

The influencing factors of blood glucose control in adolescents with diabetes: A systematic review

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Abstract: This systematic review was to investigate the factors influencing glycemic control in adolescents with diabetes. The systematic review was prepared based on the Systematic Review Report Project. The review includes 15 studies. The results show that adolescents' glycemic control factors are influenced by their own and external factors, such as eating habits, emotional patterns, sleeping habits, family support and emotional suppression. Good self-regulation, independent support and personal execution can motivate adolescents to pursue an active learning model of glycemic control. To reduce the chances of juvenile diabetes, it is recommended that public awareness be raised by providing community education.

1. Introduction

Diabetes is regarded as one of the chronic diseases. With the increasing number of T1DM patients, improving diabetes care to reduce the health and economic burden caused by the disease has become a global goal^[1]. Diabetes has gradually become younger from the elderly. Poor blood sugar control may seriously affect the health of diabetic patients^[2], including failure to achieve adequate blood sugar control levels, which ultimately leads to extensive organ damage, most notably the eyes, kidneys, blood vessels and nerves. Studies have shown that it is especially common in adolescents with poor medical compliance with diabetes. Only 17% of them have reached the 2019 American Diabetes Association's hemoglobin A1c (HbA1c) target of less than 7.5%, and 14% reached the target of less than 7% in the registration of T1D exchange clinics^[3]. Therefore, exploring the factors of blood sugar control in juvenile diabetes has become a major concern for both families and the society.

This article takes 15 literatures on juvenile diabetes as the basis of retrospective analysis. Starting from the background factors of juvenile diabetes, this article reviews the influential factors to adolescents' blood glucose control in terms of sample setting, data collection, research results,

and future recommendations. The purpose is to propose a series of measures to control the blood sugar of adolescents, and prepare for the future research direction of juvenile diabetes based on the overall situation of the current research.

2. Methods

2.1 Object

The aim of this systematic review was to investigate the factors influencing glycemic control in adolescents with diabetes mellitus.

2.2 Research questions

This study was prepared according to the preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) guidelines used in systematic review and meta-analysis studies. Ethics committee approval was not required since the data of the study will be obtained from the studies published in the literature.

2.3 Search strategy

Literature analysis includes reviewing articles in several health care disciplines such as nursing, medicine and psychology. Literature search is performed through MEDLINE, Tralee Library, CINAHL, Google, Academic Search, AHFS Consumer Medication, APA PsycArticles, and Health Source. First, keywords are used, such as adolescence, diabetes, blood sugar control, blood sugar impact, medication compliance, impact. There were a total of 5680 subject papers. Secondly, the progressive restriction included full-text with references, limited to recent submissions within the past 8 years, peer-reviewed English-language versions, and articles based on relevance and reflecting different perspectives and contexts related to glycemic control in diabetes. An article was considered relevant if the authors described the measurement of the above keywords or used a conceptual analysis approach to describe the keywords. Finally, 55 articles were screened for review and 15 articles were identified based on the above criteria. As shown in Appendix A.

2.4 Inclusion and exclusion criteria

The inclusion criteria in the systematic review were defined according to PICOS (P: Population, I: Interventions, C: Comparisons, O: Outcomes, S: Study designs).

3. Results

3.1 Features of the studies included

In the literature review, the literature has studied the influential factors to the blood sugar control of adolescents from many aspects, and proposed a number of intervention measures. Hamburger, et al. (2019), Miežienė, Šinkariova and Adomavičiūtė (2015), Lansing, et al. (2016), Lee, et al. (2020), and Spaans, et al. (2018) all mentioned that the intensity of autonomous support, and the ability of self-control are closely related to diabetes treatment and blood sugar control^[4-8].

3.2 Autonomy support strength factor

The intensity of autonomous support is blood sugar control, diabetic diet, Predictors of higher

autonomy in physical activity. Costa, Volkening and Laffel (2019) revealed that some biomedical and psychosocial characteristics differ depending on the degree of eating behavior disorder^[9]. The more eating behavior disorders, the poorer the treatment adherence. More negative impacts of glucose monitoring, poorer quality of life and more depressive symptoms, as well as more diabetes-specific family conflicts, have led to the identification of adolescents with diabetes, and support and intervention efforts can be targeted at eating behaviors. Individuals with psychological disorders and psychological anxiety may improve glycemic control. Döger, et al. (2019) showed that the telehealth system helps to provide patients with advice, information and online support^[10]. The increasing frequency of diabetes group consultations leads to T1DM improvement of patient blood glucose control. The telehealth system helps to detect the need for treatment and intervention early and promotes better self-care.

3.3 Early prevention interventions

Salameh, et al. (2016) identified that early preventive interventions in schools such as dietary guidance and Exercise guidance effectively reduced the weight and fasting blood glucose of high-risk adolescents in Jordan^[11]. Rassart, et al. (2015) showed that depression symptoms, treatment-related, food-related, emotional and social support issues are positively related to blood sugar control^[12]. They also emphasized the importance of addressing patients' views and beliefs about diabetes, and advocated depression screening and treatment as a key element of overall diabetes care.

3.4 Self-control factors

According to Laffel, et al. (2020), blood sugar control is related to the frequency and daily insulin pill frequency of adolescents^[13]. The number of SMBG has a strong, clinically relevant, and statistically highly significant association. It confirms and expands the results of a few previous studies, that is, the relationship between T1DM's BOLUS and SMBG adherence to adolescents and blood glucose control in CSII treatment. Gheller, et al. (2019) identified that compared with non-dairy snacks, the consumption of dairy snacks in NW and OW/OB children may lead to a decrease in postprandial blood glucose concentration and an increase in circulating insulin^[14]. According to Healey, et al. (2018), Nikita, et al. (2019), and Emiliana, et al. (2019), higher negative emotions in children are related to poor blood sugar control, through self-regulation to avoid rebellion and negative effects^[15-17]. Perfect, et al. (2016) proved the effectiveness of short-term sleep prolongation interventions on glucose control and neurobehavioral function in T1DM youths, and identified that adequate sleep is conducive to blood sugar control^[18].

4. The research method of the literature

The research method of most of the literature is quantitative method, and a few apply mixed method. More specifically, quantitative research method was applied in research of Hamburger, et al. (2019), Miežienė, Šinkariova and Adomavičiūtė (2015), Lee, et al. (2020), Döger, et al. (2019), Salameh, et al. (2016), Rassart, et al. (2015), Lansing, et al. (2016), Laffel, et al. (2020), Spaans, et al. (2018), Gheller, et al. (2019), Healey, et al. (2018), Nikita, et al. (2019), Emiliana, et al. (2019), and Perfect, et al. (2016). The study of Costa, Volkening and Laffel (2019) is a mixed-type study, combining two modes of cross-sectional research and interviews and using graphs to review and collect data for analysis. In terms of quantitative research, Miežienė, Šinkariova and Adomavičiūtė (2015), and Healey, et al. (2018) applied cross-sectional research. Lansing, et al. (2016) applied multi-level modeling research. A single blind randomized control experiment analysis conducted by

Salameh, et al. (2016), while a cross-lag path analysis, as a type of longitudinal research, was conducted by Rassart, et al. (2015). Laffel, et al. (2020) and Perfect, et al. (2016) adopted randomized clinical trials in their studies. Emiliana, et al. (2019) applied a quasi-experimental design, without the control group. To classify the above-mentioned literature experimentally, the research of Hamburger, et al. (2019), Miežienė, Šinkariova and Adomavičiūtė (2015), and Healey, et al. (2018), Nikita, et al. (2019) are descriptive studies in non-experimental studies. The research of Rassart, et al. (2015) is a prospective study in experimental studies. The research of Salameh, et al. (2016), Emiliana, et al. (2019), Laffel, et al. (2020), and Perfect, et al. (2016) are commonly used experimental research in nursing research.

5. Discussion

In the literature review, the philosophical foundations and the pragmatic approach have been identified and the rationale for the choice of methodology is evident. Quantitative research methods can be categorized into experimental, pilot and non-experimental research depending on whether the research subjects are intervened and whether the principle of grouping or randomization is used. It is possible to design the type of research according to different research purposes. In this way, quantitative research always specifies “what to do and how to do it”. Therefore, it can achieve the research purpose through scientific method. However, this research method may not always fully meet the needs of all research subjects. In terms of cross-sectional research, when the census of juvenile diabetic patients is huge, the work is not easy to do meticulously, the diagnostic tools are relatively simple, the research team is prone to bias, and it is easy to lead to parental sexual behavior^[5]. In terms of experimental research design, the randomized control group has a large expenditure of human and financial resources, and has strict inclusion and exclusion criteria, which limits the representativeness and authenticity of the research results^[13]. In this case, subject research can consider adding qualitative methods. Quantitative methods focus on objective and numerical data and have a limited understanding of context, while qualitative methods explore more subjective aspects and provide perspective but it is more difficult to prove rigor. In this case, mixed method research, in which quantitative and qualitative methods are an ideal solution, is an ideal solution to comprehensively understand the multi-faceted factors in juvenile diabetic blood sugar control. Therefore, the literature is suitable for the use of hybrid methods for research^[19]. In addition, it is more comprehensive to include questionnaires and interviews Costa, Volkening and Laffel (2019).

In the following research, the worldview and values of the participating researchers are to be based on science, which is theory-based and quantitatively measured by experimental methods, while respecting the methods of inquiry in philosophy, ethics, and many social fields. First, in sociological research methods, the research topic can be based on grounded theory applied to nursing and psychology. Pragmatism continues to be used^[20]. Secondly, in terms of nursing theories, self-efficacy or self-management theories can be used to intervene and study factors in adolescents with diabetes. Both self-efficacy theory and self-management theory are measurable and widely applicable to people with diabetes^[21].

6. Conclusions

In summary, adolescents' blood glucose control factors are influenced by their own and external factors, such as dietary habits, emotional patterns, sleep habits, family support and emotional suppression, etc. Good self-regulation, independent support and personal execution can motivate adolescents to pursue an active learning model of glycemic control.

6.1 Limitations of the systematic review

Although the above studies have proven some influential factors to blood sugar control in adolescents and confirmed interventions, there are still some limitations. The first limitation is the sample size. For example, the sample size is too small to be partial in the research of Hamburger, et al. (2019), Lee, et al. (2020), Costa, Volkening and Laffel (2019), Döger, et al. (2019), Rassart, et al. (2015), Healey, et al. (2018), and Nikita, et al. (2019). The second limitation is participants' awareness and background. Hamburger, et al. (2019), Miežienė, Šinkariova and Adomavičiūtė (2015), Lee, et al. (2020), Rassart, et al. (2015), Laffel, et al. (2020), Spaans, et al. (2018), and Nikita, et al. (2019) all mentioned that the adolescents participating in the experiment have some limiting factors, such as lacking ethnic background information, social expectations, and self-reporting proficiency, and tend to introduce prejudice when responding to real situations. According to Healey, et al. (2018), self-assessment reports involving parents on behalf of their children tend to introduce bias.

6.2 Future recommendations

In summary, in addition to the use of nursing theory, grounded theory is suitable for research on diabetic patients. Grounded theory is characterized by problem presentation, data collection and analysis, sample selecting, etc. at the same time, and it is suitable for process research, explaining the description of constituent phenomena or events, which is suitable for exploratory research^[22]. Establishing this framework in mixed research can promote the comprehensive exploration of diabetes influencing factors. In the future study to explore the influential factors to blood glucose control in juvenile diabetes, researchers should consider blood glucose control in the context of different social factors of the participants, rather than merely consider studying sample populations with different backgrounds and expand the sample size. Researchers can use the mixed method to facilitate research, and the survey content will be more comprehensive.

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Ethics approval and consent to participate

All studies strictly followed the requirements of the ethical review board. However, this paper does not involve investigative or interventional research that involves the ethics of the participants, so this regulation is not applicable.

Author contributions

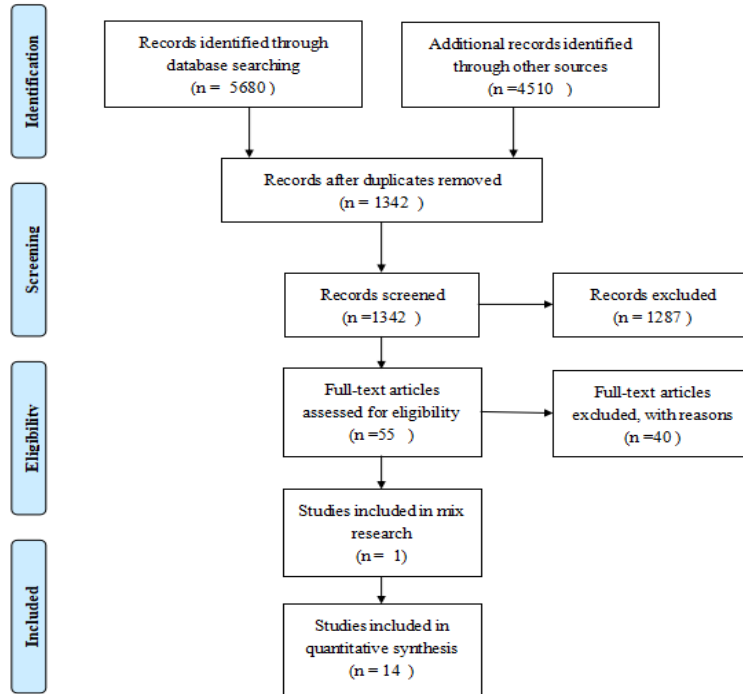
Yang L. and Lin L.J. wrote the manuscript and collected and reviewed the literature on factors affecting glycemic control in juvenile diabetes, as well as evaluating the literature. Zhang L.M. and Xu S.L. also reviewed the literature and participated in the evaluation and provided ideas and manuscript revisions. Lin L.J. and Wang F.G. checked the strengths and limitations of each piece of literature. Yang L. was the main contributors to revising the manuscript, as well as guiding the entire manuscript. All authors read and approved the final manuscript.

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Appendix A:



Appendix B: Search strategies.

Date	01/01/2021-01/01/2024	
Research Topic	The influencing factors of blood glucose control in adolescents with diabetes:A Systematic Review	
Search Strategy	Keywords/ concepts	Synonyms/alternative terminology
	Adolescence	“Adolescence” OR “Teenagers” OR “Juveniles” OR “Adolescents diabetes” OR “Type 1 diabetes” OR “Sugar disease” OR “Young people”
	Diabetes	“Diabetes” OR “Diabetes mellitus” OR “Blood sugar control”OR “Glucose control” OR “Hypoglycemia” OR “BG” OR “Inspect* glucose reason”
Limits	01/01/2017-01/01/2023	
	English	
	Full text	
	Adolescents	
	Peer-reviewed scholarly articles	
Databases	Tralee Library	
	Academic Search Complete	
	MEDLINE	
	CINAHL Complete	
	Health Source: Nursing/Academic Edition	
	AHFS Consumer Medication	
	Google	
	APA PsycArticles	