

# Cultural Practices Doing Harm to Diabetes Management: A Physician-Patient's Perspective

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**Abstract**

*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. One factor contributing to this problem is unhealthy cultural habits being practiced in different cultures. This paper lists some of the major cultural habits that need to be changed towards mitigating the global problem of diabetes and other chronic diseases.*

**Abbreviations**

ADA – American Diabetes Association  
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  
CDCES – Certified Diabetes Care and Education Specialist  
HOMA-IR – Homeostatic Model Assessment of Insulin Resistance

**Introduction**

Healthy lifestyle habits are known to help with the management, remission, and prevention of type 2 diabetes [1-6]. Unfortunately, few people are practicing healthy habits, and the prevalence of diabetes is going up [7-11]. The barriers to overcome include busy lives, resistance to change, feelings of deprivation, easy availability of good-tasting processed food, unhealthy cultural practices, no referral to a certified diabetes care education specialist (CDCES), food and medication insecurity, fear of exercise due to the risk of hypoglycemia, and glycemic dysregulation with the wrong choice of exercise. Most of these can be tackled by individuals after learning about them. Food and medication insecurities are global issues that need a concerted effort from politicians, epidemiologists, school officials, and other policymakers [12,13].

I was a practicing physician when I got my diagnosis of type 2 diabetes at age 50. My primary care physician (PCP) sent me to

CDCES and I got the proper training. Soon my A1C came down from 8.4% to below 6.5%. In 2002 I decided to do a weight reduction program. I started a 3-mile walk after breakfast every morning but hypoglycemia (neuroglycopenia) occurred multiple times. Since there were no hypoglycemia symptoms with walking before breakfast I picked for my exercise a pre-breakfast walk followed by a regular breakfast, each day. Carbohydrate intake was 5-6 carbs (75-90 g) a day. Four months into the new lifestyle using pre-meal walks, my weight decreased by 14% but neither A1C nor HDL cholesterol improved [14]. I decided to do another weight-reduction program in 2012 using a post-breakfast walk for 30 minutes, 30-minute after the start of the meal every day for four months, as in a 1982 study by a Canadian team [15]. My meals included 5-6 carbs a day as before. The new lifestyle was successful: A1C, HDL, and weight improved [14].

A training study in 2020 that compared fasted state training with fed state training, 3 times a week for 3 months in type 2 diabetes showed A1C improvement similar to mine: the fasted state training gave worse A1C (7.4 to 7.7%) and the fed state training, improved A1C (6.6 to 6.3%) [16]. I also developed impaired awareness of hypoglycemia: I almost died twice with severe hypoglycemia (25 and 15 mg/dL) causing seizures. My endocrinologist suggested a diabetes bracelet and ordered continuous glucose monitoring (CGM, Dexcom G5). As research findings kept coming out and watching my own A1Cs and CGM data it took 16 years for me to personalize my own exercise routines. I realized managing diabetes is an uphill battle for most people, and especially for hypoglycemia-prone individuals. I have been testing research findings in a diabetes self-management mode using a glucometer and CGM. This account is about various cultural practices that are doing harm to diabetes patients but they can be tackled by individuals.

## 1. Unhealthy meal composition

In the olden days the grains people used, rice or wheat, for example, looked brown. The sugar made from sugar cane also was brown. But later on, when people learned how to remove the bran from the grains, the refined grains gained popularity. All-purpose flour, white rice, white rice flour, and white sugar became popular in many cultures. Slowly diabetes prevalence started to increase [7]. In some cultures, such as south India, and Puerto Rico white rice became the popular grain [17]. In communities where spaghetti or pizza is popular also turned to white wheat flour (all-purpose flour). The people and food companies also started making different snacks and desserts using these refined grains.

Poor meal composition such as the use of refined carbohydrates and saturated fat and trans-fat are thought to be major contributors to the increasing prevalence of diabetes [18,19]. According to a 2021 report, 10 countries with the highest diabetes prevalence for adults aged 20-70, are Pakistan (30.8%), French Polynesia (25.2%), Kuwait (24.9%), New Caledonia (23.4%), Nauru (23.4%), Marshal Islands (23.0%), Mauritius (22.6%), Kiribati (22.1%), and Egypt (20.9%). In 2016 diabetes prevalence among adults, 17-21, was 38% in many parts of India including Kerala, Tamil Nadu, Punjab, Silkim and Goa [18,19].

How do we remedy this situation? We need to go back to grains containing more fiber and protein: read nutrition labels. At least 3 g fiber and 3 g protein per serving would help [1]. Brown rice, black rice, quinoa, farro, barley, and cauliflower rice are better than white rice, whole wheat flour is better than all-purpose flour, whole wheat bread is better than white bread, spaghetti made from legumes is healthier than those from white wheat flour. People with gluten sensitivity can substitute rice with quinoa or cauliflower rice. Healthy meal composition is well established and they are in the American Diabetes Association (ADA) guidelines [1]. ADA recommends the Mediterranean diet, DASH (Dietary Approaches to Stop Hypertension) diet, and the Plate method: Half of the plate contains non-starchy vegetables, fiber, nuts, and healthy fats such as avocado, and olive oil [1]. The third quarter of the plate is for lean protein, preferably fish, or vegetable protein. The fourth quarter is for good quality carbohydrates [1]. This way the carbs are controlled and balanced by healthy fillers.

## 2. Unhealthy meal timing

### a. Delayed or skipped breakfast

Many youngsters are not hungry in the morning. They rush to go to school, college or work. They have no time to prepare a healthy traditional breakfast and eat it. Instead, it is easy to grab a hot coffee and a muffin when they feel hungry late in the morning.

This is understandable. Counterregulation has been working all night. Insulin levels are low in the morning, free fatty acid levels are high, and are used as fuel for low-intensity activities [20]. The liver has been supplying glucose from liver glycogen to take care of all body's immediate energy needs under the influence of counterregulatory hormones (glucagon, cortisol, growth hormone,

and epinephrine) [20]. Muscle glycogen is also available if the intensity of the activity goes up. Because of the high counter-regulatory hormones in the morning, fasting glucose tends to be high for diabetes patients [21]. Since glucose tolerance is poor in the morning for diabetes patients or at-risk people muffin and coffee is the wrong breakfast to eat. This low-fiber high-carb breakfast may give a high post-meal glucose peak [21].

How can we solve this unhealthy practice? Mekary et al. report that a delayed or skipped breakfast increases the risk for diabetes [22]. An early light breakfast (a 2 to 3-carb (30-45 g) cold cereal/hot cereal, or egg and a toast) is better than the muffin as long as the grain has extra fiber and protein [1]. The early breakfast will switch the hormone system to a more favorable incretin-insulin system [23]. In other words, breakfast primes the body to handle carbohydrates better at lunch. If 1-hour glucose is high (close to or more than 180 mg/dL) there are two approaches: one, decrease the carbohydrate serving slightly, next time. Two, eat a half-carb high-protein morning snack (coffee/tea with ½ cup milk or a 90-calorie Kind minibar and coffee/tea) 90-minute before breakfast [24-26]. Now check the 1-hour glucose of the breakfast, it is likely a lot lower. The benefit of the high-protein morning snack in offering a second-meal effect for the breakfast is well documented [24-26]. The breakfast is also going to help with the post-lunch glucose. The benefits of early eating of breakfast and lunch as the major meals of the day are also well studied [22,27-29]. This is called circadian-friendly eating.

It is simple. Eat a morning snack, breakfast, and lunch 90-120 minutes apart. The circadian-friendly eating and second meal effect from the morning snack ensure moderate glucose levels in the morning.

### b. Late Supper

An evening coffee/tea with snacks and a late (9-9:30 PM), big supper is the norm in many communities. When the workers come home tired, the natural tendency is to relax, watch TV and eat the evening snacks and a late supper. The inactivity and late supper when glucose tolerance is poor in the evening increase fat in the liver and pancreas and push fasting glucose (FG) up [21, 30-32].

It is better to eat an early light supper. This is one approach that would improve FG fast [30-32]. Perhaps the healthy approach is to substitute the evening coffee and snacks with a light balanced supper.

Diabetes patients were told to eat a small balanced meal every 60-120 minutes to prevent hyper- or hypoglycemia [33]. Today, data support a modified meal plan: morning snack, breakfast, lunch, afternoon snack, and an early, light supper [24-32]. This is because glucose tolerance is poor in the morning and evening: early eating and starting the day with a morning snack help glycemia for the day [21].

## 3. Harmful pre-meal exercise

There is a general impression that exercise is good for us. Some young people may decide to do a bodybuilding exercise followed by a high-protein shake in the morning. Any exercise can improve physical health and body composition. But for diabetes patients, there is more to it. High-intensity morning exercise followed by a regular breakfast can cause high post-exertion glucose elevation and glucose dysregulation for up to three hours [34-39]. There can also be delayed hypoglycemia in people on insulin [40].

How can we minimize these negative effects of pre-breakfast exercise? A recent article explains it: use moderate intensity, eat a light meal or a high protein morning snack after the activity and do it every other day [14,24-26]. Then the fasted state exercise becomes very valuable. Absence of hypoglycemia during the activity, insulin sensitivity improvements that last for 24 hours and beyond, and better FG [34,41,42]. Training during fasted state also improves glycogen content, GLUT-4 protein levels, and Amk activity (a protein that promotes mitochondrial biogenesis) [43-45]. A 30 to 60-minute morning walk followed by a morning snack every other day has been my primary exercise last 3-plus years and my A1C has been 5.8 to 6.2% under different medications [14]. [In 2011 my A1C was 8.8% and healthy habits brought it down to 5.8 to 6.2%. When the morning walk was done every day my A1C was slightly higher, 6.4%]. The glucose dysregulation every other day is likely better than every day.

Now I am convinced that a morning walk followed by a morning snack every other day is very valuable for people with insulin resistance [14,46].

#### 4. Harmful post-meal exercises

Many young people think that an intense workout like 30-minute sprinting or a 60-minute Zumba is good. Most of our day time is postprandial period. The trouble is postprandial exercise can have many negative effects on glycemia and minimizing the negative effects of post-meal exercise is challenging: exercise timing and energy expenditure have to be right to moderate the postprandial glucose (PPGs) of bigger meals via contraction-mediated glucose uptake [15,48-58]. If timing and or energy expenditure is not right hyperglycemia, hypoglycemia, or glucose dysregulation can occur. [15,60-62].

Exercise is to be started once sufficient glucose has arrived in the blood. Starting the activity too early may not be effective, a big

secondary peak may be seen after the activity [59]. If it is done say two hours after the start of the meal significant glucose elevation or glucose dysregulation can occur [60-62]. In general, for a typical breakfast, exercise may be started 30-45 minutes post-meal and for lunch or supper, 45-60 minutes post-meal may work [15,48-50,52].

As for energy expenditure, high intensity [63-66] and long duration [15] should be avoided. The supply and demand should match [67]. In other words, a regular meal for 20-minute brisk walk and a bigger meal for an hour of zumba.

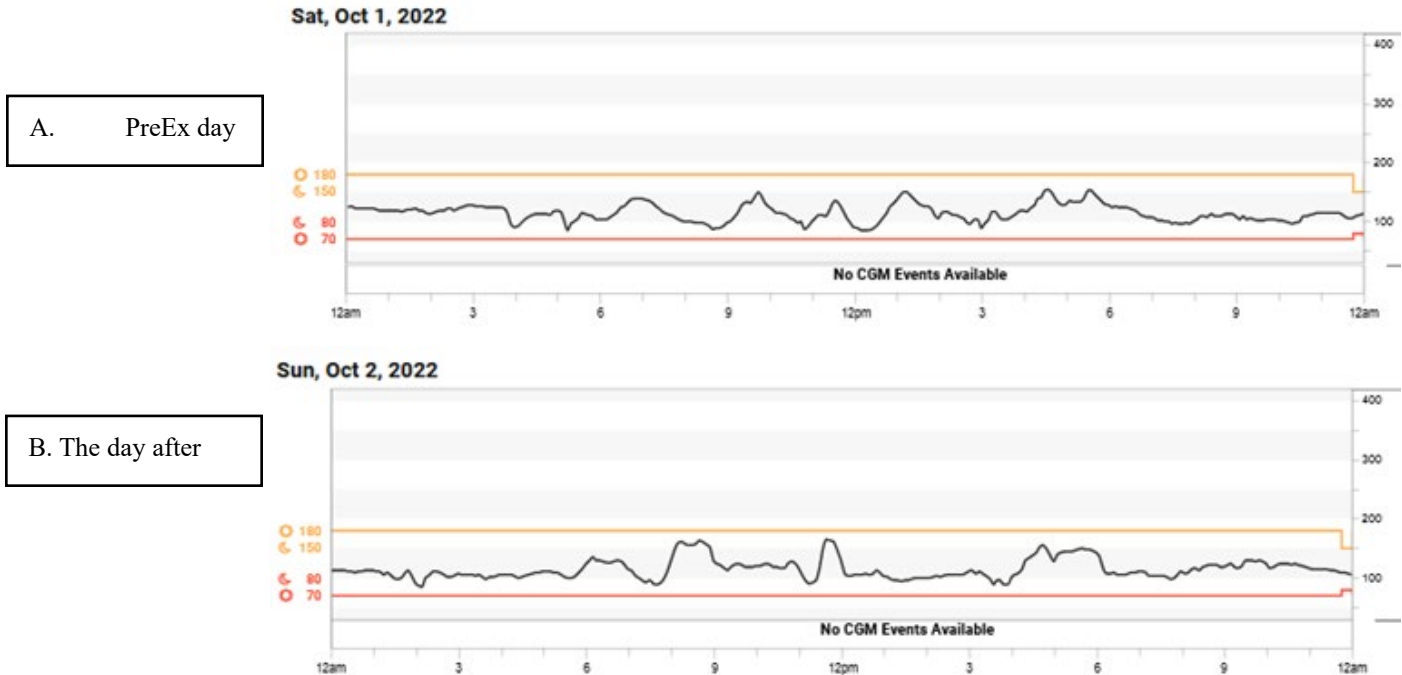
A brisk walk for 20 minutes can use up the exogenous glucose from a regular meal. A short duration resistance exercise (RE) plus a short walk (aerobic exercise (AE)) would be better than AE alone [56,68-71]. When RE is added to AE insulin sensitivity and FG may improve via muscle glycogen depletion [56]. Post-meal AE does not improve FG [42].

What to avoid with post-meal exercise are starting the exercise too early [47] or too late [59-61] high intensity [62-65] (> than 60% VO<sub>2</sub>peak) or long duration (> 30 minutes): Nelson et al. had hypoglycemia beyond 35 minutes into the exercise [15].

In summary, morning walk every other day plus timely combined exercises (RE +AE) after bigger meals is a good exercise strategy for anybody [14,58]. Those who cannot do the morning walk have other options: post-meal exercises (RE + AE) after bigger meals, 10,000 steps a day, frequent physical activity breaks from sitting [71] and periodic interval exercise [72].

Figure 1 shows the glucose profiles when safe exercises are done while meals are identical and medications were unchanged: diabetes medications are metformin 500 mg twice a day, empagliflozin 10 mg once a day and semaglutide 1 mg injection once a week. On the morning walk day (PreEx day, A), in addition to the 30-minute morning walk, there are 2 more exercises: upper body RE plus short walk after breakfast and a post-supper walk. The next day (B), there are two exercises: a lower body RE plus short walk after breakfast and a post-supper walk. Time-in-range (TIR) and 24-hour mean glucose (MG) are excellent per ADA recommendations (1): 100/115 and 100%/116 mg/dL, respectively.

Figure 1



### Conclusions

Unhealthy practices causing harm to diabetes management include

1. Poor meal composition such as refined carbohydrates, saturated fat, and trans-fat.
2. Poor meal timing such as delayed or skipped breakfast and late, big supper.
3. High-intensity pre-breakfast exercise followed by a big breakfast every day leads to glucose dysregulation for up to three hours and delayed hypoglycemia in people on insulin.
4. Post-meal exercise with early (before sufficient glucose arrives in the blood) or late timing (two hours or more after the start of the meal), high intensity (>60% VO<sub>2</sub>peak) or long duration (>30 minutes) resulting in hyper- or hypoglycemia.

As ADA recommends, good meal composition (high fiber, lean protein, non-starchy vegetables, healthy fat, and nuts added to appropriate carbohydrate serving, the MyPlate approach) is valuable for diabetes management. Minimize refined carbohydrates, saturated fat and trans-fat: read nutrition labels. Other meal options per ADA guidelines are Mediterranean diet and DASH diet.

Early eating (early breakfast, lunch, and supper) and the second meal effect of a morning snack 90 minutes before breakfast are a critical part of healthy eating for optimal physiology. Early supper has a direct effect on preventing high fasting glucose. For optimal meal timing, the meal plan may look like this: a morning snack, breakfast, lunch, afternoon snack and an early light supper.

A 30 to 60-minute morning walk followed by a light meal every other day is very valuable for diabetes patients: this exercise improves all glucose levels, fasting glucose in particular. There may be some glucose dysregulation after the activity, but doing the morning walk every other day minimizes it.

Post-meal exercise at the right time (as glucose is arriving in the blood) and with moderate energy expenditure is also useful to moderate the postprandial glucose of any big meal. A combined (RE + AE) is better than RE or AE alone for improving body composition, glucose levels, and fasting glucose.

This lifestyle is easy for a retired person with CGM. Post-meal exercise (RE + AE) after breakfast and a 20-minute brisk walk 45-60 minute after the start of supper would offer added benefits. [RE after supper may trigger nocturnal hypoglycemia in some people.] Upper body RE may be alternated with lower body RE.

Those (working people) who cannot do morning walks have other options: Moderate RE plus short walk after breakfast, post supper walks, frequent physical activity breaks from sitting, 10,000 steps a day, and periodic interval exercise.

Community-wide education is needed about improving meal timing, and meal composition, and minimizing the negative effects of exercises. A concerted effort from doctors, CDCES, policymakers, and patients is needed to put a dent in the diabetes prevalence. Randomized controlled studies or prospective cohort studies in this area would help. In the meantime, patients on any medication(s), with glucometer or CGM, are free to test and personalize their lifestyles with the help of providers as needed.

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## Duality of interest

No potential conflicts of interest to this article were reported.

## Author Contributions

The corresponding author, E.C., is the guarantor of this work and, as such, had full access to all the data and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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