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A longitudinal community study of major depression and physical activity

Scott B. Patten, M.D., Ph.D.*, Jeanne V.A. Williams, M.S.c, Dina H. Lavorato, M.S.c., Michael Eliasziw, Ph.D.

Department of Community Health Sciences, University of Calgary, Calgary, Canada T2N 4N1

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Abstract

Background: The objective of this study was to determine whether major depressive episodes (MDEs) are associated transitions between active and inactive recreational activity patterns.

Methods: The data source was the Canadian National Population Health Survey (NPHS). The NPHS included a brief instrument to assess MDEs and collected data on participation in recreational activities. In order to meaningfully categorize participation in recreational activities, the participation data was translated into overall estimated metabolic energy expenditure. A threshold of 1.5 kcal/kg per day was used to distinguish between active and inactive activity patterns. Proportional hazards models were used to compare the incidence of inactivity in initially active respondents with and without MDE and to compare the frequency of becoming active among initially inactive respondents with and without MDE.

Results: For active respondents with MDE, an elevated risk of transition into an inactive pattern was observed [adjusted hazard ratio (HR)=1.6; 95% CI 1.2–1.9]. However, MDE did not affect the probability of moving from an inactive to an active lifestyle (adjusted HR=1.0; 95% CI 0.78–1.19).

Conclusions: Major depressive episodes are associated with an increased risk of transition from an active to an inactive pattern of activity.

Keywords: Major depressive episode; Depressive disorders; Longitudinal studies; Leisure Activities; Recreation

1. Introduction

The association between depression and physical inactivity is potentially bidirectional with physical inactivity leading to depression and depression leading to physical inactivity. Elfrey and Ziegelstein [1] have used the phrase “inactivity trap” to describe this dynamic. The possibility that physical activity may prevent depression or reduce levels of depressive symptoms has been the focus of many recent studies. This literature was reviewed by Teychenne et al. [2], who found general support for the idea that physical activity reduces depressive symptom levels, especially if the activity is vigorous and takes the form of leisure activity. However, all of the published studies have used symptom scales rather than more clinically salient diagnostic categories.

Another less studied aspect of the physical “inactivity trap” is the possibility that depression may negatively influence patterns of physical activity. If so, physical inactivity may be a mechanism linking depression to various negative health outcomes such as premature mortality, cardiovascular disease, diabetes and obesity. Only a few studies have been concerned with this possibility, and none has been conducted using a general population sample. The relevant literature was recently reviewed by Roshanaei-Moghaddam et al. [3]. Most of the studies in this literature have relied on depression symptom ratings rather than on more clinically salient diagnostic definitions. One longitudinal study conducted in primary care, however, used the Patient Health Questionnaire (PHQ), a scale that is closely aligned with diagnostic criteria for major depressive episode (MDE) [4]. This study found that primary care patients with diabetes who were free of MDE symptoms at a baseline and

* Corresponding author. Department of Community Health Sciences, Faculty of Medicine, University of Calgary, Calgary, AB, Canada. Tel.: +1 403 220 8752; fax: +1 403 270 7307.

E-mail address: patten@ucalgary.ca (S.B. Patten).

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after 5 years of follow-up exercised more than patients with persistent or worsening (increase ≥5 points on the PHQ) depression [5]. The Longitudinal Aging Study Amsterdam (LASA) similarly found that respondents with an emerging depression (defined as an increase in CES-D scores ≥1 S.D.) were more likely to make a transition into a sedentary lifestyle [6]. However, both of these studies focused on specific populations and their results may not be generalizable to the broader population. Also, the CES-D instrument employed in LASA assesses depressive symptoms rather than depressive disorders.

In summary, it is possible that depression may have a bidirectional relationship with physical inactivity. The literature contains some support for an effect of activity on depressive symptom levels, but the effect of depression on physical activity has been less well studied. No relevant studies have used general population samples, and most studies have relied on depressive symptom ratings rather than on assessment of depressive disorders.

The objective of this study was to examine whether depressive episodes are associated with an increased risk of transition from an active to an inactive pattern of physical activity in the general population. We also sought to evaluate the possibility that people with a recent MDE would be less likely to initiate an active pattern of recreational physical activity.

2. Method

2.1. Data source

The National Population Health Survey (NPHS) is a longitudinal study based on a nationally representative community sample assembled by Statistics Canada (Canada's national statistical agency) in 1994/1995. The baseline NPHS interview was conducted face to face and since that time NPHS respondents have been reinterviewed every 2 years by telephone. Data collected up to 2004 were used in the analysis reported here. Statistics Canada has reported a 77.6% rate of successful follow-up to the 2004 NPHS cycle [7].

The NPHS longitudinal cohort included 17,276 participants in total, but the current analysis was restricted to 15,254 respondents who were over the age of 12 at the time of the initial 1994 interview. This subset was further reduced to those respondents at risk of one of the health transitions of interest to the study. In the part of the analysis concerned with MDE as a risk factor for physical inactivity, the analysis was restricted to 5695 respondents who reported an active lifestyle (see definition below) at the baseline interview in 1994. In the part of the analysis concerned with the initiation of physical activity, the analysis was restricted to n=8422 respondents who were inactive at the baseline interview.

2.2. Assessment of major depression

The NPHS interview included the Composite International Diagnostic Interview Short Form (CIDI-SF) [8] for major depression, which assesses past year MDE. The CIDI-SF was developed using data from the National Comorbidity Survey [9], which used the *DSM-III-R* classification. The instrument consists of a modified subset of CIDI items capable of identifying respondents with a high probability of past-year MDE. The CIDI-SF is scored using an algorithm that produces a predictive probability of MDE. For the current analysis, the 90% predictive cut-point was used. This scoring procedure requires endorsement of five symptom-based criteria (at least one of which must be depressed mood or loss of interest), providing face validity for the *DSM-IV* definition of MDE.

2.3. Assessment of physical activity

Each cycle of the NPHS also included items assessing participation in specific recreational activities. Each of these activities was assigned a metabolic indicator (MET) value [10] representing an estimated metabolic energy cost (in kilocalories expended per kilogram of body weight per hour) which is expressed as a multiple of the resting metabolic rate. For example, the MET value for playing basketball is 6, whereas that for social dancing is 3. Daily estimated energy expenditure was then calculated based on the amount of time spent participating in the specified activities. A total estimated energy expenditure of 1.5 kcal/kg per day was used to categorize respondents into active or inactive categories. This level of activity corresponds approximately to 30 min of walking for exercise per day. The methodological approach to the assessment of leisure time physical activity used in the NPHS was developed by the Canadian Fitness and Lifestyle Institute (http://www.cflri.ca).

2.4. Other measures

A set of additional available variables were included in the analysis because they were judged to be potential effect-modifying or confounding variables. As a confounding variable must be an independent determinant of outcome (recreational physical activity) and associated with exposure (MDE), variables thought likely to be associated with recreational physical activity were regarded as potential confounding variables. Sex was assessed in the survey using standard items. Age was categorized into five groups (12–18, 19–25, 26–45, 46–65 and 66+) for stratified analysis but was treated as a continuous variable in regression models (see below). Asthma or other long-term medical conditions were evaluated using items that inquired about chronic medical conditions diagnosed by a health professional. Additional NPHS items allowed the identification of current smokers. A subset of respondents reporting injuries of any type that were "serious enough to limit your normal activities" were also identified. Obesity was also included as a covariate. The NPHS collected self-report data on height and weight, allowing calculation of body mass index (BMI). Analyses involving BMI were restricted to ages 18 and over and excluded pregnant women. A BMI ≤18.5 was considered underweight, whereas ≥25 was considered overweight/obese.

2.5. Statistical analysis

After preliminary descriptive and stratified analyses, the effect of MDE on the incidence of physical activity and inactivity was evaluated using proportional hazards models for grouped time data. The models were fit as generalized linear models of the binomial family with a complementary log–log link function. Jenkins [11] outlines procedures for implementation of such analyses in STATA [12]. The proportional hazards assumption was evaluated using a likelihood ratio test for time-by-exposure interactions, either MDE or physical activity by time (depending on the analysis). MDE was treated as a time-varying factor. MDE status as determined at the start of each 2-year follow-up interval determined whether a respondent was in the exposed or nonexposed cohort during that interval. Because of the possibility that fatigue may be an important symptom linking MDE to inactivity, the model linking MDE to inactivity was rerun with the CIDI short form being rescored so as not to count the fatigue/low energy item: “during those two weeks…did you feel tired or low on energy all of the time?”

The target population for the NPHS consisted of household residents. Residents of institutions, certain remote areas, Indian reserves and the Armed Forces were excluded from the sampling frame. The NPHS used a multistage sampling procedure that resulted in unequal selection probabilities and potential correlations within sampling units. To correct for these design effects, Statistics Canada recommends a bootstrap procedure that uses a set of 500 replicate sampling weights. The NPHS sampling weights also include a nonresponse adjustment. Respondents who were lost to follow-up, died or were institutionalized were censored in the analysis. All analyses, including the bootstrap procedure, were conducted using STATA 9.0 [12].

3. Results

Table 1 presents the characteristics (weighted percentages) of the study groups.

A large proportion of active respondents made a transition to an inactive lifestyle at each cycle. Between 1994 and 1996, 1884 of the initially active respondents (*n*=5695) entered the inactive lifestyle category, a weighted frequency of 35.7%. The risk of transition during this initial follow-up interval was similar in men at 33.5% (95% CI 31.0–36.0) and in women at 38.2% (95% CI 35.6–40.9). However, the risk of transition was lowest in the youngest (12–18) age group (28.2%, 95% CI 23.7–32.7) and highest in respondents over the age of 65 (43.2%, 95% CI 37.9–48.4). In subsequent cycles, between 13.1% and 25.8% of those remaining physically active through prior cycles moved to the inactive category. By 2004, 3533 of the 5695 originally active respondents had entered the inactive category.

In order to estimate the unadjusted HR for the effect of MDE on transition to inactivity, we initially fit a proportional hazards model that did not contain any covariates. No violation of the proportional hazards assumption was identified (likelihood ratio test for time interval by MDE interaction: χ^2=1.66, *df*=4, *P*=.80). The unadjusted HR was 1.6 (95% CI 1.3–2.0). No interactions between the identified covariates and MDE were found. In models including main effects of MDE and each individual

Table 1
Characteristics of the study sample at the baseline interview, by MDE and physical activity

	Physically active (*n*=5695)		Physically inactive (*n*=8422)	
	MDE (*n*=336)	No MDE (*n*=5318)	MDE (*n*=513)	No MDE (*n*=7852)
Sex				
Females	60.7 (53.5–67.9)	46.4 (44.9–47.9)	75.1 (70.4–79.8)	55.3 (54.2–56.4)
Males	39.3 (32.1–46.5)	53.6 (52.1–55.1)	24.9 (20.2–29.6)	44.7 (43.6–45.8)
Age				
12–18	19.6 (13.1–26.0)	18.2 (16.9–19.5)	9.1 (5.0–13.1)	7.2 (6.4–7.9)
19–25	21.0 (15.1–26.8)	11.9 (10.8–13.0)	14.1 (9.9–18.3)	9.0 (8.3–9.7)
26–45	40.3 (33.5–47.1)	37.6 (36.3–38.9)	47.2 (41.8–52.6)	42.7 (41.7–43.8)
46–65	15.8 (11.0–20.6	21.7 (20.5–22.9	22.3 (18.0–26.7	26.5 (25.6–27.4
66+	3.4 (1.5–5.3	10.6 (9.7–11.4	7.3 (5.1–9.6	14.6 (14.0–15.3
Asthma	7.2 (4.1–10.4)	7.2 (6.3–8.1)	9.6 (6.0–13.1)	5.5 (4.8–6.2)
Other long-term condition	58.5 (51.5–65.4)	49.0 (47.3–50.6)	65.1 (60.0–70.3)	50.5 (49.0–52.1)
Smoking (current)	44.1 (36.9–51.4	25.6 (24.2–27.0	50.8 (45.5–56.2	30.3 (29.1–31.5
Injuries	36.2 (29.4–43.1)	21.8 (20.4–23.2)	20.8 (16.1–25.6)	13.7 (12.6–14.8)
Obesity				
Underweight	2.2 (0.5–3.6)	1.9 (1.3–2.5)	4.1 (2.0–6.3)	3.1 (2.5–3.6)
Normal	61.7 (54.4–69.0)	51.5 (49.6–53.4)	53.1 (47.1–59.1)	47.3 (45.6–49.0)
Overweight/obese	36.1 (28.8–43.4)	46.6 (44.7–48.5)	42.8 (36.8–48.8)	49.6 (48.0–51.3)

Values are shown as % (95% CI).

Table 2
Proportional hazards model describing MDE as a determinant of transition from active to inactive recreational activity

	HR	95% CI	*P* value
MDE	1.6	1.2–1.9	<.001
Female sex	1.1	1.0–1.3	.019
Age	1.0	1.0–1.0	.002
Smoking	1.3	1.2–1.5	<.001
Asthma	1.1	0.9–1.4	.381
Other medical conditions	1.0	0.9–1.2	.409
Injuries	1.0	0.8–1.1	.694
BMI			
Underweight	1.8	1.2–2.7	.006
Overweight/obese	1.2	1.1–1.4	<.001

Table 3
Proportional hazards model describing MDE as a determinant of transition from inactive to active recreational activity

	HR	95% CI	*P* value
MDE	1.0	0.8–1.2	.845
Female sex	0.8	0.8–0.9	<.001
Age	1.0	1.0–1.0	<.001
Smoking	0.9	0.8–0.9	.002
Asthma	1.2	1.0–1.4	.084
Other medical conditions	0.9	0.8–0.9	.001
Injuries	1.1	1.0–1.3	.095
BMI			
Underweight	0.8	0.6–1.0	.081
Overweight/obese	1.0	0.9–1.1	.878

covariate, there was no association found between the risk of inactivity and injury (HR=0.9; 95% CI 0.8–1.1), chronic conditions (HR=1.1; 95% CI 1.0–1.2) or asthma (HR=1.1; 95% CI 0.9–1.4). However, smoking (HR=1.3; 95% CI 1.1–1.5), underweight (HR=1.9; 95% CI 1.3–2.9) and overweight/obese status (HR=1.3; 95% CI 1.1–1.4) increased the risk. A model containing these covariates is presented in Table 2. The HR after adjustment ~~for age, sex, smoking and obesity~~ was 1.6% (95% CI 1.2–1.9), essentially unchanged from the unadjusted HR. In brief, MDE was associated with a 60% increase in the risk of transition to an inactive lifestyle pattern and there was no evidence of effect modification or confounding by the covariates included in the analysis. When this model was rerun with exclusion of the fatigue item from the scoring interval, the HR was essentially unchanged at 1.7 (95% CI 1.3- 2.2).

Between 1994 and 1996, 1941 of the initially inactive respondents (n=8422) entered the active lifestyle category, a weighted frequency of 27.3%. The risk of transition during this initial follow-up interval was 30.0% (95% CI 27.8–32.2) in men and 25.3% (95% CI 23.6–27.0) in women. However, the probability of becoming active was highest in the youngest (12–18) age group (48.5%; 95% CI 42.4–54.6) and lowest in respondents over the age of 65 (20.5%; 95% CI 17.3–23.7). In subsequent cycles, between 27.3% (1996) and 16.8% (2004) of those remaining inactive through prior cycles moved to the active category.

In the proportional hazards analysis, no violation of the proportional hazards assumption was identified (likelihood ratio test: χ^2=2.19, df=4, P=.701). The unadjusted HR was 1.0% (95% CI 0.8–1.2). In models including main effects of MDE and each individual covariate, there was no association found between the probability of this transition and smoking (HR=0.9; 95% CI 0.8–1.0), asthma (HR=1.1; 95% CI 0.9–1.3) and being overweight/obese (HR=0.9; 95% CI 0.8–1.0). There was, however, an association with injury (HR=1.2; 95% CI 1.0–1.3), other chronic conditions (HR=0.8; 95% CI 0.7–0.9) and being underweight (HR=0.7; 95% CI 0.5–0.9). A model containing ~~age, sex and~~ these covariates is presented in Table 3. The HR after adjustment ~~for age, sex, smoking and other chronic conditions~~ was 1.0 (95% CI 0.8–1.2), identical to the unadjusted HR.

4. Discussion

As the NPHS is a general health survey, its measures of physical activity and MDE were fairly crude. The measurement of participation in physical activity was not objectively confirmed. Also, the choice of variables that were included in the modeling was partially determined by the availability of measures in the NPHS. However, the longitudinal nature of the NPHS is a strength, as is the large and representative nature of the sample. The measure of MDE was a brief instrument, not as detailed as the full version of the CIDI interview. There is no reason to expect that misclassification of MDE status by the CIDI short form would depend on physical activity. As a result, the direction of any resulting bias can be expected to be towards the null value ~~[13]~~. Such bias cannot explain the association reported here between MDE and emergence of an inactive lifestyle pattern.

Preferably, the data collection interviews would have been conducted more frequently than every 2 years. This would have allowed a more detailed description of temporal relationships. A respondent found to have MDE at one interview might have recovered from that episode and then subsequently made a transition at a time when they were not depressed. Similarly, a nondepressed respondent may have become depressed during the year after an interview and then may have made a transition subsequently while depressed. In each of these scenarios, the result is misclassification of depression status. The most probable result would be a bias towards the null value [13].

MDE may be an important modifiable determinant of transitions to an inactive lifestyle. An intriguing possibility is that exercise, which is usually regarded as a sensible, if questionably efficacious, component of depression treatment ~~[14]~~ may serve the dual purpose of improving mental health outcomes while also preventing the emergence of an inactive lifestyle. However, MDE does not appear to lower the probability of becoming active.

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