

Blunting post-meal glucose surges in people with diabetes

Elsamma Chacko

Elsamma Chacko, Connecticut Valley Hospital, Middletown, CT 06457, United States

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Correspondence to: Elsamma Chacko, Principal Physician, Connecticut Valley Hospital, 1000 Silver Street, Middletown, CT 06457, United States. elsammac@msn.com
Telephone: +1-860-2625000
Fax: +1-860-2625307

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Abstract

Worldwide, the morbidity and mortality associated with non-communicable diseases have been climbing steadily - with costs aggressively keeping pace. This letter highlights a decidedly low-cost way to address the challenges posed by diabetes. High levels of postprandial blood glucose are disproportionately linked to much of the microvascular damage which, in the end, leads to macrovascular complications and organ failures. Systematically controlling post-meal glucose surges is a critical element of overall glycemic management in

diabetes. Diet, exercise and medications form a triad of variables that individuals engaged in diabetes self-management may manipulate to achieve their targeted glucose levels. As a rule, diabetes patients in developing countries as well as those living in the pockets of poverty in the western world cannot afford special diets, medications, glucometers and supplies, lab tests and office visits. Exercise is the one option that is readily accessible to all. Decades of research in laboratory settings, viewed holistically, have established that light to moderate aerobic exercise for up to 60 min starting 30 min after the first bite into a meal can blunt the ensuing glucose surge effectively. Moderate resistance exercise, moderate endurance exercise or a combination of the two, practiced post-meal has also been found to improve many cardio-metabolic markers: Glucose, high density lipoprotein, triglycerides, and markers of oxidative stress. On the other hand, pre-breakfast exercise and high-intensity exercise in general have been decidedly counterproductive.

Key words: Pre-meal exercise; Post-meal exercise; Exercise timing; Exercise intensity; Glucose surge; Insulin resistance

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Core tip: A critical part of diabetes self-management is the systematic blunting of the post-meal glucose surge. The reason for this is that the glucose surge is closely linked to the vascular complications of diabetes and eventual organ damage. Decades of studies have shown that a moderate intensity exercise - aerobic, resistance or combined - starting 30-40 min after the start of the meal can efficiently blunt the glucose peak. Post-meal studies starting at other times have also shown improvements in other metabolic markers including high density lipoprotein, triglycerides and markers of oxidative stress. Promoting post-meal exercise can make a big difference in the daily lives of diabetes patients worldwide.

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TO THE EDITOR

Non-communicable chronic diseases are costly^[1]. The public at large foots a sizable chunk of the economic cost while patients are faced with the double whammy of compromised general health and sizable monetary costs. This note highlights a surprisingly low-cost way to address this problem worldwide.

Moderating post-meal glucose surges is a critical part of diabetes management because these surges are directly linked to the microvascular complications that in turn lead to organ damage and increased morbidity and mortality^[2]. There are three well recognized approaches to managing post-meal glucose peaks: Diet, exercise and medications. Poverty, however, stands in the way of using food and medications properly to fight post-meal glucose surges. Physical activity is free for all.

People with insulin resistance have difficulty processing carbohydrates. The general recommendation for getting around this problem has been to rely on "appropriate" carbohydrate intake. American Diabetes Association (ADA) recommends individualized meal plans with the right carb count that would offer a postprandial glucose (ppg) value under 180 mg/dL (9.99 mmol/L)^[3] with an expected HbA1c of 7.0%. American Association of Clinical Endocrinologists (AACE) is even more cautious: AACE recommends a ppg under 140 mg/dL (7.77 mmol/L) and an expected HbA1c of 6.5%^[4]. Since glucose levels peak around 1 h after the start of meals^[5] patients who have glucometers should be able to adjust the carb content of meals with the help of the 1-h glucose value following the major meal of the day. Balancing meals with protein, vegetables, fiber and healthy fat decreases the glycemic load of the meal and offers lower glucose peaks^[6,7].

Studies featuring moderate exercise after meals consistently show glucose levels going down. It is possible to blunt the post-meal glucose surge substantially by starting the physical activity about 30 min post-meal and continuing it for up to 60 min^[8-11]. This enables the body to use up the incoming glucose molecules to do the work involved in the activity - before they get to build up into a big peak. Insulin levels go up following meals, hepatic glucose production is suppressed and the meal-derived glucose gets used up preferentially as fuel^[12]. Hypoglycemia is not of concern during this period^[8]. Symptomatic exercise-induced hypoglycemia occurs rarely when the activity is performed during the late postprandial period, two hours or more after the meal^[13]. Pre-meal exercise, on the other hand, increases postprandial glucose surges^[9,14-17] although glucose is fairly steady for the duration of the pre-meal exercise itself^[18-20]. The post-

exercise glucose elevation is even more pronounced in the case of high-intensity exercise^[21-24]. Pre-breakfast exercise is fueled mainly by hepatic glucose and at the end of the exercise bout the excess glucose arriving from the liver accumulates in the blood, resulting in a post-exercise glucose elevation^[21-24]. If lowering the post-meal glucose peak is the goal, pre-meal exercise is the wrong thing to do. A brisk walk for 30 min after the start of every major meal is one option. If walking three times a day is too much, one may opt for one major meal, preferably breakfast, along with smaller meals the rest of the day.

Moderate resistance exercise for 45 min at 45 min post-meal also lowered glucose levels, partially blunting the glucose peak^[25]. When post-meal resistance exercise was combined with endurance exercise, hyperglycemia was reduced for the subsequent 24 h by 39%^[26]. Moderate post-meal exercise, resistance or aerobic or a combination, improved other metabolic markers also: lipids and markers of oxidative stress^[25,27-30]. It looks like moderate resistance and aerobic activities decrease glucose levels directly during the exercise by increasing glucose transport out of the bloodstream. Moderate resistance exercise also improves insulin sensitivity for 24 h or more after the exercise bout.

Taken together, the available data point to 30 min post-meal as the optimal point to start the exercise activity. The mode of exercise can be resistance, aerobic or a combination at moderate intensity. The guidelines recommend resistance exercise 3 times a week^[3,4]. There are also other health benefits -mainly physical fitness and body composition - to be had by doing resistance before endurance to minimize the interference effect^[31]. The aerobic activity can include a brisk walk, treadmill, elliptical, rowing, stationary bike, dancing or swimming. Resistance exercise can be a 10 min workout using free weights involving major muscle groups. It is important to keep the intensity below 80% VO_{2max} . People under free living conditions have at least three ways to keep the right intensity. They may exercise at a pace that causes a slight shortness of breath. They may also keep HR_{max} at 60%-70%. The maximum heart rate, HR_{max} , is calculated as $220 - age$ (For example, the HR_{max} for a 40-year-old is 180 beats/min; the corresponding pulse rate during the physical activity should be 104-126 beats/min). Those who have glucometers may also check glucose at the end of the workout and adjust the intensity accordingly for the next session.

When it comes to medications, various classes of drugs are available today specifically to manage post-meal glucose surges. These include glinides, short-acting insulins, gliptins, DPP-4 inhibitors and miglitol.

These three approaches to post-meal glucose control would work and complement one another nicely for people who have the resources to afford them. In developing countries and in the pockets of poverty in the Western world, high carb food is the norm. The vast

majority of these diabetes sufferers simply cannot afford the out-of-pocket expenses of office visits, lab tests, glucometers and medications. The one thing universally affordable for the rich and the poor alike is a timely moderate post-meal exercise. It is free, hypoglycemia is not an issue and the patient is in charge. Diabetes patients adopting this approach won't be violating any current guidelines, which encourage any-time exercise.

On the basis of elementary physiology and at least three decades of data, one initiative that could make a difference in the lives of current and future diabetes patients worldwide is to promote post-meal walks (or comparable physical activities) after the major meal of the day. The science is there. It is now up to the public and private agencies in the field and health care providers to make a concerted effort to promote timely post-meal exercise as a self-management tool for diabetes people with diabetes everywhere.

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