grams serving the older homeless population, counseling on substance use, addressing risk factors for falls, and facilitating access to glasses or hearing aids may help avoid a substantial number of ED visits and hospitalizations.

The study has several limitations. We may not have captured all ED visits or hospitalizations, particularly if they occurred outside Boston. Moreover, because the study was conducted in Massachusetts, a state with universal health insurance, our results may not be generalizable to other states.

Providing primary care to older patients living in the street or a shelter is challenging. Focusing limited resources on targeting modifiable factors, including alcohol problems and common geriatric conditions, may lower rates of burdensome and costly acute care use in this vulnerable population.

Rebecca T. Brown, MD, MPH
Dan K. Kiely, MPH, MA
Monica Bharel, MD, MPH
Laura J. Grande, PhD
Susan L. Mitchell, MD, MPH

Author Affiliations: Division of Geriatrics, Department of Medicine, University of California, San Francisco (Brown); Hebrew SeniorLife Institute for Aging Research, Boston, Massachusetts (Kiely, Mitchell); Boston Health Care for the Homeless Program, Boston (Bharel); Psychology Service, Veterans Affairs Boston Healthcare System, Boston (Grande).

Corresponding Author: Rebecca T. Brown, MD, MPH, San Francisco Veterans Affairs Medical Center, 4150 Clement St, 1B1G, San Francisco, CA 94122 (rebecca.brown@ucsf.edu).


Author Contributions: Dr Brown 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.

Study concept and design: Brown, Mitchell.

Acquisition of data: Brown, Bharel, Grande.

Analysis and interpretation of data: All authors.

Drafting of the manuscript: Brown, Mitchell.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Brown, Kiely.

Obtained funding: Mitchell.

Administrative, technical, and material support: Grande, Mitchell.

Study supervision: Bharel and Mitchell.

Conflict of Interest Disclosures: None reported.

Funding/Sponsorship: This work was supported by National Institutes of Health grant NIH-NIA T32 AG000212 and the John A. Hartford Foundation. Dr Mitchell was supported by National Institutes of Health grant NIH-NIA K24 AG033640.

Additional Contributions: Mit Patel, MD (Department of Medicine, St Elizabeth’s Medical Center, Boston, Massachusetts), Kevin L. Ard, MD, MPH (Department of Medicine, Brigham and Women’s Hospital, Boston), Deborah Blazey-Martin, MD, MPH (Department of Medicine, Tufts Medical Center, Boston), and Daniella Floru, MD (Division of Geriatric Medicine, Lennert Shattuck Hospital, Boston) completed medical record reviews and provided comments on the manuscript.


The Influence of Hyperglycemia on the Therapeutic Effect of Exercise on Glycemic Control in Patients With Type 2 Diabetes Mellitus

Randomized clinical trials show that aerobic exercise training improves glycemic control in patients with type 2 diabetes mellitus (T2DM). However, interindividual variability is large. This may be explained by genetic variability, but ambient hyperglycemia and pancreatic β-cell function may also contribute. We examined whether changes in glycemic control following a 12- to 16-week aerobic exercise training intervention were influenced by the pretraining glycemic state in 105 individuals with impaired glucose tolerance or T2DM.

Methods | This study was approved by our institutional review board, and subjects provided informed consent. Before and following a 12- to 16-week period of aerobic exercise training, body composition, aerobic fitness (maximal oxygen uptake [VO2max]), and glycemic control (hemoglobin A1c [HbA1c], fasting glucose, and oral glucose tolerance test [OGTT] levels) were determined in a total of 105 older (mean [SEM] age, 61 [1] years), overweight or obese (mean [SEM] body mass index, 33 [1] [calculated as weight in kilograms divided by height in meters squared]) individuals with impaired glucose tolerance (n = 56) or T2DM (n = 49; diagnosed a mean [SEM] 4.8 [0.9] years prior and not insulin treated). Relationships between preintervention variables and intervention-induced changes in variables were assessed by linear and nonlinear regression. See eMethods in the Supplement for full details of the study design.

Results | Mean (SEM) change in body weight (−4.6 [0.5] kg), whole-body adiposity (−1.9% [0.3%]), VO2max (0.23 [0.03] L/min), fasting plasma glucose (−0.35 [0.08] mmol/L), and 2-hour OGTT (−0.8 [0.2] mmol/L) (to convert glucose to milligrams per deciliter, divide by 0.0555) were significantly improved following exercise training (full data are given in the eTable in the Supplement). Pretraining fasting plasma glucose level did not influence exercise-induced changes in glycemic control. However, there was a nonlinear quadratic relationship between pretraining 2-hour OGTT and exercise-induced changes in the 2-hour glucose response (r2 = 0.26; P = .06) (Figure, A). Subjects with a pretraining 2-hour OGTT
Individuals with impaired glucose tolerance or type 2 diabetes mellitus underwent 12 to 16 weeks of moderate-intensity exercise training, 5 days per week for 60 minutes per day. Individual subject data points are plotted on both panels; the x-axis represents the pretraining variable, and the y-axis indicates the exercise-induced change, such that the data points above the axis indicate an exercise-induced increase and vice versa. Open circles represent impaired glucose-tolerant subjects, and open triangles represent subjects with type 2 diabetes mellitus. The solid line represents the regression curve, and the dotted line represents the 95% confidence interval. A, There was a nonlinear quadratic relationship between pretraining 2-hour oral glucose tolerance test (OGTT) level and the training-induced change in 2-hour OGTT level ($y = 0.06x^2 - 1.5x + 7.6$ [$r^2 = 0.26; P = .06]$ [N = 105]). For every 1-mmol/L increase in pretraining 2-hour glucose level above 13.1 mmol/L (the inflection point of the curve), there was a 0.2-mmol/L loss of improvement in 2-hour glucose level following exercise. B, There was also a nonlinear quadratic relationship between pretraining hemoglobin A1c (HbA1c) level and the training-induced change in HbA1c level ($y = 0.33x^2 - 3.8x + 11.7$ [$r^2 = 0.33; P = .02$] [N = 52]). For every 1–percentage-point increase in pretraining HbA1c level above 6.2% (the inflection point of the curve), there was a 0.2–percentage-point loss of improvement in HbA1c level following exercise. C, An inverse linear relationship between pretraining HbA1c level and the training-induced change in aerobic fitness was found ($y = -0.11x + 0.91$ [$r = -0.38; P = .006$] [N = 52]). For every 1–percentage-point increase in pretraining HbA1c level, there was 0.11-L/min loss of improvement in maximal oxygen uptake ($V_\text{O}_2\text{max}$) following exercise training.

Prior work shows that diabetes remission following exercise and diet intervention is more likely in individuals with a shorter disease history and lower HbA1c level.6 We show that aerobic exercise-induced improvements in glycemic control are blunted by ambient hyperglycemia, particularly in subjects with T2DM. Mechanistic studies are required to help us understand this phenomenon, but underlying impairments in β-cell function are likely to be very important.5 That hyperglycemia blunted the cardiovascular adaptations to exercise ($V_\text{O}_2\text{max}$) is in agreement with some prior reports7 and may be explained by the causal association between chronic hyperglycemia and microvascular and macrovascular dysfunction.9

The clinical relevance of these new findings is paramount and highlights the need to understand the metabolic “nonresponder.” Because chronic hyperglycemia (>6.2% HbA1c level; >13.1-mmol/L glucose level) potentially predicts a poor therapeutic effect of aerobic exercise on glycemic control and fitness, using exercise to treat patients with poorly controlled T2DM may have limited chances of a successful outcome.

Discussion | These findings emphasize that exercise-induced improvements in glycemic control are dependent on the pretraining glycemic level. We demonstrate that although moderate-intensity aerobic exercise can improve glycemic control, individuals with ambient hyperglycemia are the most likely to be nonresponders. Our key observation is that pretraining hyperglycemia predicts exercise-induced improvements in glycemic control: for every 1–mmol/L rise in pretraining 2-hour OGTT glucose level above 13.1–mmol/L (the curve inflection point in Figure, A) we predict a 0.2–mmol/L loss of improvement in 2-hour OGTT glucose following exercise. Accordingly, for every 1–percentage-point increase in pretraining HbA1c level above 6.2% (the curve inflection point in Figure, B), we predict a 0.2% point loss of improvement in HbA1c level following exercise. Pretraining hyperglycemia also predicted the exercise-induced increment in aerobic fitness: for a 1–percentage-point increase in pretraining HbA1c level, we predict a 0.11-L/min loss of improvement in $V_\text{O}_2\text{max}$ following exercise.

Thomas P. J. Solomon, PhD
Steven K. Malin, PhD
Kristian Karstoft, MD
Jacob M. Haus, PhD
John P. Kirwan, PhD

Author Affiliations: Centre of Inflammation and Metabolism, Rigshospitalet, Copenhagen, Denmark (Solomon, Karstoft); Faculty of Health Sciences, University of Copenhagen, Copenhagen, Denmark (Solomon, Karstoft); Department of Pathobiology, Cleveland Clinic, Cleveland, Ohio (Malin, Kirwan);
Use of propofol for sedation for screening colonoscopy in low-risk patients: Are we paying too much?

Use of propofol for sedation for screening colonoscopy in low-risk patients has increased markedly recently. The potential benefits of propofol are limited. For screening colonoscopy in low-risk patients, the question thus becomes, what is propofol worth? For a patient who has never had a colonoscopy, this is a very difficult question to answer, since it is challenging to associate a dollar amount to comfort without knowledge of the likely degree of discomfort. Hence, we approached this question by asking those who are most familiar with colonoscopy and sedation medications—namely gastroenterologists and endoscopy nurses.

Methods | We validated a 3-question questionnaire by interviewing and asking 20 endoscopy physicians and nurses from 3 different endoscopy units to answer questions in an opened-ended manner; responses were used to construct the final questionnaire, which was then reviewed by additional gastroenterologists. The questions were as follows:

1. If you were to have screening colonoscopy, what sedation would you prefer?
   - Unsedated.
   - Midazolam-fentanyl (moderate sedation).
   - Propofol (deep sedation).

2. If you prefer propofol, how much extra would you be willing to pay out of pocket?
   - $0
   - $1-$100
   - $101-$200
   - $201-$300
   - $301-$500
   - More than $500
   - Doesn’t matter

3. I prefer propofol because (check all that apply):
   - I do not want to feel anything.
   - My recovery time will be faster.
   - I want to be taken care of by an anesthesiologist/certified registered nurse anesthetist.

The questionnaire was placed on SurveyMonkey.com and the link emailed to specific gastroenterology division directors asking them to distribute it to their faculty. Responses were also obtained by direct distribution and/or interview at the Digestive Diseases Week (the major national gastroenterology meeting). To obtain nurse responses, we attended 6 Society of Gastroenterology Nurses Association meetings and distributed paper questionnaires at the beginning of random oral sessions; responses were collected immediately after the session.

Results | Responses were received from 451 gastroenterologists and 460 nurses. The response rate for nurses, calculated as number of questionnaires with responses divided by number of questionnaires distributed, was 84%. For the gastroenterologists, the response rate was 87% for directly distributed questionnaires and 23% by web (SurveyMonkey.com).