

Research Article

## Glucometer Manipulation in Adolescents with Type 1 Diabetes Mellitus

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### Abstract

This study sought to determine the frequency of and reasons for manipulation of glucometers in adolescents with Type 1 diabetes. Using a cross sectional study design, adolescents with Type 1 diabetes who attended Baystate Pediatric Endocrinology Clinic, completed a brief, confidential questionnaire assessing intentional glucometer manipulation. Eligible subjects were aged 12-22 years with a Type 1 diabetes diagnosis for greater than two years. One hundred thirteen teenagers (mean age  $16.7 \pm 2.7$ ) with Type 1 diabetes for an average of 8.7 years ( $\pm 4.2$  years) and an average A1c of 8.7% (SD=1.5) participated in this study. Fourteen (12.4%) teenagers admitted to intentionally manipulating their glucometer, reasons included: high readings make them feel bad (55.8%), make their parents upset (61.1%), and make their doctors upset (54.0%). Clinicians caring for adolescents with type 1 diabetes should be aware of the possibility and implications of glucometer manipulation.

**Keywords:** Diabetes Mellitus; Type 1; Adolescent; Blood Glucose; Patient Compliance; Patient Adherence

### Introduction

Type 1 diabetes mellitus is one of the most common chronic diseases affecting adolescents. With the onset of adolescence comes the desire for greater autonomy and control over one's life and body. As a result, adolescents with type 1 diabetes start to assume a more active role in their disease management, and the transition from parental control to patient control occurs. While some adolescents do a very good job with their diabetes management, others will use their newly granted autonomy as a chance to rebel and manage their disease on their own terms. Thus, commonly there is a deterioration in diabetes management during this time period, particularly around ages 14-15 [1]. Despite the commonalities of rebellion and need for independence, the adolescent years are also marked by a strong desire for

approval and acceptance. Most adolescents desire successful achievements and the concomitant approval and pride of their parents. Moreover, teenagers often lie in order to gain such approval and minimize the potential for (their parents') disappointment [2]. Anecdotally, we have observed that doctors who have been treating these patients since childhood may take the role similar to a surrogate parent, thus the adolescent's desire to please and the need to rebel may be seen within the doctor-patient relationship.

While there is some literature to show that the adolescent years are a time of poor diabetes control, more research is needed to explore why and how adolescents aim to control their illness. By gaining a better understanding of such information, we may be able to impact the delivery of care of adolescents with diabetes.

Glucometers play a critical role in type 1 diabetes management by providing real time feedback, aiding decisions in insulin dosing, tracking blood glucose (BG) trends, and detecting hypoglycemic episodes [3]. Many of today's glucometers have a lengthy memory capacity and can be downloaded at patient visits. Glucometer information is used in conjunction with Hemoglobin A1C (HbA1C) measurements to determine how well patients are managing their illness between visits.

In clinical practice there are sometimes discrepancies between meter averages and HbA1c results. Given various studies documenting high levels of accuracy and precision in modern glucometers when used correctly and their ease of use [4], the question is raised whether some patients are intentionally manipulating glucometers. Despite the suspicion, published material on this topic is limited; our literature search found only one case report [5].

Our primary objectives were to determine the frequency with which adolescents try to manipulate their glucometers and to understand the reasons why they may do so. As secondary aims, we explored the ways in which adolescents try to manipulate their meters and examine whether those who manipulate their meters may differ (age, gender, A1c) from those who don't.

## Materials and Methods

We conducted a cross sectional study. Subjects were recruited over a 3 month time period from Baystate Pediatric Endocrinology Clinic, Springfield, MA. Approximately 400 adolescents with Type 1 diabetes attend this clinic. Eligible subjects were aged 12-22 years and had a Type 1 diabetes diagnosis for greater than 2 years. Individuals with a diagnosis of a developmental disability were excluded. Eligible subjects who expressed an interest in participating completed a written informed consent, approved by the Baystate Health Institutional Review Board.

Since, to our knowledge, no other questionnaire assessing intentional glucometer manipulation existed, we created such a tool. The brief (approximately 5 minutes) questionnaire (see Appendix) consists of 16 questions related to demographics, blood sugar control preferences, glucometer habits, and glucometer manipulation. Subjects were approached by a pediatric endocrine research nurse or resident (SDP) at their routine diabetes clinic visit. Subjects filled out questionnaires by themselves in a private room and then put the completed questionnaire into a locked box. Average blood glucose, glucose variability, average number of daily glucose checks over the previous two weeks (from glucometer), and a baseline HbA1c were collected.

Following administration of the surveys, data was scanned into an analytic file using Remark Office OMR 8 software. Logic checks were conducted on the scanned data and random records were verified following the scanning process. Subsequent data analysis was conducted using Stata v12.1.

## Results

Overall, our sample consisted of teenagers (mean age  $16.7 \pm 2.7$ ) with Type 1 diabetes for an average of 8.7 years ( $\pm 4.2$  years) and had an average A1c of 8.7 (SD=1.5). The majority of our sample was Caucasian (91.2%) and non-Hispanic (85.0%).

Among all 113 subjects, at least 12% admitted to intentionally manipulating their glucometer, and these adolescents appeared to be similar to non-trickers in terms of subject characteristics (Table 1).

**Table 1.** Subject Characteristics

	Overall n=113	Trickers n=14 (12.4%)	Non-Trickers n=99 (87.6%)
Age			
mean $\pm$ sd	16.68 $\pm$ 2.67	15.86 $\pm$ 3.18	16.80 $\pm$ 2.59
Years with Diabetes			
mean $\pm$ sd	8.74 $\pm$ 4.17	7.07 $\pm$ 3.77	8.98 $\pm$ 4.19
A1c (%)			
mean $\pm$ sd	8.69 $\pm$ 1.49	9.14 $\pm$ 1.77	8.63 $\pm$ 1.44
missing: n(%)	2 (1.8)	0	2 (2.0)
Blood Glucose Checks			
mean $\pm$ sd	3.48 $\pm$ 2.16	3.93 $\pm$ 1.90	3.42 $\pm$ 2.20
missing: n(%)	13 (11.5)	2 (14.3)	11(11.0)
Mean Blood Glucose			
mean $\pm$ sd	210.2 $\pm$ 53.8	215.4 $\pm$ 46.2	209.5 $\pm$ 55.1
missing: n(%)	11 (9.7)	1 (7.1)	10 (10.1)

Race			
Caucasian/African American	103 (91.15)	12 (85.71)	91 (91.92)
Other	7 (6.19)	1 (7.14)	6 (6.06)
Missing	3 (2.65)	1 (7.14)	2 (2.02)
Gender			
Female	52 (46.02)	6 (42.86)	46 (46.46)
Missing	0	0	0
Insulin Administration			
Pump	67 (59.29)	11 (78.57)	56 (56.57)
Injections	45 (39.82)	2 (14.29)	43 (43.43)
Missing	1 (0.88)	1 (7.14)	0
Type of Meter Used			
One Touch	87 (76.99)	11 (78.57)	76 (76.77)
Free Style	20 (17.70)	1 (7.14)	19 (19.19)
Other	5 (4.42)	2 (14.29)	3 (3.03)
Missing	1 (0.88)	0	1 (1.01)

When restricted to those who admitted to manipulating their glucometer, approximately three quarters said they have rarely (1-5 times) manipulated their glucometer. The remaining quarter admitted to tricking their meters somewhere between 5-50 times (in their lives).

When we asked the entire sample to choose possible reasons for why someone might trick their meter, most subjects endorsed the fact that high readings make them feel bad (63/113, 55.8%), make their parents upset (69/113, 61.1%), and make their doctors upset (61/113, 54.0%) (Table 2).

**Table 2.** Reasons for manipulating glucometer.

	Overall N (%)	Trickers N (%)
High readings make you feel bad	63 (55.75)	10 (71.43)
High readings upset parents	69 (61.06)	10 (71.43)
High readings upset the doctor	61 (53.98)	7 (50.00)

Lower readings give me permission to eat more sugar	29 (25.66)	2 (14.229)
Other	12 (10.62)	1 (7.4)

Some teenagers (25.7%) said a reason to trick the meter would be related to being able to eat sweets (if the number was lower). Among the group of teenagers who admitted to having manipulated their meters, there was a similar pattern of reasons endorsed for trickery. Of those adolescents who provided us with an example of how it may be possible to manipulate the glucometer (n=23), the most frequent (61%) strategy cited was to put something, such as food, on the finger prior to testing. Other less commonly cited strategies included diluting blood with water (13%), taking too much insulin (13%), and using someone else's blood (9%).

As expected, there was a negative correlation between A1c and average number of blood sugar readings per day (-0.443) and a positive correlation between A1c and average blood sugar (0.535). The pattern was similar in trickers and non-trickers (data not shown).

### Conclusion

Based on our clinical suspicions and our observations that there are sometimes discrepancies between meter averages and HbA1c results, we developed what is, to our knowledge, the first study to examine whether adolescents with type 1 diabetes intentionally manipulate their glucometers. We found that 12% of adolescents admitted to tricking the glucometer. A limitation of this study is that we used only the most concrete question of tricking to determine the prevalence of glucometer manipulation. Although this questionnaire was not validated we feel that there is face validity in estimating a lower bound for the prevalence of tricking. While only a small percentage of subjects admitted to having tricked their meters at some point in their lives, a much larger percent (40%) endorsed the assertion that it is possible to alter a number on their meters. Thus, the number of teenagers who manipulate their glucometers is likely to be higher than reported here.

The fact that adolescents report manipulating their meters may have implications for diabetes management. We did not find any distinguishing characteristics (age, gender, A1c, BG average, difference between A1c estimated BG and BG average) that would be helpful in identifying trickers. Clinicians taking care of adolescents with type 1 diabetes should be aware of the possibility of glucometer manipulation.

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discussion of data results.

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