



Diabetes-Specific Risk-Taking in Young Adulthood: A Closer Look

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Risk-taking behaviors are not a new phenomenon for young adults (YAs) and are an important aspect of understanding decision-making for YAs with diabetes. This article builds on a previous model of diabetes-specific risk-taking by providing other examples of risky situations and behaviors that are specific to YAs with type 1 diabetes, reviewing models of risk-taking behavior, and discussing how these models might inform clinical care for YAs with diabetes.

Despite advances in type 1 diabetes care, adolescents and young adults (YAs) continue to have the highest average A1C values and the highest incidence of life-threatening diabetic ketoacidosis (DKA) of any age-group (1). Many factors help explain why. For example, type 1 diabetes self-management and engagement generally decline during this period, at the same time that most youths take on more independence with their diabetes care. One factor that has received little attention, despite being a normal and common part of adolescence and young adulthood (2), is risk-taking behaviors. Risk-taking behaviors can include healthy (e.g., starting a new relationship or medication) or unhealthy (e.g., substance use) risk-taking. In general, unhealthy risk-taking behaviors such as experimentation with alcohol, drug use, and risky sexual behaviors increase across adolescence and peak in young adulthood (3,4).

We previously proposed that adolescents and YAs may knowingly engage in behaviors that are unhealthy and that some nonadherence behaviors observed in adolescents and YAs with type 1 diabetes may result from risks that individuals take with their diabetes care (5) in favor of meeting other psychosocial goals (e.g., fitting in with peers and having increased independence). Such behaviors, which we termed “diabetes-specific risk-taking” behaviors, focus on behaviors related to type 1 diabetes management or outcomes. Type 1 diabetes risk-taking behaviors can either precede unhealthy self-management choices (e.g., excessive alcohol use can lead to an inability to participate in type 1 diabetes care tasks) or take the form of unhealthy self-management choices (e.g., restricting insulin as an unhealthy weight loss strategy). We sought to explore how and why these risk-taking behaviors may present in

adolescence and young adulthood, including neurodevelopmental considerations (6,7), changes in social contexts (8), and as a part of identity development (9).

Developmental psychologist J.J. Arnett describes the developmental period of young adulthood as having five main features/tasks: 1) identity exploration (who am I?), 2) instability (in love, work, and residence), 3) self-focus (minor obligations to others), 4) feeling in-between (neither an adolescent nor an adult), and 5) possibilities/optimism (unparalleled opportunities for life transformations) (10). Specific to risk-taking behaviors, Brown (9) suggests that these behaviors may help to foster or impede developmental tasks or that people may use these behaviors (e.g., substance use) as a coping strategy to deal with failure in completing these developmental tasks.

Young adults with type 1 diabetes engage in general risk-taking behaviors at similar rates as peers (11–13). Still, it is likely that risky behaviors may look different for YAs with type 1 diabetes, as they may also involve diabetes care tasks (e.g., deciding not to give insulin) and/or may carry risk for more severe health implications related to diabetes (e.g., DKA). The American Diabetes Association Transitions Working Group noted that these general risk-taking behaviors are important to consider in YAs with type 1 diabetes because of their potential to lead to both immediate and long-term diabetes complications (14). Although engaging in risk-taking behaviors involves inherent risk for injury or death, some risk-taking behaviors are particularly dangerous in the context of type 1 diabetes. For example, drinking alcohol puts a person with type 1 diabetes at risk for alcohol-induced hypoglycemia. YAs with diabetes who drink alcohol around others who do not

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know they have type 1 diabetes may incur additional risk because the people around them might confuse symptoms of hypoglycemia for signs of intoxication, resulting in delay of hypoglycemia treatment (15). As noted by Arnett (10), the period of young adulthood is characterized by instability in relationships and residence, making YAs with type 1 diabetes highly likely to be in situations in which other people do not know about their diabetes status or are unaware of how to provide emergency assistance.

Several authors have highlighted specific behaviors that could be particularly risky for adolescents and YAs with type 1 diabetes, including using alcohol, tobacco, and illicit drugs; engaging in sexual behaviors that could result in unintended pregnancy or sexually transmitted diseases; having eating disorders (16); using unsafe driving practices (17); and mismanaging insulin (18). Wasserman et al. (19) directly asked YAs with type 1 diabetes about their experiences in risky situations and with unhealthy risk-taking behaviors (Table 1). Themes of risky behaviors and situations overlapped a bit with those previously proposed (16–18), but new categories of risky behaviors/situations were also identified, including routine diabetes management (e.g., not having a treatment for hypoglycemia when exercising), relationships (e.g., participating in an organized sport without the coach knowing you have type 1 diabetes), substances (e.g., getting so high that it interfered with taking care of diabetes tasks), interactions with the health care system (e.g., deciding to skip a scheduled diabetes appointment), and mental health/well-being (e.g., deciding to just stop managing diabetes for a while) (19).

Some of the risky situations identified by Wasserman et al. map clearly to Arnett's features of young adulthood. For example, Arnett notes that young adulthood is marked by instability (10), and most of the risky situations related to routine diabetes management have to do with new, novel, or unexpected situations that can make starting/maintaining a routine or schedule for diabetes management tasks difficult. On the other hand, risky situations and behaviors related to interactions with the health care system may be unique to YAs with type 1 diabetes and/or possibly other medical conditions.

This article applies examples from Wasserman et al.'s focus group (Table 1) to YA risk-taking models and presents ways to conceptualize the interplay between developmentally typical YA risky decision-making and diabetes-specific risk-taking behaviors.

Models for YA Risky Decision-Making and Risk-Taking Behaviors

Several models for risk-taking behaviors have emerged from distinct research disciplines, including cognitive, emotional,

psychobiological, and social development (20). Taken as a whole, the larger body of risk-taking research suggests that the likelihood of a person engaging in risk-taking behaviors increases if there is a deficit in cognitive capacities and emotion regulation skills (e.g., low or inexperienced executive functioning and emotion regulation), if early physiological developments occur (e.g., earlier puberty), and if the social environment is conducive to risk-taking (e.g., peers engage in risk-taking and less adult supervision) (20). To provide clinical recommendations for how to address risk-taking behaviors in YAs with type 1 diabetes, we first review three prevalent theories for YA risk-taking behavior and provide examples of how these theories might apply specifically to YAs with type 1 diabetes.

Prototype Willingness Model

In 1998, Gibbons et al. (21) introduced a model of adolescent unhealthy risk-taking behavior. In this seminal article, the authors made two main observations: 1) that much of adolescent and YA risk-taking behavior is based on unplanned reactions to risky situations and opportunities and 2) that willingness to engage in risk-taking behaviors and intention to engage in risk-taking behaviors are two distinct constructs that independently predict future risk-taking behaviors (21). Based on these observations, Gibbons et al. concluded that there may be two distinct pathways to adolescent and YA risk-taking behavior: the social-reaction pathway (based on behavioral willingness) and the reasoned pathway (based on behavioral intention) (22). In the social-reaction pathway, adolescents react to a risk-conducive situation (e.g., they are with a group of friends who start to vape, and one friend offers them a "hit"). For this pathway, the decision to engage in a risk-taking behavior (e.g., to vape) is quick and reactive rather than reasoned or intentional. It is possible that this person had no intention of vaping, but instead reacted to an opportunity to do so. Alternatively, in the reasoned pathway, the behavior is thought through with future consequences premeditated (e.g., the person seeks out the opportunity to smoke by buying a vape).

It is possible that diabetes-specific risk-taking behaviors also fall into these two different pathways. One example of the social-reaction pathway could include the following situation: a YA with type 1 diabetes is out to lunch with a new group of peers who do not know that she has diabetes. She decides to skip giving herself an insulin injection because she does not want to have to explain to these new friends that she has diabetes. In this example, this person probably did not think or anticipate that she would be skipping her lunchtime bolus, but instead made a quick decision in response to a socially/emotionally charged situation. Alternatively, a similar risky

TABLE 1 Examples of Risky Behaviors and Situations for YAs With Type 1 Diabetes

Theme	Risky Situations	Risky Behaviors
Routine diabetes management	<ul style="list-style-type: none"> • Having a hard time starting/maintaining a typical routine or schedule for diabetes management • Feeling unprepared to manage diabetes in a new environment or situation (e.g., in a new class or while traveling to a new place) • Feeling unprepared to manage diabetes in an unexpected situation (e.g., during a natural disaster) 	<ul style="list-style-type: none"> • Exercising without supplies to treat a low blood glucose level • Going to bed knowing the pump will run out of insulin before you get up • Trying to “push through” low blood glucose symptoms without treating them • Putting off giving insulin until later
Relationships	<ul style="list-style-type: none"> • Feeling like there was no one who could share some of the burden of having type 1 diabetes • Needing help treating a low blood glucose level but did not have anyone around who could help 	<ul style="list-style-type: none"> • Participating in an organized sport or activity without telling the coach about having diabetes • Working at a job without the supervisor, boss, or Human Resources staff knowing you have diabetes • Living with a roommate who does not know about your diabetes
Substances	<ul style="list-style-type: none"> • Being unable to recognize symptoms of a low blood glucose level (i.e., the symptoms could be caused by medication side effects, using alcohol/drugs, or some other reason) • Being around other people who are drinking alcohol/using tobacco or other drugs 	<ul style="list-style-type: none"> • Drinking alcohol when no one around knows about your diabetes • Going to sleep after drinking alcohol with no plan for checking blood glucose during the night • Getting so high you cannot take care of your diabetes
Health care system	<ul style="list-style-type: none"> • Being without medical insurance • Being without a diabetes medical “home” for >6 months • Needing help from a diabetes care team but not being able to access it • Feeling that you could not be honest with a diabetes care team 	<ul style="list-style-type: none"> • Deciding to manage diabetes differently from how the diabetes care team recommended • Deciding to skip a scheduled diabetes appointment • Rationing insulin or diabetes supplies so they will not run out
Mental health/well-being	<ul style="list-style-type: none"> • Being so sleep deprived it is hard to manage diabetes • Feeling that anxiety or depression has interfered with managing diabetes • Feeling that the burden of type 1 diabetes is “too much” • Feeling that losing weight is more important than diabetes health* 	<ul style="list-style-type: none"> • Deciding to just stop managing diabetes for a while • Intentionally taking less insulin than needed* • Using insulin or diabetes supplies to hurt or punish yourself* • Deciding to stop taking care of diabetes to hurt or punish yourself*

*Added after the focus group based on clinical observations and discussions with other diabetes psychologists; not yet verified by YAs with type 1 diabetes.

behavior might occur via the reasoned pathway. For example, a YA with type 1 diabetes has an important exam in his next class period and does not want to have to ask the professor to leave in the middle of it or for an extended time. Thus, he decides to forgo taking insulin at lunch to purposefully keep his blood glucose high so he does not have to leave or pause the exam because of hypoglycemia. Of note, the reasoned pathway in this example is not void of emotion, but the social-reaction pathway seems to be primarily driven by emotion with little consideration of alternatives because the YA is willing to take this risk; in the reasoned pathway, the model proposes that there may be more deliberation of options before the decision to take the risk.

In this model, Gibbons et al. also note the importance of social influences. They argue that prototypes (an individual's idea of what it means to be someone who engages in the risk-taking behavior) play a strong role in both pathways to risk-taking (21). For example, some YAs who are in college and serious about their studies/career may think that a “good student” is one who makes sacrifices to achieve “good grades.” For YAs without type 1 diabetes, this “good student” prototype may present in the form of sacrificing one's health (e.g., studying until late hours in the night, sacrificing sleep, or sacrificing healthy eating so that one spends less time cooking and has more time for studying). In the type 1 diabetes example above, in which the student decides to forgo taking insulin during an exam, it is possible that

this action might contribute to a willingness to sacrifice diabetes-related health because it fits the prototype of being a “good student.”

Researchers who tested the Prototype Willingness model in varying age-groups concluded that there may exist a developmental shift from the social-reaction pathway to the reasoned pathway as experience with behavior (22) and age (23) increase. For example, a person's first experience drinking alcohol may occur because of an opportunity (e.g., the person is offered a drink at a party) but then may become subsequently sought out (e.g., the person buys alcohol for the next party). Additionally, some risky behaviors become more socially appropriate with age (e.g., alcohol use), as we generally assume that age may bring a higher level of maturity and competence in managing a potentially dangerous behavior (e.g., legal drinking at 21 years of age). Thus, it is possible that individuals' prototype of someone who engages in a risky behavior (e.g., someone who drinks alcohol) becomes more favorable, as they themselves reach an age at which the behavior is more socially acceptable (e.g., the legal drinking age).

For YAs with type 1 diabetes, it is possible that the first time they engage in risky decision-making around diabetes care is “by accident” via the social-reaction pathway. For example, perhaps a person is traveling on vacation and is so busy and out of her usual routine that she does not think about checking her blood glucose for more than 24 hours. However, this risky behavior (not knowing one's blood glucose for an extended period of time) may be sought out in the future via the reasoned pathway (e.g., the next time she has a busy travel day, she decides ahead of time not to check her glucose until she arrives at her destination to reduce any worry about blood glucose during the day and focus on the task of traveling).

Hot Versus Cool Executive Functioning

Another model applied to risky decision-making is that of hot versus cool executive functioning. As discussed in more detail in a previous publication (5), Steinberg's dual systems model posits that adolescents and YAs are particularly vulnerable to making risky decisions because of a gap in brain development between an earlier developing limbic system, which regulates social/emotional rewards, and the pre-frontal cortex, which regulates impulse control and executive functioning (EF) (7). EF tasks are cognitive tasks that involve planning/reasoning, organization, follow-through, social appropriateness, and problem-solving (24) and develop in spurts over the course of childhood and into late adolescence/young adulthood (25). Although it is possible that many, if not most, people reach full capacity for EF tasks by young adulthood, Zelazo and Carlson (26) note that there may still be differences in a

person's ability to use EF in emotionally salient (“hot EF”) situations versus affectively neutral (“cool EF”) situations.

To apply this model to a situation common for YAs with type 1 diabetes, take the example of treating low blood glucose. In a cool setting without competing attentional or emotional demands, the task of treating a low blood glucose level might require the following EF tasks: 1) self-monitoring (recognizing symptoms of low blood glucose and verifying via fingerstick or continuous glucose monitoring), 2) attentional control (shifting attention from the current task to that of treating the low blood glucose), 3) initiation (starting the process of treating the low blood glucose level), and 4) working memory (remembering to check blood glucose again in 15 minutes to see if it has gone up). In a hot setting such as during a busy shift at work, YAs with type 1 diabetes must complete all of the “cool EF” tasks while also communicating to others the need to take a break to check and treat the low blood glucose, managing their physiologic symptoms of hypoglycemia and emotional reaction (e.g., frustration that they have to stop what they are working on, embarrassment, or feeling like they are not pulling their weight with the busy shift), and maintaining focus on treating the low.

The model suggests that adolescents and YAs might be able to execute EF tasks in cool contexts more easily than in hot contexts. Thus, YAs with type 1 diabetes might appear ready for more responsibility (e.g., know how to explain to others that they have type 1 diabetes) in the cool context of a doctor's office or at home, but may still struggle in hot contexts such as with friends or in emotionally charged situations (e.g., when meeting their college roommate for the first time). Another aspect to consider that might apply for YAs with type 1 diabetes is that temporary reductions in the ability to execute EF tasks (27) may not just be in hot situations, but could also be the result of increased cognitive load, lack of sleep, and—specifically for YAs with type 1 diabetes—low or high blood glucose (28,29), all of which affect cognitive processing.

Emotion Regulation

The final model we highlight in this review is Gross and Thompson's model of emotion regulation (30). Gross and Thompson argue that emotion is paramount to any decision—risky or not and cool or not—and that the type, timing, and intensity of emotion lead to healthy versus unhealthy decision-making. Gross builds on this idea that emotions are not inherently good or bad but can be helpful or hurtful, focusing on the idea that people become motivated to change emotions when they are the wrong type, occur at the wrong time, or present at the wrong intensity level (31). Attempts, whether automatic or effortful, to influence which emotions arise, when they arise, and how they are experienced and expressed to

others are what Gross describes as “emotion regulation” (31). He provides a model for how an emotion arises and how emotion may be regulated at various points in the sequence of emotion development. Figure 1 is a recreation of this model.

To apply the model to a situation that might occur for a YA with type 1 diabetes, take the situation of a YA woman telling a new roommate that she has diabetes. The “situation” is that she is meeting her new college roommate for the first time and should tell her that she has type 1 diabetes. “Attention” is how much she is thinking about how, when, and whether she will tell her roommate (e.g., ruminating about how badly the roommate will respond). “Appraisal” is what she thinks of the situation given her goal of telling the roommate (e.g., How familiar is it? How important it is? Or, perhaps she has been bullied for having diabetes in the past and presumes this is a bad situation). Finally, the “response” is her emotional and physical response that emerges from the previous aspects of the situation (e.g., she might feel sweaty, have a racing heart, or have thoughts about being rejected, consistent with the emotion of fear). Of note, a person’s response can also change the situation. For example, the young woman in this situation may decide to postpone telling her roommate, thus delaying the current situation.

Gross’ theory of emotion regulation, however, postulates that whether or not a person is aware, there are points during an experience in which the person could change or alter (i.e., regulate) his or her emotions using one or more of five emotion regulatory processes. Situation selection refers to the actions that make it more or less likely to be in a situation that will evoke wanted (or unwanted) emotions. In this example, the YA with diabetes may manage anxiety by choosing not to engage in the situation of telling her roommate. Although this choice contributes to longer-term risk, it regulates the emotion in the moment. Situation modification typically refers to altering the situation or environment to affect its impact. The YA with diabetes might manage features of the situation by waiting until she is alone with her roommate or including a parent in the discussion. Attentional deployment includes strategies that

direct attention to cues that reduce (or enhance) the targeted emotion. The YA with diabetes may avoid eye contact with the roommate or focus on explaining the use of her testing supplies to decrease the emotional intensity of the interaction. Cognitive change refers to altering the ways in which one interprets a situation to change its emotional effect. For example, reappraising the situation as an opportunity to become closer with the new roommate rather than a source of embarrassment may decrease feelings of anxiety and increase feelings of competence for the conversation. Finally, response modulation occurs after the emotion has begun and refers to attempts to influence the experience (often physiological) of the emotional response. The YA with diabetes might take deep breaths to slow her heart rate and the associated physical sensations of anxiety (32).

Overall, Gross’ model has implications for any situation in which decision-making occurs. In fact, recent studies have also identified emotion regulation as an important contributing factor to diabetes distress and subsequent decreased engagement in self-management and higher A1C for adults with type 1 diabetes (33). Indeed, it is possible that this model could help to explain how people might have very different emotional reactions to the same situations (e.g., seeing a low number on a blood glucose meter, having a stubborn high blood glucose level that will not go down despite several boluses of insulin, or having a technology failure with their continuous glucose monitoring system). In any of these situations, the type of emotional response and conscious or unconscious emotion regulation strategies a person adopts may lead to safer or riskier decisions.

Model Limitations and Other Clinical Considerations

One drawback about the models discussed in this article is that they do not include much discussion or consideration of social determinants of health (SDOH). Social determinants, including society institutions, ideologies, and inequalities (34) certainly play a role either directly or indirectly in experiences of YAs that may make it more or less likely for them to be in a risky situation. The prototype willingness model touches on the idea that societal stereotypes and stigmas can play a role in the prototypes that inform a YA’s decision-making. However, there are many other ways that SDOH might affect risky situations and behaviors for YAs with diabetes, and the models do not address or manage these factors well. For example, SDOH might affect resources available to YAs with type 1 diabetes (e.g., insurance status), exposure to risky situations (e.g., insufficient housing), trust of the health care system (e.g., feeling that the medical team does not understand or is not acting in their best interest), having a present versus future perspective (35) (e.g., focusing

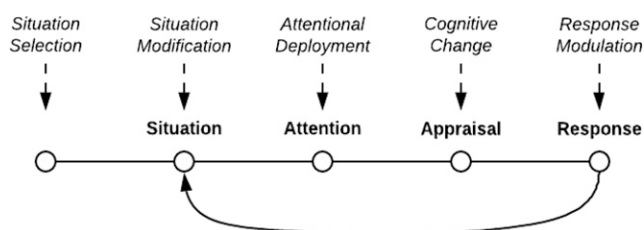


FIGURE 1 Recreation of Gross’ process model of emotion regulation, with the features of emotional experience shown in bold (the modal model of emotion) and categories of emotion regulation strategies shown in italics.

on getting through the day rather than on the long-term effects of chronically high blood glucose), having family/social support versus antisocial influences (e.g., a caregiver or friends with substance abuse disorder), and reliance on “chosen family” versus traditional family (e.g., leading to conflict regarding who receives formal diabetes education and support by the medical staff).

Here, we specifically discussed examples of risky situations and behaviors reported by YAs with type 1 diabetes (19). However, it is possible that the same models and frameworks might apply to risk-taking behavior in YAs with type 2 diabetes or other medical conditions. Wasserman et al. (19) were the first to present descriptions of risky situations and behaviors for YAs with type 1 diabetes. Further research is necessary to explore risky situations and behaviors that YAs with other medical conditions such as type 2 diabetes experience. It is possible that risky situations and behaviors may be similar and/or different among YAs with type 1 versus those with type 2 diabetes. For example, type 2 diabetes is more likely associated with obesity; thus, risky behaviors may include more of a focus on dietary and weight management decisions.

Opportunities for Addressing YA Risk-Taking

Once we reconceptualize and understand the complexity of diabetes-specific risk-taking situations and behaviors that may have previously been described as “patient non-compliance,” it may become possible to apply the vast and well-established literature on risky decision-making and risk-taking prevention to identify ways to support YAs with type 1 diabetes. Three overarching conclusions from this review may help to guide the type of clinical care providers can offer to reduce unhealthy YA risk-taking behaviors.

First, the context in which YAs engage in risky behaviors is extremely important to understand. The context has implications for whether a YA has an opportunity to engage in risky behaviors and may affect the YA's functioning directly, depending on the “temperature” of the situation. Asking a YA what led up to making a risky decision and what was positive about making that decision can be quite unexpected to the YA but can offer insights to help in exploring alternate decision points.

Second, prevention is key. For many reasons, the period of young adulthood is primed for risk-taking to occur. Thus, the work to reduce risky behaviors needs to begin before adolescents reach the period of young adulthood. One strategy is to help YAs identify personal reasons for not engaging in risk-taking behaviors to reduce their willingness to engage in them later, if given the opportunity (e.g., in the reactive pathway of the prototype willingness model described above).

Finally, emotions appear to be paramount to decision-making and are especially influential in YA decision-making. Thus, helping YAs identify, communicate, and regulate emotions around diabetes care may help them make healthier decisions and engage in healthier diabetes-related behaviors. Role-playing and working through hot and cool EF scenarios that YAs are likely to experience are potential ways to explore these challenges in a safe environment.

DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

R.M.W. contributed to the conceptualization and execution of the manuscript topic and to the writing and editing of the manuscript. C.D.H., L.G., and S.G. contributed to writing and editing of the manuscript. R.M.W. is the guarantor of this work and, as such, had full access to all the data included and takes responsibility for the integrity and accuracy of the review.

PREVIOUS PRESENTATION

Portions of this article, including findings from the YA focus group, were published in abstract form and presented at the 2020 International Society of Pediatric Diabetes Virtual Conference, 15–17 October 2020.

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