety and glycemic control when planning cognitive-behavioral interventions.
Hilliard, et al. [31]	To explore the effects of depression and anxiety screenings on A1C and BGM.	n=150 ages 13-18	Longitudinal Study (12 months)	Increase in anxiety and depression symptoms are predictive of poor glycemic control and poor QoL.
Hilliard, et al. [6]	To calculate diabetes specific minimal clinically important difference for the PedsQL tool.	n=5,004 ages 8-17	SEARCH for Diabetes in Youth Study Longitudinal	Clinically meaningful improvements in total score for at least one PedsQL module were predicted by lower BMI and lower A1C baseline.

Hilliard, et al. [33]	To examine whether problems in QoL as associated with T1D management behavior affect gc over one year.	n=150 ages 13-18 years	Longitudinal Study (one year)	Results support clinical efforts to routinely monitor QoL and to intervene to promote both QoL and diabetes management to ultimately improve glycemic control.
Ingerski, et al. [7]	Aims: 1. To confirm previous research documenting a significant relationship between gc and QoL and 2. to identify clinically relevant characteristics associated with four different gc QoL profiles and correlates of membership in these groups.	n=276 ages 13-18	Cross-sectional Study	Findings support routine QoL clinical assessment to individual care and identify intervention to increase glycemic control.
Kichler, et al. [22]	Replication of a treatment protocol that combined two types of diabetes management groups.	n=30 ages 13-17 years	Longitudinal Replication Intervention Study	Findings show implications for improvement in other modifiable individual and family diabetes related factors.
Markowitz and Laffel [13]	To explore the implementation and evaluation of a support group for young adults with T1D as a pilot project.	n=15 ages 18-30	Longitudinal Intervention Pilot Study (5 months)	Findings show that emerging adults appear to value the social support generated in-group sessions.
Mlynarczyk [25]	To explore whether perceived parental support and different parenting styles are related to adherence to T1D gc and QoL.	n=102 ages 12-18 years	Cross-sectional Study	Study showed that perceived parental support and authoritative parenting styles affect adolescents' ability to positively manage their T1D and increase QoL.
Stupiansky, et al. [26]	Purpose was to 1. Examine the relationship between impulse control and diabetes management and 2. To test diabetes-specific self-efficacy as a mediator of this relationship.	n=204 ages 17-19 years	Longitudinal Study	Findings suggest that emerging adults with low impulse control may experience difficulties with diabetes management, partially mediated by self-efficacy.
Wheeler, et al. [28]	To examine the associations between broad personality traits and adolescent adherence to diabetes management.	n=28 ages 13-18	Cross-sectional Study	Positive correlations were found between the conscientiousness domain related to adherence to T1D management ultimately affecting glycemic control

25], low impulse control [26], perceived problems in symptom management [27], personality type [28], stress and anxiety [29-31], and support groups [13]. These were all found to have positive effects on glycemic control.

Parent and friend support

Kichler, et al. [22] use an intervention comprised of a combining diabetes education, behavior therapy and family therapy. This intervention study shows how these modalities affect glycemic control in a group of adolescents. Although findings were not statistically significant, marginal improvement was seen in glycemic control among the participants as compared with the control group. Family function and support positively affects glycemic control among adolescents and emerging adults living with T1D. Mlynarczyk [25] shows that the adolescent's perception of increased parental support correlates with increased adherence to glycemic management. An additional finding shows that authoritative parenting styles positively impact the adolescents' ability to manage their T1D, which increases their perceived QoL [25].

Helgeson, et al. (2014) [23] focused on the effect of parental and friend support on behaviors associated with glycemic control. Findings demonstrate self-care behavior relates to glycemic control and is significantly improved by the quality of the relationship with parents. This supportive relationship extends from adolescence into

emerging adulthood. Herzer, et al. [30] examined links over time between caregivers and adolescents' glycemic control. Conversely, Grabill, et al. [10] explored the direct impact of family variables on glycemic control in a 2-year longitudinal study. Findings show that although family variables do not directly impact glycemic control, the perception of parents as a critical and negative influence, is related to the adolescent's difficulty with adherence to their T1D management protocol. The results indicate that in the presence of diabetes-related family conflict, anxiety is triggered.

Emotional factors

Physical symptoms associated with anxiety, such as shortness of breath, palpitations, dizziness, nausea and vomiting, contribute to poor glycemic control. More frequent BGM during times of high anxiety will help to lower A1C results and increase glycemic control. Stupiansky, et al. [26] examined the relationship between impulse control (related to risky behavior such as drinking alcohol), and diabetes management in adolescents (n=204). Impulse control, diabetes specific self-efficacy, and diabetes management are measured in this study. Findings suggest that emerging adults with low impulse control may experience difficulties with T1D management.

Fortenberry, et al. [27] examined adolescents' views of diabetes control (n=209) when interfaced with daily relationships between emotions and diabetes management. Daily diaries of feelings,

perceptions, and BGM show that perceived negative experiences and relationships are associated with more self-reported problems of daily glycemic control in T1D management. No long term effects were seen on A1C results.

Wheeler, et al. [28] examined the associations between broad personality traits and adolescent adherence to T1D management regimes such as BGM. Positive correlations were found between being conscientious and the relationship to adherence and compliance. This finding suggests using personality screenings for individuals during initial diagnosis of T1D. Knowledge of the individual's personality traits could guide endocrinologists in individualized T1D management methods, aimed at having positive effect on glycemic control.

The effects of anxiety and stress on T1D management and glycemic control are exposed in the literature. In addition to findings by Herzer, et al. [30], research by others [29-31] found similar adverse effects of anxiety and stress on glycemic control. Helgeson, et al. [29] studied the adolescent/emerging adult population living with T1D and glycemic control over a period of 5 years. Findings show that stressful events directly relate to poor glycemic control. The adverse effects of these events on glycemic control decrease with increased parental involvement in T1D management, particularly in the adolescent population.

Herzer and Hood [30] report similar findings in their study aimed to document the rates and correlates of anxiety in a sample of adolescents (n=276) living with T1D and their caretakers. They report that increased symptoms of anxiety are predictive of suboptimal glycemic control. A study by Hilliard, et al. [31] aimed to investigate the ability of psychological screening to predict the level of diabetes management and glycemic control over a period of one year. The CDI and the STAIC assessment tools were used in this study. Findings support research by Helgeson, et al. [29] and Herzer and Hood (2010) [30] by showing that higher levels of anxiety are predictive of increased A1C values. The researchers also reported that depressive symptoms are associated with less frequent BGM and poor perceived QoL.

Quality of life measurement

Perceived QoL directly affects glycemic control in adolescents and emerging adults living with T1D. The more positively the adolescent or emerging adult perceives their QoL to be, the better their glycemic control is. This is a shared finding among research done by Hanna, et al. [32], Hilliard et al. [6], Hilliard, et al. [33], and Ingerski, et al. [7]. Although the findings of these studies were similar, the research approach varies.

Studies by Hilliard, et al. [33] and Hilliard, et al. [6] examine whether a decline in QoL is associated with diabetes management behaviors and glycemic control over time. This was accomplished using the PedsQL, a validated QoL measurement tool. Findings show that deficits in adolescent general and health-related QoL, especially when related to depression and anxiety, predict less frequent BGM and poor glycemic control. Ingerski, et al. [7] also support the routine use of QoL screening tools, such as the CDI and the PedsQL, during T1D management visits. Findings of their study show that increased glycemic control is associated with higher QoL in general, particularly when there is less evidence of family conflict. Both studies demonstrate the need for frequent monitoring using validated QoL

screening tools. Use of these tools in T1D management will assist endocrinologists in reaching the treatment goal of optimal glycemic control in this population.

Conversely, Hanna, et al. [32] also studied frequent use of QoL screening tools in this population during the transition from pediatric to adult T1D management. The DQOL measurement tool is used in this study. Overall their findings show that QoL measurement tools are not as useful in predicting glycemic control during this transition period. The exception to this is the presence of depressive symptom and scores indicating lower life satisfaction. This would be important to assess in individuals who are living independently and no longer have direct parental support and guidance. The authors note the need for further research on ways to more adequately use this tool during diabetes management visits with this population.

Markowitz and Laffel [13] conducted a study focusing on participation in a T1D focused support group, which includes an educational component. Findings show that adolescents and emerging adults appear to value the social support generated by in-group educational sessions. This participation shows a direct positive impact on QoL and subsequent improvement in glycemic control.

Exercise and nutrition

Attempts to address the effects of exercise and nutrition on glycemic control in adolescents and emerging adults have been done [34]. This study describes the relationships between current cardiovascular fitness levels of T1D and T2D participants using a self-report diary reflecting on the prior week. Results show no significant difference between groups in relation to QoL. Participants living with T1D are likely to be more physically fit, which is a factor positively affecting glycemic control in these individuals.

Transitioning from pediatric to adult T1D management

Transitioning from pediatric to adult T1D management care is a challenging time for adolescents and emerging adults. This transition can be especially difficult when combined with developmental changes occurring during this time. Hanna, et al. [35], reveals that adolescents and emerging adults increase levels of responsibility for T1D management during this transitional period.

Garvey, et al. [12] surveyed emerging adults (n=258) transitioning from pediatric to adult care. The majority of participants revealed that they felt prepared for this transition in their T1D management care. In cases where transition indicates individuals are doing well, there are no differences in A1C results. Qualitative research by Garvey, et al. [11] examined the impact of this transition on glycemic control and shows that individuals with poor glycemic control are more reluctant to leave pediatric care. Individuals with stable glycemic control are ready to transfer their T1D management care. This study also shows that the college age individual living with T1D is more vulnerable and at risk due to the additional transitions, such as living on their own and social obligations, occurring in their lives during this time.

Discussion

Optimal glycemic control in adolescents and emerging adults living with T1D is critical to their future health and well-being. Knowledge obtained from this integrative literature review will be helpful in developing interventions for improvement with glycemic

control in this population. Areas of focus for future studies with adolescents and emerging adults living with T1D include individual perceptions of depression, anxiety, and quality of life, impulse control related to risky behavior, parental relationships, and transitions from pediatric to adult health care.

Anderson [36] and Hilliard, et al. [31] recommend using a risk of depression screening questionnaire at each diabetes management appointment. This screening takes less than ten minutes to administer and would provide the health care provider with valuable information, ultimately leading to increased glycemic control. Another recommendation by Anderson [36] and Hilliard, et al. [33] is to routinely monitor QoL with a validated assessment tool, such as PedsQL, at routine follow-up appointments. This allows healthcare practitioners an opportunity to intervene as they address anxiety and depression symptoms and promote an increase in perceived QoL leading to optimal glycemic control. Research aimed toward understanding cultural beliefs of adolescents and emerging adults living with T1D, in relationship to diabetes management in adolescents and emerging adults living in the United States is needed. This research will assist in the inclusion of cultural considerations when designing T1D education and management programs.

Conclusion

Understanding effects on glycemic control in the adolescent and emerging adult population will enhance existing knowledge in T1D management. Psychological and social support include diabetes camps, educational programs, family function and support, impulse control, personal traits, stress and anxiety. Knowledge gained from this integrative literature review show the benefit of including routine personality, depression, anxiety, and QoL screenings during T1D management. Findings of these screenings will aid in the planning of education and intervention programs, along with support groups, contributing toward ultimate glycemic control in this population.

Qualitative studies examining these effects from the individual's view will add valuable insight to existing knowledge. Further studies looking at the effects of the transition process from pediatric to adult T1D management will be helpful in understanding the unique needs in this population. These combined research strategies and subsequent findings will enhance understanding of glycemic control in adolescents and emerging adults living with T1D. The goal is to identify predictors of glycemic control so interventions can be tailored toward improvement in areas of T1D management that are aimed at reaching and maintaining ultimate glycemic control in this population.

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