VIEWPOINT | Aging and Exercise

Commentaries on Viewpoint: A time for exercise: the exercise window

THE OPTIMAL EXERCISE TIMING “WINDOW” DEPENDS ON THE OUTCOME

TO THE EDITOR: We read with great interest Dr. Chacko’s Viewpoint (1) on exercise timing in relation to meals for people with diabetes. We agree that exercise timing is an understudied issue. However, we would caution against an overemphasis on exercise during the mid-postprandial period based on the attenuation of a single meal-induced hyperglycemia with minimal risk of hypoglycemia.

For many patients with type 2 diabetes, impaired glycogen synthesis, increased intramuscular/intrahepatic triglycerides or lipid intermediates, and reduced mitochondrial content/function have been considered upstream contributors to insulin resistance and hyperglycemia. To address this underlying pathophysiology, targeting mobilization and oxidation of endogenous glycogen and lipids stores with fasted-state exercise may be preferable to targeting postprandial hyperglycemia with postprandial exercise.

Unfortunately, we are not aware of any longer term exercise training trials in people with diabetes to support this hypothesis. For now, we must rely on experience from studies in normoglycemic adults and athletes. For example, fasted-state exercise training has been demonstrated to increase glycogen content, insulin sensitivity, and AMPK activity [a protein that promotes mitochondrial biogenesis (5)] to a greater extent than exercise performed after glucose ingestion (4). Additionally, although acute glycemic reduction may be minimal during exercise, studies cited by Dr. Chacko showed that fasted-state exercise attenuates glucose excursions in response to subsequent meals (e.g., Refs. 2, 3), likely due to increased insulin sensitivity to favor the replenishment of glycogen stores.

We share Dr. Chacko’s opinion that longer term trials in people with type 2 diabetes are required to properly address the issue of exercise timing.

REFERENCES


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COMMENTARY ON VIEWPOINT: A TIME FOR EXERCISE: THE EXERCISE WINDOW

TO THE EDITOR: Dr. Chacko provides an interesting viewpoint on the optimal time to exercise for glycemic control (1). While intuitive to suggest that moderate-intensity exercise in the mid-postprandial state might best normalize blood glucose, other factors warrant consideration. Patterns of exercise and its intensity, along with diabetes classification, require individualized attention because they differentially influence glucose/insulin levels (2, 3) and underlying phenotype. Immediately after high-intensity interval exercise, blood glucose is reduced, independent of whether it is performed before or after breakfast (4), an effect that is greater in magnitude than with moderate-intensity exercise (2, 4). As indicated (1), whether exercise timing matters for chronic effects is unknown (notwithstanding the importance of acute effects). Research is urgently needed to determine whether acute exercise-induced responses translate to chronic adaptations underpinning improved insulin sensitivity and beta-cell function. Some studies have examined exercising fasted vs. fed. Training fasted or at higher intensities appears likely to elicit greater muscle and whole body adaptations (5), including reduced lipid deposition that impairs insulin signaling, and greater transcriptional regulation of proteins involved in glucose disposal (i.e., GLUT-4, AMPK). Further research is needed to determine the long-term effects of fasted exercise on preventing and treating T2DM. Ultimately the diversity of human physiology, disease progression (and treatment) and individual behaviors (e.g., feeding pattern) complicates a “one-size-fits-all” optimal exercise prescription. Also important to consider are other risks (e.g., morning-impaired cardiovascular control) balanced against the proven benefits of exercise and a need to promote exercise compliance at the population level.

REFERENCES


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COMMENTS ON VIEWPOINT: A TIME FOR EXERCISE: THE EXERCISE WINDOW

TO THE EDITOR: The Viewpoint article by Chacko (2) raised pertinent questions regarding a critical time-dependent window (30–90 min) for exercise to effectively reduce the postprandial glucose surge. An important consideration that was absent from the Viewpoint concerns the timing of meals leading up to exercise and the glycemic index of the foods eaten. Research now supports the concept of a second meal effect (3), whereby a slow digesting, low glycemic carbohydrate eaten in the morning or dinner time can improve glucose tolerance in the postprandial period during the subsequent meal (1, 3–5). The result of this is a lower postprandial absorption, which in turn minimizes postprandial glycemia and insulin. Reduced insulin levels decrease the likelihood of glucose falling to below fasting levels, resulting in an enhanced glucose uptake (3). Thus the benefits of incorporating low glycemic foods into a diet extends beyond the immediate postprandial phase, and the efficacy of glucose disposal with exercise is likely associated with the specific conditions of glycemic loads and timing of multiple meals before exercise.

Perhaps more important to the discussion of timing/eating/exercising strategies, as Chacko (2) describes, is whether this approach is feasible to individuals living in Western societies where the general work requirement does not allow the individual to exercise within 30 min of “lunch break” that may otherwise stave off the postprandial glucose surge. How do we change our way of living so that the utility and rationale of this approach is applied practically for the future of preventative metabolic risk and an overall healthy living? Food for thought.

REFERENCES


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COMMENTS ON VIEWPOINT: A TIME FOR EXERCISE: THE EXERCISE WINDOW

TO THE EDITOR: For exercise to normalize short- and long-term glycemic control in people with diabetes, Dr. Chacko (2) proposes that exercise bouts occur 30–90 min after a large breakfast, with smaller meals ingested throughout the day. Beyond the general lack of practicality (school/work commitments or nausea associated with exercising on a full stomach), flaws exist with this approach. Briefly, this recommendation ignores morning hyperglycemia that is commonly experienced in individuals with diabetes due to nocturnal spikes in growth hormone (dawn phenomenon) and places minimal importance on improvements in dyslipidemia and insulin sensitivity that occur after fasted exercise (with minimal risk for hypoglycemia in insulin-independent diabetes), as outlined in the review cited by Dr. Chacko (4); 2) does not take into account meal composition and insulin dosing for insulin-dependent diabetes. High-fat or low-glycemic index foods can affect postprandial glycemia by causing lower glucose concentrations (1), and preprandial insulin analogs are most active during the proposed exercise time period (30–90 min postprandial) (5), resulting in a higher risk for hypoglycemia owing to the additive effect of contraction- and insulin-mediated glucose uptake. We agree with Dr. Chacko that exercise timing should be reported in greater detail in the literature and support the use of an exercise-periprandial framework; however, given the varying glycemic responses to meals (i.e., composition, insulin dose) and exercise (mode/intensity, fed/fasted-state) with diabetes and the efficacy of alternative approaches [i.e., suspending insulin pre-exercise (3)], we believe it is premature to adopt the central thesis proposed (2).

REFERENCES


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position statement of ADA/ACSM states that RT should be performed at least 2–3 days per week in addition to aerobic training by persons with type 2 diabetes (2). Nevertheless the effects of RT on blood glucose control is less studied, and thus physicians are less willing to add RT to diabetic exercise programs. RT could affect positively glycemic control and could help in body weight loss through both the IGFl/AKT/mTor pathway and the AMPK pathway (4). It is in the interests of researcher to carefully consider also the effects of RT performed before or after a meal on blood glucose control to avoid underestimating the possible additive effect of this kind of exercise to the more common ET.

REFERENCES


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EXERCISE STRATEGIES TO IMPROVE POSTPRANDIAL METABOLIC CONTROL: MORE TO BE DONE

TO THE EDITOR: Exercise represents a powerful tool to mitigate postprandial glycemic and lipemic fluctuations and therefore to reduce the related cardiometabolic risk. These effects depend on the time lapse between exercise and the meal. Surprisingly, this relationship has been insufficiently evaluated. Chacko (1) therefore raises an important point and suggests a practical strategy for improving the metabolic control in diabetic patients.

Behind the proposed scenario is the idea that at least part of the glucose originating from the ingested food during the “mid-postprandial period” would be destined to satisfy the energy needs of the contracting muscles and therefore glucose serum concentration is reduced. This attractive picture should be tested with future studies aiming to investigate glucose kinetics during the specific postprandial timeframe.

Other factors should be considered and scientifically explored. The effect of exercise timing on the metabolic postprandial responses are related to the caloric content and the composition of the meal as well as to the time of the day the exercise is performed and the meal is consumed. Given the shift in time between the effect of exercise on the postprandial glycemic and lipemic responses (3), the composition of the different meals of the day may be tailored accordingly. The fractionation of the postprandial exercise bout may be also considered (4) as well as the combination with multiple short activity breaks (2).

Importantly, the long-term effect of the pre-/postprandial exercise timing strategies remains to be tested, as well as the interaction with glucose lowering medications and/or insulin administration.

REFERENCES


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COMMENTARY ON VIEWPOINT: A TIME FOR EXERCISE: THE EXERCISE WINDOW

TO THE EDITOR: Dr. Chacko (1) postulates the importance of exercise timing in relation to glycemic control in individuals with diabetes. Indeed, a single bout of exercise performed in the early postprandial phase has been shown to blunt the postprandial rise in blood glucose and insulin concentrations in patients with type 2 diabetes (2, 5), whereas exercise performed before food intake seems less effective in countering blood glucose excursions during the subsequent postprandial period (2). We need to stress, however, that a single bout of exercise improves insulin sensitivity and glycemic control for up to 24 to 48 h (3, 4), thereby exerting its glucoregulatory properties over multiple postprandial periods regardless of the timing of exercise. Hence, the benefits of regular exercise for long-term glycemic control can be attributed to transient improvements in insulin sensitivity and glycemic control after each successive bout of exercise (4). In this regard, most of the currently available evidence indicates that the volume of exercise is the main determinant driving exercise-induced improvements in glycemic control (4). Although the timing of exercise may be used to suppress specific postprandial blood glucose excursions, the importance of exercise timing for overall glycemic control seems less evident. Therefore, from a clinical and practical perspective, we should encourage our patients to focus on achieving and adhering to a prespecified volume of exercise, before the timing of exercise is being considered.

REFERENCES

3. Perseghin G, Price TB, Petersen KF, Roden M, Cline GW, Gerow K, Rothman DL, Shulman GI. Increased glucose transport-phosphorylation and muscle glycogen synthesis after exercise training in insulin-

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DOES THE “EXERCISE WINDOW” WORK IN TYPE 1 DIABETES?

TO THE EDITOR: In reading Dr. Chacko’s (2) Viewpoint article on mid-postprandial exercise, I couldn’t help but feel that the evidence was being oversimplified with respect to type 1 diabetes (T1D). There is little evidence to support the argument that mid-postprandial exercise decreases the risk of exercise-induced hypoglycemia in T1D individuals. In fact, 30 min of aerobic morning exercise in a fasting state is associated with increasing, rather than decreasing, blood glucose levels in T1D individuals (4, 5). Lower exogenous insulin levels and higher growth hormone levels found at this time of day will probably decrease hypoglycemia risk more than exercise in the mid-postprandial period.

To avoid hyperglycemia, T1D patients are instructed to take an insulin bolus before meals. This would elevate hypoglycemia risk in the postmeal period by exacerbating the hyperinsulinemia that already exists during exercise in T1D (exogenous insulin levels do not decrease during exercise as endogenous insulin levels do). Another point to consider is that mobilization of exogenous insulin from subcutaneous depots may be increased by exercise (3), further elevating hypoglycemia risk. If one were to omit this bolus, it could result in levels of hyperglycemia that may be considered unsafe for exercise.

Finally, meal composition profoundly affects postmeal glucose excursions in T1D individuals. This recognition led to the suggestion of splitting insulin dosage in the postmeal period after high-fat, high-protein meals (1). In these instances (and especially in the absence of an insulin bolus), the “dome of the glucose peak” may not fit the time frame suggested by Dr. Chacko. Unfortunately, exercise in T1D is complicated, and the mid-postprandial period is an oversimplified solution.

REFERENCES


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COMMENTARY ON VIEWPOINT: A TIME FOR EXERCISE: THE EXERCISE WINDOW

TO THE EDITOR: This month’s Viewpoint by Elsamma Chacko (1) discusses the effects of exercise timing relative to a meal on blood glucose control. The author proposes that exercise in the 30–90 min after a meal (i.e., the mid-postprandial period) may be especially effective in blunting large glucose excursions among people at risk for type 2 diabetes. This benefit presumably is due to the greater potential for glucose uptake by the contracting muscles and for greater glucose oxidation due to its being the prevailing fuel source. This notion has important implications for older people, because exercise can also supplement peripheral insulin action in the presence of an aging-related blunted insulin secretory response that makes older people particularly vulnerable to postprandial hyperglycemia. This susceptibility to postprandial hyperglycemia may be especially apparent in the evening, when insulin secretion in response to food is lower than in the morning (5). We published data indicating that 15 min of walking (3 METs) performed 30 min after each meal was equally effective as 45 min of sustained morning walking in significantly improving 24-h glycemic control in older people at risk for impaired glucose tolerance (3). Moreover, postmeal exercise was particularly effective in lowering 3-h postdinner glucose levels, whereas 45 min of either morning or predinner walking was not. In short, our own findings and those of others (2, 4) corroborate the views of Chacko in that regular postmeal walking appears to be an effective way to control postprandial hyperglycemia, and this may be especially true for older people.

REFERENCES


Loretta DiPietro
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Andrei Grubok
William Rumpler
United States Department of Agriculture