2013

Blood Glucose Responses to Type, Intensity, Duration, and Timing of Exercise

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Original Publication Citation

Colberg, S. R., Hernandez, M. J., & Shahzad, F. (2013). Blood glucose responses to type, intensity, duration, and timing of exercise. *Diabetes Care, 36*(10), E177. doi:10.2337/dc13-0965

OBSERVATIONS

Blood Glucose Responses to Type, Intensity, Duration, and Timing of Exercise

The Big Blue Test (BBT) is an annual initiative by the Diabetes Hands Foundation to raise awareness of the importance of physical activity in managing diabetes. Individuals with diabetes voluntarily exercise and record self-monitored blood glucose levels. During the 2012 BBT, 5,157 diabetic participants (~90% insulin users) anonymously entered exercise type, intensity, duration, time elapsed since last meal, and blood glucose readings before and after one or more bouts of exercise separately through www.BigBlueTest.org or an iPhone app.

Based on a prior BBT (1), exercise choices were walking, running/jogging, cycling, conditioning machines, dancing, and other exercise (nonspecified). Intensity was moderate or vigorous. Duration was ≤10, 11–19, 20–29, or ≥30 min. The timing of exercise after the last meal was 30 min and 1, 2, or ≥3 h ago. Data were reported as mean ± SD.

Walking was reported most frequently (48.5%), followed by other exercise (18.7%), running/jogging (11.9%), cycling (8.8%), conditioning machines (6.4%), and dancing (5.7%). Overall, mean blood glucose levels were lower (−31.3 ± 47.1 mg/dL, 16.8%) after exercise, although only 75.8% decreased, 8.8% were unchanged, and 15.4% increased. Walking resulted in the smallest decrease (−25.0 ± 42.4 mg/dL) compared with nonspecified exercise (−33.5 ± 50.0 mg/dL), running/jogging (−40.1 ± 55.1 mg/dL), cycling (−42.4 ± 48.8 mg/dL), conditioning machines (−35.9 ± 48.8 mg/dL), and dancing (−37.4 ± 45.3 mg/dL, $P < 0.05$). Moderate exercise resulted in a mean decrease of −32.7 ± 44.1 mg/dL, whereas blood glucose only decreased −28.0 ± 53.6 mg/dL after vigorous activity of all durations ($P < 0.05$). Longer exercise duration generally resulted in increasingly greater decreases in blood glucose for exercise intensities combined ($P < 0.05$) and moderate exercise ($P < 0.001$) but not necessarily for vigorous exercise alone (Table 1). Exercise undertaken 1 and 2 h after eating led to a similar decrease (−40.1 ± 47.2 and −40.1 ± 45.9 mg/dL, respectively), but both were more than exercise done for either 30 min (−28.6 ± 50.6 mg/dL) or ≥3 h (−21.2 ± 44.0 mg/dL) afterward ($P < 0.05$). The largest decrease followed ≥30 min of exercise undertaken 1 h (−49.3 ± 53.1 mg/dL) or 2 h (−46.4 ± 49.8 mg/dL) after eating ($P < 0.001$) compared with 30 min (−34.3 ± 53.5 mg/dL) or ≥3 h (−19.6 ± 47.0 mg/dL).

Although the 2012 BBT confirms that participation in varying types, intensities, and durations of exercise generally lowers blood glucose levels, engaging in just a 10-s sprint before or after moderate activity can prevent a fall in glycemia in type 1 diabetes because of a greater release of glucose-raising hormones from intense activity, suggesting that exercise variations play a role in the expected response (2,3). However, most exercise that is longer in duration reduces blood glucose levels and may require regimen changes to prevent hypoglycemia (4). Because 50 min of moderate exercise undertaken 60 or 180 min after breakfast carries a similar risk of exercise-induced hypoglycemia (5), the timing of exercise after the last meal must be considered. In conclusion, varying types, intensities, and durations of exercise generally lower blood glucose levels in most individuals, although exercise of longer duration is likely most effective, and elapsed time since eating should be considered.

Table 1—*Mean change in blood glucose levels (mg/dL) by exercise intensity and duration*

	n	≤10 min	11–19 min	20–29 min	≥30 min
All exercise	7,157	−17.9 ± 44.9◦	−25.0 ± 34.4◦	−30.9 ± 42.0◦	−34.5 ± 51.7◦
Moderate	5,051	−16.9 ± 43.8	−25.6 ± 32.9	−29.9 ± 40.2*	−39.0 ± 48.6*∞†
Vigorous	2,106	−25.1 ± 51.4	−22.1 ± 40.8‡	−36.1 ± 49.9*∞¥	−27.6 ± 55.5*‡

Data are mean ± SD. ◦For all exercise, all values differ from one another ($P < 0.05$). For moderate and vigorous, *$P < 0.001$ vs. ≤10 min moderate, ∞$P < 0.001$ vs. 11–19 min moderate, †$P < 0.001$ vs. 20–29 min moderate, ‡$P < 0.001$ vs. ≥30 min moderate, and ¥$P < 0.001$ vs. 11–19 min vigorous.

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DOI: 10.2337/dc13-0965

Acknowledgments—No potential conflicts of interest relevant to this article were reported.

S.R.C. wrote the manuscript, contributed to the study design, and analyzed the data. M.J.H. contributed to the study design and collected the data through the Diabetes Hands Foundation. F.S. analyzed the data. S.R.C. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Parts of this study were presented in abstract form at the 73rd Scientific Sessions of the American Diabetes Association, Chicago, Illinois, 21–25 June 2013.

The authors thank Andreina Davila, Emily Coles, and Emily Walton of the Diabetes Hands Foundation, Berkeley, California, for assistance in formulating the data collection mechanisms for the BBT and collecting and managing all the data.

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