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Commentary Article

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Diabetes Patients Can Improve Satiety by Practicing Healthy Lifestyle Habits

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Abstract

Healthy eating and safe exercise are known to help with the management, remission, and prevention of type 2 diabetes. Unfortunately, few people are practicing healthy habits, and the prevalence of diabetes is going up. The barriers to overcome include busy lives, resistance to change, feelings of deprivation, unhealthy cultural practices, no referral to certified diabetes care and education specialists, food and medication insecurity, fear of exercise due to the risk of hypoglycemia, and glycemic dysregulation with the wrong choice of exercise. This paper shows that practicing healthy lifestyle habits is the key to improved satiety along with improving most metabolic parameters.

Introduction

In spite of extensive efforts to control diabetes with the help of healthy meals, exercise, and medications, the prevalence of diabetes is on the rise [1]. Healthy lifestyles help with management , prevention, and remission of type 2 diabetes [2-5]. The 2021 National Health and Nutrition Examination Survey (NHANES) found only 21% of US adults diagnosed with diabetes reached their goals for A1C, blood pressure, and LDL cholesterol [1]. Siegel et al. reported that less than 3.1% of adults without diabetes met most of the type 2 diabetes risk reduction goals – healthy meals, physical activity, and little or no alcohol [6]. Moreover, according to two early surveys, only 6.8 to 13.4% of people with diabetes were getting health education visits from certified diabetes care and education specialist (CDCES) or nutritionist [7,8]. In 2020, the ADA concluded, "Despite proven benefits and demonstrated value of diabetes self-management education and support (DSMES), the number of people with diabetes who are referred to and receive DSMES is significantly low" [9]. On the other hand, a systematic review and meta-analysis of randomized clinical trials that focused on diabetes prevention approaches brought some encouraging news: medications and lifestyle modifications reduced diabetes incidence. The medication effects were short-lived. Lifestyle modifications, however, were sustained for several years [10]. Promoting healthy lifestyle habits is, no doubt, worth the effort.

Healthy lifestyle habits typically include a well-balanced diet, regular physical activity, control of body weight and blood pressure, non-smoking, and little or no alcohol consumption. Now there are solid data supporting additional healthy habits [11-22]. Although the effects of meal composition on glycemia are well established, and included in the ADA guidelines [2], many people with diabetes are unaware of the glycemic benefits of meal timing. For example, the century-old second-meal phenomenon and the significance of early eating remain underrecognized [11-20]. In many cultures, a big supper late in the evening is the norm. Eating a big supper late, followed by several hours of inactivity combines two practices that can raise supper postprandial glucose (PPG) [18-20] leading to increased liver fat and high fasting glucose (FG). Metabolic benefits of early eating, including upregulating circadian clock genes, and the effects of meal timing, in general, have received recent attention [14-17,21,22].

Unlike meal-related habits with fairly straightforward glycemic effects, the effects of exercise on glycemia are quite complex: hyperglycemia or hypoglycemia can occur with certain types of physical activities. Studies in various populations have shown the negative and positive effects on glycemia of pre-meal and post-meal exercises [21]. Minimizing the negative effects on glycemia of any exercise is a desirable goal for people with diabetes, but many patients may not know how to accomplish this.

Pre-meal exercise comes with two negative glycemic effects. One is post-exertion glucose elevation which leads to glucose dysregulation for 1-3 hours after the physical activity [23]. The second problem is delayed hypoglycemia following high-intensity exercise in people on insulin [24]. A fasted state training study with endurance exercise done three times a week for 12 weeks, in type 2 diabetes patients showed many health benefits including better

Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) (4.5 to 4.0) [25]. A1C (7.4 to 7.7%) and C-reactive protein (1.2 to 1.5 mg/L) were, however, worse. My CGM data have repeatedly shown that the negative effects of pre-meal exercise can be easily minimized by keeping the intensity of the activity moderate and by opting for a relatively light meal after the exercise [21,22,26].

Minimizing the negative effects, however, of post-meal exercise is more challenging: timing of the exercise and energy expenditure both have to be right [27,28-35]. A 12-week training study in people at risk for diabetes using 30-minute of light activity, daily, 30 minutes after the meal [35] improved body weight, LDL cholesterol, and waist circumference, but there was no significant glycemia benefit: energy expenditure seemed too low. When Verboven et al. did the post-meal training study three days a week for 12 weeks in T2D patients with appropriate timing and energy expenditure (60-minute post-meal, 65%VO2peak, and 60-minute duration), A1C (6.6 to 6.3%), and C-reactive protein (1.6 to 0.9 mg/dL) improved [25].

Monitoring FG daily is an important part of diabetes self-management [22,36]. This is because FG impacts postprandial glucose and A1C. Normal FG signifies sound diabetes management and optimal insulin use [37]. FG is sensitive to many factors and learning how to keep it in the target range is an essential part of diabetes management. Monitoring post-supper PPG as needed is also valuable for diabetes management since it influences FG.

I was a practicing physician when I got my diagnosis of T2D at age 50. My primary care physician (PCP) sent me to certified diabetes care and education specialist (CDCES) and I got the proper training. Still, I was not proactive for 14 years and I now regret the damage I likely inflicted on my pancreas and liver. For my first weight reduction program, I went on a pre-breakfast walk followed by a regular breakfast, each day. In four months, my weight decreased 14% but neither A1C nor HDL cholesterol improved [26]. It took 18 years for me to learn how to minimize the negative effects of exercise on glycemia from research findings and my own CGM data [26]. I almost died twice with severe hypoglycemia (25 and 15 mg/dL) causing seizures. I realized managing diabetes is an uphill battle for most people, and especially for hypoglycemia-prone individuals. The barriers to overcome include busy lives, resistance to change, feelings of deprivation, unhealthy cultural practices, no referral to CDCES, food and medication insecurity, fear of exercise due to risk (or perceived risk) of hypoglycemia, and glycemic dysregulation with the wrong choice of exercise [26]. I have been testing research findings in a diabetes self-management mode ever since I gained access to a CGM. This account focuses on how to improve satiety for diabetes patients by practicing healthy habits.

Improving satiety

Many people with diabetes feel deprived at mealtime. When family members eat ice cream or apple pie or both, they feel left out. Some may choose to partake of a small bite out of the forbidden food. Others may feel defiant and go for the full portion. The feeling of deprivation is one factor contributing to non-adherence to healthy habits in many diabetes patients. This account illustrates how people with diabetes can safely eat three regular meals (plus 1-3 small snacks) a day and improve satiety by practicing healthy meals and safe exercise activities.

CGM data

I now use a continuous glucose monitoring (CGM) device as a practical remedy for impaired awareness of hypoglycemia. I have been practicing a new lifestyle involving a five-step diabetes management program for minimizing hypoglycemia [22]. Meal timing and meal composition are optimal [21,22]. Nutrient sequencing is used on and off. Meals include a morning snack, regular breakfast and lunch, afternoon snack, and light supper. When it comes to exercise, a pre-meal exercise day (PreEx day) is alternated with a post-meal exercise day (PostEx day). The PreEx day starts with a 30 to 60-minute pre-breakfast walk followed by a morning snack and a regular breakfast 90-120 minutes later. The PostEx day includes a timely post-meal exercise after any big meal per high alert from the CGM (set at 150 mg/dL) [22]. Medications have been metformin, 1000 mg twice a day, and semaglutide, 1 mg by injection once a week. Carb servings are adjusted as needed.

I got a surprising glucose profile on August 25, 2021 (Figure 1 A), a post-meal exercise day with fasting glucose of 114 mg/dL. Both breakfast and lunch had postprandial glucose (PPG) above 180 mg/dL: 214 and 201 mg/dL, respectively. I decided not to eat any more carbohydrates the rest of the day: snacks and early supper included lean protein, non-starchy vegetables, healthy fat (a slice of avocado), and nuts. Time in range (TIR), daily mean glucose (MG) and fasting glucose (FG) the next day were 94%, 119 mg/dL, and 96 mg/dL, respectively.

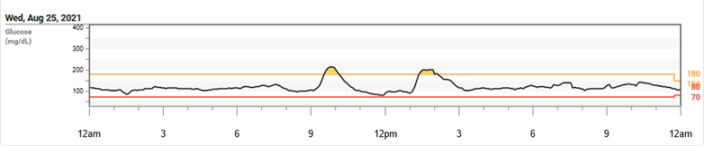

Figure 1A. Glucose profile of August 25th showing breakfast PPG, lunch PPG, TIR, MG, and FG of the 26th: 214 mg/dL, 201 mg/dL, 94%, 119 mg/dL, and 96 mg/dL.

I expected, since FG was normal on August 26 after being high for 11 days, PPGs would be moderated and I would enter a virtuous cycle. I decided to do my pre-meal walk and eat identical meals except for a big supper the second day (Figure 1B). I had a balanced, two-carb supper containing barley as the main carb and I did a brisk walk for 20 minutes at 45 minutes after the start of supper. TIR, MG and FG (next day) were 100%, 108 mg/dL and 101 mg/dL, respectively.

On the third day, August 27, I continued the same meal plan as on the second day but the supper was consumed late (Figure 1C). I exercised after breakfast and lunch but not after supper. The supper

PPG was 212 mg/dL. TIR, MG and FG (next day) were 94%,121 mg/dL and 111 mg/dL respectively.

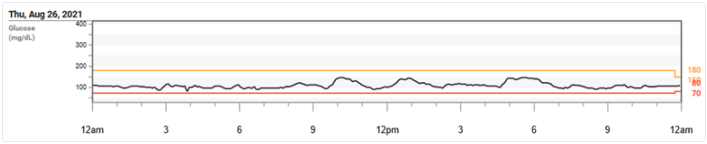

Figure 1B. Glucose profile of August 26th when a post-supper walk was done showing TIR, MG, and FG of next day: 100%, 108 mg/dL, and 101 mg/dL.

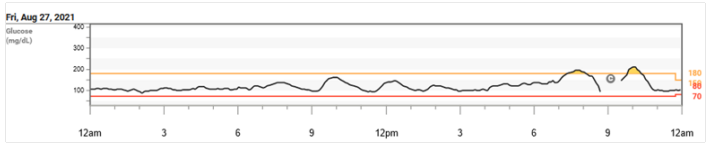

Figure 1C. Glucose profile of August 27th when a late, big supper was eaten showing supper PPG, TIR, MG and FG of next day: 212 mg/dL, 94%, 121 mg/dL, and 111 mg/dL.

Discussion

In Figure 1A, although both breakfast and lunch PPG values were high, there was little harm done to MG and FG (next day). Both the breakfast and lunch glucose surges came down fast (<2 hours) and did not vitiate the MG much. On the other hand, when supper PPG was high, as in Figure 1C (even though there was a brief sensor error), the surge lasted longer (~4 hours) and MG and FG went up. These CGM data reaffirmed to me the importance of meal timing. Early eating was more diabetes-friendly: it was okay to eat two regular meals with high PPG in the morning, however, a big PPG after supper was to be avoided [14-22]. Also, Figure 1B suggested that supper could be substantial provided an appropriate post-supper exercise was completed.

When Kohleova et al. showed two big meals, breakfast and lunch, offering many benefits, there was also hypoglycemia in some of the subjects [14]. When I tested the two-meal option, PPG levels for breakfast and lunch were very high, so I ended up lightening the breakfast. When I added an early morning snack 90 minutes before breakfast, that attenuated the breakfast PPG, possibly by way of the second-meal effect [11-13]. Also, the prospect of hypoglycemia made me add an afternoon snack to the meals. My CGM data suggested a modified version of the meal plan Kohleova et al. used: a morning snack, regular breakfast and lunch, afternoon snack, and light supper [18-20]. This was my "Meal Plan 1". Paradoxically, breakfast could be bigger if the morning snack was used (Figure 1 A, B, and C) [11-13]. Early eating and the morning snack helped with poor glucose tolerance in the morning while improving satiety [38]. A regular supper with the post-supper walk helped with poor glucose tolerance in the evening and improved TIR, MG, FG, and satiety (Figure 1B) [38].

Thus, people with diabetes can counter poor glucose tolerance in the morning by eating a regular breakfast and lunch provided a morning snack is also eaten 90-120 minutes before breakfast [21,22,26,38]. Since glucose tolerance is poor in the evening for most people and a high supper PPG increases fasting glucose, it is preferable to eat an early light supper or to do a timely post-meal walk after a regular supper (Figure 1 B) [18-20,38]. If weight reduction is the goal, one may pick the former or with satiety as the goal, one may pick the latter.

Early eating and the second meal effect from the prior meal make breakfast and lunch bigger than usual. A regular supper can also improve satiety, provided a timely post-supper exercise is done. Patients do have the option to add more non-starchy vegetables, healthy fat (a slice of avocado), and lean protein to the plate. As we practice healthier habits (optimal meal timing, meal composition, nutrient sequencing, and safe exercises) and remain in a virtuous cycle, our body can tolerate more carbohydrates, improving satiety further

Conclusion

Diabetes patients do not have to feel deprived. They can improve most of the metabolic parameters and satiety by practicing healthy meal habits and safe exercises. Diabetes patients with a glucometer or continuous glucometer are free to test these evidence-based healthy habits themselves or with the help of providers, preferably certified diabetes care and education specialists.

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Abbreviations

CGM – Continuous Glucose Monitoring
TIR –Time-In-Range
MG – daily Mean Glucose
PPG -- PostPrandial Glucose
FG – Fasting Glucose
RE – Resistance Exercise
AE – Aerobic Exercise
1 carb -- 15 g carbohydrates
PreEx day – Pre-meal Exercise day
PostEx day – Post-meal Exercise day
CDCES – Certified Diabetes Care and Education Specialist
HOMA-IR – HOmeostatic Model Assessment of Insulin Resistance

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