



Original article

Momentary Assessment of Social Context and Glucose Monitoring Adherence in Adolescents With Type 1 Diabetes

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Article history: Received June 4, 2012; Accepted October 5, 2012

Keywords: Type 1 diabetes; Momentary sampling; Adolescents; Adherence; Social context

 A B S T R A C T

Purpose: To investigate the associations between momentary social context and glucose monitoring adherence in adolescents with type 1 diabetes (T1D).

Methods: For 14 days, patients (14–18 years old, T1D duration >1 year) of a pediatric diabetes clinic carried handheld computers that prompted them to report their location, companionship, and attitudes toward companions at the times they usually checked their glucose, and again 30 minutes later to report whether they checked their glucose and, if not, why. Associations between social context factors and checking glucose (adherence) were analyzed using logistic generalized estimating equations and adjusted for age, sex, duration of T1D, and pump use.

Results: Thirty-six participants (mean age 16.6 ± 1.5 years, mean duration of T1D 8.7 ± 4.4 years) completed 971 context and 1,210 adherence reports, resulting in 805 paired reports. Median signal response rate was 63%. The odds of checking glucose was higher when participants expressed very strong desire to blend in (adjusted odds ratio [AOR] = 2.30, 95% confidence interval 1.07–4.94, *p* = .03). Strong desire to impress others was associated with decreased likelihood of checking glucose (AOR = .52, 95% confidence interval .28–.97, *p* = .04.) Location, solitude, type of companion, and attitudes toward companions were not significantly associated with checking glucose.

Conclusions: Desire to blend in may support glucose monitoring adherence and desire to impress others may impede this behavior in adolescents with T1D. Other dimensions of social context were not linked to checking glucose in this study.

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**IMPLICATIONS AND
 CONTRIBUTION**

Using real-time assessments, this study uncovered the importance of selective social contexts on glucose monitoring behaviors in adolescents with type 1 diabetes. Desire to blend in supported and desire to impress others impeded glucose monitoring, offering providers an avenue to encourage glucose monitoring by preparing adolescents for these environments.

Type 1 diabetes (T1D) is among the most common chronic illnesses in adolescents [1,2]. Effective treatments exist, but nonadherence remains a major source of preventable medical

None of the authors report any conflicts of interest with regards to this manuscript.

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expenditure and suffering [3,4]. Despite advances in technology that facilitate insulin delivery, adherence to diabetes regimens continues to be most difficult during adolescence [5]. Mounting concerns about fitting in with peers [6] and social context (companions, physical environment) [7] converge with physiologic changes [8] and transitions to more autonomy [9], leading to adolescents' tendency to suboptimal glycemic control.

Studies examining how social context affects adherence have primarily investigated the role of friends and families in

supporting adolescents with diabetes [4], with inconsistent findings. Although some studies demonstrate no impact or a negative impact on adherence by friends and family members [10,11], other literature supports increased adherence behaviors such as increased blood glucose monitoring [12] and dietary adherence [13]. Many adolescents mistakenly believed that friends would have negative reactions to their diabetes, leading to poorer adherence in hypothetical situations [7], even though empirical data suggest friends tend to provide encouragement [14]. Data from Australia demonstrate a link between anxiety in social situations and poor adherence in boys, but not in girls [15]. Thomas et al. [16] looked at the differences in children and adolescents with regard to diabetes problem-solving and adherence in social situations. They found that adolescents were less adherent because of concerns about fitting in despite their increasing knowledge about T1D management and consequences. These studies are limited by their use of hypothetical situations or survey instruments that asked participants to answer questions based on assessment of previous behavior, condensing weeks of self-care information into a summary of an adolescent's perceived adherence long after the fact.

These issues can be addressed by using momentary sampling techniques [17], in which participants answer queries about behavior and context as they go about their regular activities. Momentary sampling has been used to study various behaviors in adolescents [18,19] and provides a means to further our understanding of diabetes self-management. Limitations of previous work can be addressed by asking about context, motivations, and factors associated with adherence at a specific moment in real time, ameliorating concerns about recall bias. The method does place burden on participants who need to agree to disruptions in their day and feel comfortable answering questions in a variety of settings. In patients with diabetes, this is further complicated because the demands of participation overlay the substantial demands of disease management and previous work has suggested that adolescents display difficulty sustaining interest in longer but less intense interventions [20]. However, there have been recent studies in adolescents with T1D who have used momentary sampling methods successfully [21,22] over short study periods.

In this study, we used momentary sampling techniques to investigate the associations of location type, companionship, and attitudes toward companions with adolescents' decisions to check their glucose levels according to their routine monitoring schedules. We hypothesized that adolescents would be less likely to check their glucose when in locations that felt public compared with private. We also hypothesized that adolescents would be less likely to check glucose levels when they wanted to blend in or impress those around them. Finally, we thought that adolescents would be more likely to check glucose levels when they felt their companions were supportive of their diabetes care. We explored the associations between these sociocontextual factors and glucose monitoring while adjusting for age, sex, duration of diabetes, and insulin regimen (pump treatment vs. injected insulin). Finally, we evaluated the adolescents' interest in and compliance with the potentially intrusive momentary sampling procedures. By gaining a richer understanding of the role of social context in glucose monitoring adherence, we hoped to learn how to better support adolescents as they face the simultaneous challenges of increasing social demands, assuming increased responsibility for their self-care, and combating the regimen-fatigue that comes with managing chronic illness.

Methods

Participants

A convenience sample of patients 14 to 18 years old with T1D were recruited during their routine visits at a pediatric diabetes clinic in a large northeastern city. To participate, patients had to have been diagnosed with T1D for at least 1 year, be checking their blood glucose at least four times a day, and be able to communicate in English. Fifty-six patients were approached over a 6-month period, with 40 (71%) agreeing to participate. Thirty-seven of 40 participants (92.5%) provided data. In addition, data from one of the participants were irretrievable owing to a hardware malfunction, yielding data from 36 participants for analysis.

Procedure

The study protocol was approved by the clinic institutional review board. Adolescents 14 to 17 years old provided assent and a parent provided informed consent; those 18 years old provided informed consent.

Participants were asked to identify times when they were likely to check their glucose levels each day during the next 2 weeks both in and out of school. Research staff programmed a handheld computer (Palm Tungsten E2 personal digital assistant; CERTAS software, PICS, Inc., Reston, VA) to signal at times that were personalized to fit the participant's expected glucose checking schedule. Participants could have different report times each day of the week to accommodate their schedules.

For 14 days, the computer signaled participants to complete reports for each of four scheduled daily glucose checks, including while at school. For three of the four daily checks, a social context report was signaled at the time of the scheduled glucose check. For all four daily checks, an adherence behavior report was signaled 30 minutes after the scheduled glucose check.

The signal prompting a report about social context was omitted from one of the four scheduled glucose checking times each day with the omitted signal rotating each day to assess the effect of signaling on glucose checking behavior (did signaling at a scheduled checking time change actual checking behavior) and to account for reactivity (did signaling at a scheduled checking time change response to other signals). Thus, there were three context and four glucose monitoring adherence signals daily, for a total of 56 glucose monitoring adherence and 42 social context reports per participant over the 14 days (42 context-adherence pairs of reports per participant \times 36 participants = total of 1,512 possible pairs of reports). Reports took 2 to 3 minutes to complete.

After the study visit, data regarding diabetes management (i.e., insulin regimen, frequency of daily blood glucose monitoring, HbA1c at enrollment visit) were obtained from the medical record. After 2 weeks, adolescents were asked to complete a paper-and-pencil survey about study burden and return the survey and handheld computer by mail. Remuneration was based on signal response rate with completion of >70% of reports required for full compensation of \$100.

Measures

The social context questionnaire was informed by previous research [23] but developed for this study. The report assessed, at the time of a scheduled glucose check, the participant's location (school, house, transportation, recreational space, public

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