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Motivating Health Behaviors in Adolescents Through Behavioral Economics

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We are not rational beings when it comes to our health. Although we know that our personal behaviors are linked to the development of diseases such as obesity, heart disease, and type 2 diabetes, we still eat unhealthy foods, do not exercise enough, and drink and smoke too much. Our tendency to satisfy short-term interests and discount more impactful long-term consequences is an example of a cognitive bias examined in behavioral economics research.[1,2] This type of cognitive bias is likely magnified for adolescents, and the health consequences are much more serious for youth with type 1 diabetes, who face the development of life-threatening diabetes complications years or decades later if they do not attend to health behaviors, such as blood glucose (BG) monitoring and insulin delivery in the present.

Behavioral economics is a field of study that health researchers are increasingly applying to chronic disease management, designing interventions to overcome human cognitive biases and improve health outcomes. The use of financial incentives to promote positive health behaviors is a feasible intervention approach and has been tested in multiple health conditions among adults but less so in children,[3] which is why the novel work of Wong and colleagues[4] reported in this issue of *JAMA Pediatrics* is of interest.

This study was an investigator-blinded randomized clinical trial of financial incentives for improving daily adherence to BG monitoring among adolescents and young adults aged 14 to 20 years with type 1 diabetes in suboptimal control (hemoglobin A_{1c} [HbA_{1c}] >8.0% [to convert to percentage of total Hb, multiply by 0.01]). The authors incorporated the concept of loss aversion in their monetary incentive system, as behavioral economic theory suggests that given the same quantity of reward, individuals would prefer to avoid losses rather than acquire gains. The participants were given a $60-monthly incentive in a virtual account during a 3-month period. On a daily basis, the participants were required to perform a minimum of 4 BG checks, with least 1 of the BG levels in range (70–180 mg/dL [to convert to millimoles per liter, multiply by 0.0555]). For every day that they did not meet this goal,

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$2 would be removed from their account. After the 3-month intervention period, the participants were monitored for an additional 3 months with no incentives.

Both groups improved in the primary outcome of HbA_{1c} levels and the difference was not statistically significant. The study was powered to detect an ambitious 1.0% difference. The intervention group had greater improvement in the secondary outcome of adherence to BG monitoring goals (50.0% for intervention vs 18.9% for controls). In the follow-up period, there was no significant difference in either adherence to BG monitoring goals or HbA_{1c} levels.

The ultimate goal of any incentive-based program is to move the needle on glycemic control. Although it was encouraging that BG monitoring adherence was significantly higher in the participants during the intervention period, the lack of difference in the primary outcome indicates that the mechanisms of glycemic control are only partly related to monitoring BG. The authors targeted BG monitoring as a behavioral outcome as it is a critical element of diabetes self-management that provides the opportunity to see BG trends and prevent or correct high blood glucose levels.[5] However, no amount of BG monitoring will be effective for lowering HbA_{1c} levels unless the administration of insulin is optimally timed and dosed to correct BG levels.

Alternatively, it is possible that an adherence goal of 4 checks per day may have been too low a threshold to have an overall effect on glycemia, given that the mean number of BG checks at baseline were 3.91 and 3.96 for the control and intervention groups, respectively. Observational studies have shown that the greater the number of BG checks per day the lower the HbA_{1c} level.[6] Future studies may need to incentivize a higher minimum number of BG checks per day.

An interesting twist to the study design is that the authors encouraged an outcome variable of at least 1 “in range” reading per day, which could have motivated increased adherence to insulin administration to better control BG levels. However, the authors found that the majority of days of nonadherence during the study were due to an insufficient number of BG checks. Furthermore, it is unclear whether 1 in-range value per day would be clinically relevant in improving glycemic control for these adolescents and young adults. It may be important in future interventions to target the frequency of insulin administration as a behavior rather than just BG monitoring, but there are current practical barriers to objective measurement of this behavior, as the majority of youth are not using Bluetooth-connected insulin pens and access to raw data from insulin pumps is not readily available.

There have been a few other behavioral economic interventions conducted in adolescents with type 1 diabetes, all of which have targeted BG monitoring as the behavioral out-come. Raiff et al[7] conducted a randomized clinical trial that also targeted monitoring of blood glucose in 41 adolescents with type 1 diabetes who were completing fewer than 4 BG checks a day. Participants in the intervention group earned incentives only if they demonstrated at least 4 BG checks a day using a web camera, compared with participants in the control group who earned incentives independent of their BG monitoring behaviors. In contrast to participants in the Wong et al study,[4] they had to actively earn their monetary rewards, with the possibility of earning up to $11 per day. However, the duration of the study was short with 20 days of treatment followed by 20 days of follow-up; no significant differences in BG levels were found.

Additional small pilot studies have used incentives in adolescents with type 1 diabetes. One study of 10 adolescents with type 1 diabetes were paid $0.10 per test with increasing bonuses up to day 9 for 4 or more tests per day, and a $251.40 maximum over the 12-week period.[8] That study found that the frequency of BG monitoring increased from 1.8 to 4.9 tests per day and mean HbA_{1c} levels decreased from 9.3% to 8.4%, but this difference was not statistically significant and there was no control group. Finally, another study of 17 adolescents with type 1 diabetes used financial incentive strategies, but it was part of a larger multicomponent intervention that also incorporated motivational interviewing and cognitive behavioral therapy, which makes the effects of the financial incentives on outcomes difficult to disentangle.[9]

The Wong et al study[4] provides some evidence of the short-term potential of financial incentives in health behavior interventions. As medical devices are increasingly becoming connected to the cloud and a majority of adolescents have mobile phones, there is opportunity for further experimentation in the arena of behavioral economics to answer the following questions: Do adolescents respond better to loss aversion or gains in rewards? What types of behaviors should optimally be targeted using financial incentives? What amount of financial reward is needed to affect behavior change and is there a threshold value? What are the developmental consequences of providing extrinsic motivation for health behaviors in adolescence (ie, financial incentives) and could it affect their intrinsic motivations for health behaviors?

Regardless of the relative feasibility and our enthusiasm for a new incentive-based technology paradigm for chronic disease management, we must caution that interventions that target a single behavioral process, such as frequency of BG monitoring, may not be as effective as multicomponent interventions that address emotional, social, or family processes to help facilitate diabetes self-management in the long-term.[10] Therefore, incentive-based approaches will likely need to be integrated with other intervention components to achieve a sustainable or meaningful effect on health outcomes in adolescents.

Conflict of Interest Disclosures:

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