Preventive Medicine 65 (2014) 128–132

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Diabetes diagnosis and exercise initiation among older Americans

Leigh Ann Leung [a,*], Shailender Swaminathan [a], Amal N. Trivedi [a,b]

[a] Brown University, Center for Gerontology and Health Care Research, 121 South Main Street, Box G-S121-6, Providence, RI 02912, USA
[b] Providence VA Medical Center, 830 Chalkstone Avenue, Providence, RI 02908, USA

ARTICLE INFO

Available online 10 May 2014

Keywords:
Tertiary prevention
Type 2 diabetes
Diagnosis
Exercise
Health behavior
Physician counseling

ABSTRACT

Objective. To determine whether exercise participation increased following a new diagnosis of diabetes using a sample of U.S. individuals aged 50 and over who did not report exercise prior to diagnosis.

Methods. We used data from the 2004–2010 Health and Retirement Study in a pre–post study design. Individuals newly-diagnosed with diabetes (N = 635) were propensity score matched to a comparison group with no diabetes.

Results. In the year following a reported diagnosis, 35.7% (95% confidence interval 32.0 to 39.5) of those newly diagnosed with diabetes initiated exercise as compared with 31.4% (95% confidence interval 27.9 to 35.1) for the matched cohort with no diabetes, with a between-group difference of 4.3 percentage points (95% confidence interval −0.9 to 9.4). Among individuals with fewer health risk factors at baseline, the between-group difference was 15.6 percentage points (95% confidence interval 1.58 to 29.5).

Conclusion. Over 35% of persons with a new diagnosis of diabetes initiated moderate or vigorous exercise in the year following their diagnosis. Among individuals with fewer health risk factors at baseline, those newly-diagnosed with diabetes were more likely to begin exercise than those without diabetes.

Introduction

Exercise and diet modification are foundations in the management of type 2 diabetes, with oral medications reserved for patients with severely elevated blood glucose or for those who do not achieve glucose control through lifestyle modification (Nathan, 2002; Ripsin et al., 2009; Short, 2012). Medication in conjunction with exercise improves glycemic control beyond that achieved by medication alone (Boulé et al., 2001; Castaneda et al., 2002; Dunstan et al., 2002). Moreover, an intensive lifestyle intervention consisting of exercise and diet has been shown to induce a partial remission of type 2 diabetes among overweight adults (Gregg et al., 2012). Even without weight loss, exercise has been shown to effectively lower blood glucose, cholesterol, and blood pressure (Marwick et al., 2009; Sigal et al., 2004, 2006).

Prior cross-sectional studies have found that persons with type 2 diabetes are less likely to engage in exercise than those without type 2 diabetes (Hays and Clark, 1999; Morrato et al., 2007; Nelson et al., 2002; Nothwehr and Stump, 2000). However, despite the central importance of exercise in diabetes management, it is unknown whether a new diagnosis of diabetes prompts patients to initiate exercise. This knowledge is critical to understanding the value of screening for diabetes and guide clinicians about whether a diagnosis of diabetes is associated with successful behavior change. For example, the United States Preventive Services Task Force (USPSTF) has stated that screening for type 2 diabetes other than for asymptomatic adults with high blood pressure will not improve outcomes. Others have argued that expanding the screening to a greater number of asymptomatic adults can prevent disease onset and improve outcomes (Gillies et al., 2008; Kahn et al., 2010; Knowler et al., 2002; Villarivera et al., 2012). Whether screening improves outcomes is contingent on whether patients respond to a diagnosis of diabetes and associated physician lifestyle counseling by changing health behaviors such as exercise.

The purpose of this study was to estimate the effect of a new diagnosis of diabetes on the initiation of exercise. This work is informed by Grossman's model of health production, in which an individual's health is a stock variable that depreciates over time but can be augmented by investments in time, income and medical care (Grossman, 1972). Each person's optimal level of health occurs when the marginal cost of maintaining a certain level of health equals the marginal benefit. Using this model, we hypothesized that when patients receive a new diagnosis of diabetes by a physician, they gain information that increases their demand to invest in their health. If individuals understand that diabetes leads to disease or death if not properly managed and exercise is recommended as a way to improve outcomes, then individuals will choose to exercise more. As a secondary hypothesis, we posit the effect of a diabetes diagnosis to be larger for moderate exercise because it is more attainable than vigorous exercise while the health benefits are comparable (Powell et al., 2005).

* Corresponding author at: 121 South Main Street, Box G-S121-6, Providence, RI 02912, USA. Fax: +1 401 863 3489.
E-mail address: leigh_ann_leung@brown.edu (L.A. Leung).

http://dx.doi.org/10.1016/j.ypmed.2014.05.001
0091-7435/

Methods

We employed a quasi-experimental study design that assessed longitudinal trends in the adoption of exercise among individuals who were newly diagnosed with diabetes compared to concurrent trends among a propensity-matched comparison sample who were not diagnosed with diabetes.

We used the University of Michigan Health and Retirement Study (HRS), a nationally representative sample of more than 30,000 individuals born between 1931 and 1941 and their spouses who could be of any age. Information on demographics, physical health, health behaviors, insurance coverage, financial status, and labor market status is collected in survey waves every two years since 1992. The study cohort, recruitment, and data collection procedures are described elsewhere (Heeringa and Connor, 1995). Brown University's Human Research Protection Office deemed the study to be exempt from Institutional Review Board (IRB) review.

Variables

The primary outcome variable was the initiation of exercise, defined as engaging in either moderate or vigorous physical activities at least twice per week after a prior wave in which the same respondent reported not participating in any moderate or vigorous physical activities. Vigorous physical activities include running or jogging, swimming, cycling, aerobics or gym workout, tennis, or digging with a spade or shovel. Moderate physical activities include gardening, cleaning the car, walking at a moderate pace, dancing, or floor or stretching exercises. Fig. 1 shows the time trend in exercise prevalence for the HRS cohort by survey year for individuals with and without diabetes.

The initiation of vigorous exercise, defined as participating in vigorous physical activities at least twice per week after a prior wave in which the same respondent reported not participating in any moderate or vigorous physical activities, was used as a secondary outcome variable.

The primary independent variable was a new diagnosis of diabetes, which we defined as a respondent indicating that a physician diagnosed him/her with diabetes after a prior wave in which the same respondent did not indicate he/she had been diagnosed with diabetes.

Other important covariates were age (in years), sex, race/ethnicity (white, black, Hispanic, other), education (number of years of schooling), income (continuous), current employment, presence of health insurance coverage, marital status, self-rated health (excellent, very good, good, fair or poor), body-mass index (continuous), smoking status, presence of high blood pressure, presence of heart disease, and hospitalization since prior wave. These variables were measured at baseline defined as the wave prior to a new diabetes diagnosis except for hospitalizations, which were measured in the same wave since it was asked retrospectively.

Study sample

Using data for waves 2004, 2006, 2008, and 2010, when questions on exercise were asked, we identified 1532 individuals who reported that a physician had diagnosed him/her with diabetes in waves 2006, 2008, and 2010 after a previous survey wave in which they indicated that they had never been diagnosed with diabetes. Those who reported "ever" diagnosed, e.g. not newly diagnosed, with diabetes were not included in the study sample. Of these newly diagnosed individuals, we excluded 106 who had cancer or lived in a nursing home prior to the diagnosis and 45 who were missing data on covariates. We further excluded 746 newly diagnosed individuals who had reported that they exercised at least 2 times per week in the prior survey wave. We matched each newly diagnosed individual in the final sample (N = 635) to a control respondent from the same pool of HRS individuals who did not report a new diagnosis of diabetes. Controls could not have reported exercise in the prior survey wave.

As shown in the Table 1 for exercise participation outcome, the matched control group had 597 unique persons. This means that 38 observations used a person more than once. However, no person–wave was used more than once. So if a person was used more than once as a matched control, he/she was observed in a different wave for each match.

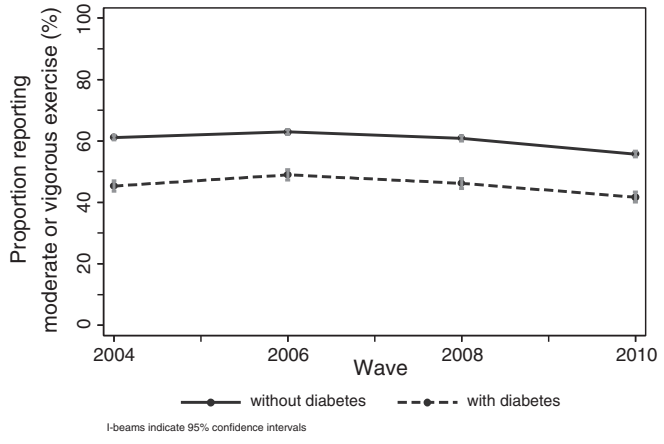

Fig. 1. Exercise prevalence rates from the Health and Retirement Study (HRS) for individuals with and without diabetes by survey year.

Statistical analysis

The propensity-score was estimated using a logit model specification such that the likelihood of a diabetes diagnosis is a function of the baseline and current characteristics of the individual. Individuals in the study sample were matched to individuals in the comparison sample based on the propensity-score using one-to-one nearest neighbor matching with a greedy algorithm, no replacement, and common support for the baseline characteristics. All individuals in the study sample were matched.

To analyze how the effect of a diabetes diagnosis varies with the presence of other health risk factors, we sorted and assigned individuals into 6 stratas according to their estimated propensity score where each strata is balanced on baseline characteristics. Within each strata, individuals in the study sample were then matched to individuals in the comparison sample using one-to-one nearest neighbor matching with a greedy algorithm, no replacement, and common support for the baseline characteristics.

All reported P values are two-sided, and P values of less than 0.05 were considered to indicate statistical significance. STATA software, version 12 was used for statistical analyses. In the Sensitivity analysis section, we report results using other matching and non-matching estimation methods.

Results

Table 1 shows the mean and standard error of each baseline characteristic in the propensity score estimation model for the study and matched comparison samples. None of the characteristics were statistically significantly different at the 5% significance level.

Fig. 2 (left panel) shows the estimated adjusted difference in exercise initiation in the wave of a reported diabetes diagnosis and the wave before and after the diagnosis. As designed, prior to the diagnosis, exercise participation rate is zero for both the study and matched cohorts. In the year following a reported diagnosis, the proportion reporting moderate or vigorous exercise was 35.7% (95% CI 32.0 to 39.5) for those newly diagnosed with diabetes and 31.4% (95% CI 27.9 to 35.1) for the matched cohort who were not diagnosed with diabetes. Therefore, the adjusted between-group difference in exercise initiation was 4.3 percentage points (95% CI −0.9 to 9.4).

Fig. 2 (right panel) shows that of the patients newly diagnosed with diabetes, 10.0% (95% CI 7.6 to 12.3) initiated vigorous exercise in the year following their diagnosis. The concurrent rate of vigorous exercise initiation was 8.9% (95% CI 6.6 to 11.1) for the matched cohort with no diabetes. The adjusted between-group difference in vigorous exercise participation was 1.1 percentage points (95% CI −2.1 to 4.3).

Fig. 3 shows the adjusted between-group difference in exercise initiation by propensity score strata, where 1 is the strata with the lowest propensity scores and 6 the highest. There is a clear negative relationship between propensity score and difference in exercise initiation. The between-group difference in exercise initiation is highest for strata 2 at 15.6 percentage points (95% CI 1.6 to 29.5) and lowest for strata 5 at −4.4 percentage points (95% CI −16.9 to 8.2). Since propensity scores are positively associated with the presence of health risk factors such as obesity, age, hypertension, and smoking, the negative relationship