



## The projected effect of increasing physical activity on reducing the prevalence of common mental disorders among Canadian men and women: A national population-based community study

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### ABSTRACT

**Objective.** Little quantitative research has been conducted on the effect of physical activity (PA) modification on the prevalence of mental disorders in a nationally representative sample. We aimed to provide quantitative evidence regarding the potential effectiveness of PA in the management of mental disorders.

**Methods.** We used data from the national Canadian Community Health Survey of Mental Health and Well-being (CCHS 1.2) designed to represent the approximately the 25 million national community population aged 15 years and over in 2002.

**Results.** Around 1 in 10 Canadians reported a 12-month mental disorder. Women reported more mood and anxiety disorders, men more substance dependence. Almost half of Canadians were physically inactive. After adjusting for covariates, physical inactivity was a significant risk factor for common mental disorders, except manic episode. Approximately 780,000 cases nationally are attributable to physical inactivity. A 10% reduction in the rate of physical inactivity would reduce common mental disorders by 167,000 cases, a 25% reduction would result in 389,000 fewer cases. PA was more beneficial for men.

**Conclusions.** Clinicians and public health campaigns targeting individual patients and general populations can improve patients' symptoms and prevent a significant proportion of future mental disorders by increasing the amount of PA.

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### Introduction

Mental disorders are often chronic and recurrent and are associated with a tremendous burden. Although mental disorders have some effective treatments (Butler et al., 2006; Koenig and Thase, 2009; Leucht et al., 2011), the public health impact of these measures is limited (Fournier et al., 2010; Weisberg et al., 2007; Weissman et al., 2006). There is a need for additional cost effective treatment modalities to be identified.

To reduce the burden of mental disorders, greater attention should be given to prevention and promotion strategies which can be used by clinicians targeting individual patients and public health program planners targeting large population groups (WHO, 2002). These public health interventions should be low cost, accessible, and effective.

**Abbreviations:** CCHS, Canadian Community Health Survey; DSM-IV, Diagnostic and Statistical Manual of Mental disorders, 4th Edition; MDE, major depressive episode; PA, physical activity; M&ADs, mood and anxiety disorders; OR, odds ratio; PAFs, population attributable fractions; WMH-CIDI, World Mental Health-Composite International Diagnostic Interview Instrument.

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There has been considerable research interest in the effect of physical activity (PA) upon mental disorders (e.g. depression) (Daley and Jolly, 2012; Daley et al., 2007; Lawlor and Hopker, 2001; Legrand and Heuze, 2007; Trivedi et al., 2011). A recent review of reviews on exercise and depression concludes that exercise as treatment for depression is more effective than no treatment and is as effective as traditional interventions, at least in the short term, although it has minimal side effects, it can be limited by high remission rates, commitment, and motivational commitment from patients (Daley, 2008). Previous literature has qualitatively explored the association between PA and mental disorders, especially for depression (Cairney et al., 2009). Trivedi et al. (2011) quantitatively exploring the effectiveness of PA in a randomized controlled trial, found that exercise was a viable augmentation strategy for depressed patients who were not sensitive to selective serotonin reuptake inhibitors. Rimer et al. (2012) in their systematic review of randomized controlled trials found that: exercise may improve depressive symptoms for those with depression when compared with no treatment or control intervention; the effect of exercise decreased in the more robust trials; caution is needed when interpreting the positive role of exercise in treating depressive symptoms.

There has been a promising trend of using population attributable fractions (PAFs) as effective tools to quantify the potential effects of

risk factors on mental disorders at population level (Barnes and Yaffe, 2011; Bolton and Robinson, 2010; Sareen et al., 2008). PAFs are commonly defined as the proportional reduction in average disease risk that would be achieved by elimination of the exposure of interest (Rockhill et al., 1998). Strohle et al. (2007) using a community cohort of adolescents and young adults to explore relationships between PA and mental disorders found that: regular exercise was associated with a substantially reduced risk for some mental disorders and co-morbidity; the potentially preventive effects were greater for males than females. While the research linking PA to the prevention of mental disorders is promising, more research is needed at a national population level to provide quantitative measures of the potential effects of PA modification on the prevalence of mental disorders.

The aim of this study was to provide quantitative evidence regarding the potential effectiveness of PA in the control of mental disorders by calculating PAFs, which takes into account the prevalence of PA as well as the strength of its association with the outcome of interest. *Physical inactivity* is a largely modifiable risk factor, that can be modified and thus affect health outcomes.

## Methods

### Data source

Data analyzed was from a national mental health survey of the Canadian community population collected between May and December 2002 – Canadian Community Health Survey (CCHS 1.2) (Gravel and Beland, 2005). The survey employed a multistage sampling framework to ensure representation of Canadian community population. Sampling was based on the standard area probability frame employed by Statistics Canada for its Labor Force Survey (Statistics Canada, 2008). The sample consisted of 36,984 respondents. The response rate was 77.0%. Respondents were assigned weights therefore it was possible to calculate Canadian population parameters. The survey objectives and data collection methods were approved by the steering committee of Statistics Canada. Respondents were informed that their participation in the survey was voluntary. All personal information collected or held by Statistics Canada is kept confidential and secure. The present study is a secondary analysis of data from the CCHS 1.2. Details about this survey can be found from previous publications (Dewa et al., 2007; Gravel and Beland, 2005).

### Physical activities

The PA measures in CCHS 1.2 are based on sources used by Canadian Fitness and Lifestyle Research Institute ([www.cflri.ca](http://www.cflri.ca)), and in other surveys such as Ontario Health Survey ([www.chass.utoronto.ca/datalib/codebooks/utm/ohs/ohs90.htm](http://www.chass.utoronto.ca/datalib/codebooks/utm/ohs/ohs90.htm)) and the Campbell's Survey on Well-Being in Canada ([www.cflri.ca/cflri/pa/surveys/88survey.html](http://www.cflri.ca/cflri/pa/surveys/88survey.html)). Exposure to leisure time PA in the past three months was assessed through a series of questions, e.g. "Have you done any of the following (physical activities) in the past three months...?"; "In the past three months, how many times did you participate in that activity?"; "How much time did you spend on each occasion?". Energy expenditure values previously developed were used to categorize an individuals' PA level as active, moderate, and inactive ([www.cflri.ca/cflri/pa/surveys/88survey.html](http://www.cflri.ca/cflri/pa/surveys/88survey.html)).

### Mental disorders

The CCHS 1.2 used selected modules from World Mental Health-Composite International Diagnostic Interview Instrument (WMH-CIDI) to assess the prevalence of common mental disorders (Kessler et al., 2004). This diagnostic instrument has been widely used internationally (Kessler et al., 2007). The WMH-CIDI is a lay-administered psychiatric interview that generates a profile of those with a disorder according to the definitions of the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV). Past-year prevalence of the following DSM-IV mental disorders were assessed: major depressive episode (MDE), manic episode, panic disorder, social phobia, agoraphobia, any mood disorder, any anxiety disorder, any substance dependence, alcohol dependence, illicit drug dependence, and any selected disorder or substance dependence. Individuals with any of mood or anxiety disorder were also grouped together as mood and anxiety disorders (M&ADs) positive. Comorbidity was defined as suffering more than one mental disorder.

**Table 1**  
Demographic characteristics of the study sample of Canadians, 2002.

	Men, n (%) <sup>a</sup>	Women, n (%) <sup>a</sup>
Total	16,773 (49.2)	20,211 (50.8)
Age, years		
15–25	2926 (18.6)	3220 (17.6)
26–45	6131 (39.3)	6080 (37.5)
46+	7716 (42.1)	10,191 (44.9)
Marital status		
Married/common law	9234 (63.5)	9950 (59.9)
Never married	5138 (28.1)	4660 (22.8)
Separated/widowed/divorced	2388 (8.4)	5582 (17.1)
Household income		
Highest	4722 (33.5)	3955 (26.5)
Upper middle	5721 (33.4)	6061 (31.4)
Middle	3309 (17.4)	4772 (20.4)
Lower middle	989 (4.8)	2366 (7.9)
Lowest	651 (2.6)	948 (3.1)
Education		
Post secondary graduation	7659 (47.7)	8955 (45.8)
Some post secondary	1363 (8.5)	1687 (8.1)
Secondary school graduation	2887 (17.8)	3610 (19.7)
Less than secondary school graduation	4739 (25.0)	5853 (25.5)
Immigrant status		
No	14,128 (77.4)	17,024 (77.2)
Yes	2540 (21.9)	3059 (22.1)
Place of residence		
Rural	3870 (19.3)	4368 (18.4)
Urban	12,903 (80.7)	15,843 (81.6)

Totals for each variable vary due to missing data.

<sup>a</sup> Numbers are unweighted, and percentages are weighted.

### Suicidality

Past-year suicidal thought was measured by using the following question: "Did you seriously thought about committing suicide or taking your own life?" Past-year suicidal attempt was measured by using the question: "Have you ever attempted suicide during the past 12-month?"

### Statistical analyses

The bootstrap procedure recommended by Statistics Canada utilizing a set of 500 replicate sampling weights that are representative of the national community population was used. The CCHS 1.2 survey sample was weighted to represent the Canadian community population of 24,996,593 individuals aged 15 and over in 2002 (12,286,109 males and 12,710,483 females). All analyses were conducted using the CCHS 1.2's confidential Master data files at the Saskatchewan Research Data Centre on the University of Saskatchewan campus. All analyses were based on SAS software, version 9.1 (SAS Institute Inc., Cary, NC). We examined the prevalence of PA, mental disorders, and suicidality stratified by gender. We used the  $\chi^2$  test to determine the differences between men and women with respect to exposure to the PA variables and dependent variables. PAFs of dependent variables represent the percentage of all cases of each outcome among national community population exposed to different levels of PA that would not have occurred if the exposure had not occurred.

The definition of PAF is the proportional reduction in average diseases risk that would be achieved by elimination of exposure of interest (Rockhill et al., 1998). The PAF was calculated by the following formula based on previous

**Table 2**  
Physical activity status among Canadians in 2002.

Physical activity status	Total, n (%) <sup>a</sup>	Men, n (%) <sup>a</sup>	Women, n (%) <sup>a</sup>	P-value <sup>b</sup>
Active	9526 (26.1)	4950 (29.0)	4576 (23.4)	<0.001
Moderate	9818 (26.7)	4342 (26.1)	5476 (27.2)	
Inactive	17,634 (47.2)	7478 (44.9)	10,156 (49.4)	

<sup>a</sup> Numbers are unweighted, and percentages are weighted.

<sup>b</sup> The chi-square test was used for two gender groups.

**Table 3**  
Prevalence of past-12 month selected mental disorders among Canadians in 2002 by gender.

Past 12-month disorders	Men, n (%) <sup>a</sup>	Women, n (%) <sup>a</sup>	P-value <sup>b</sup>
Major depressive episode	687 (3.7)	1257 (5.9)	<0.001
Manic episode	173 (1.0)	220 (1.0)	0.091
Panic disorder	184 (1.0)	433 (2.0)	<0.001
Social phobia	450 (2.6)	739 (3.4)	0.001
Agoraphobia	78 (0.4)	195 (1.1)	<0.001
Any selected mood disorder	768 (4.2)	1354 (6.3)	<0.001
Any selected anxiety disorder	624 (3.5)	1179 (5.7)	<0.001
Any selected mood and anxiety disorder	1154 (6.4)	2132 (10.3)	<0.001
Alcohol dependence	736 (3.8)	312 (1.3)	<0.001
Drug dependence	191 (1.1)	97 (0.5)	<0.001
Any substance dependence	840 (4.5)	375 (1.7)	<0.001
Any selected disorders/substance dependence	1789 (9.9)	2345 (11.4)	0.002
Suicidal thoughts	640 (3.6)	816 (3.8)	0.550
Suicidal attempts	85 (0.4)	145 (0.6)	0.013

<sup>a</sup> Numbers are unweighted, and percentages are weighted.

<sup>b</sup> The chi-square test was used for two gender groups.

literature (Barnes and Yaffe, 2011; Rockhill et al., 1998; Sareen et al., 2008).  $PAF = \frac{p(OR-1)}{p(OR-1)+1}$ , where p is the population prevalence of the risk factor and OR is the odds ratio of outcomes given the level of PA holding other covariates constant. We calculated ORs based on multiple logistic regression analyses in which PA level was the independent variable and mental disorders and suicidality were the dependent variables. We conducted an individual logistic regression model for each dependent variable. Potential confounders were adjusted for all models including age, gender, marital status, education, income, immigrant status, place of residence, and a measure of chronic medical condition.

## Results

The standard reporting format for population-based survey tables presents unweighted numbers (n) based on sample and percentages that are weighted to represent the national community-dwelling population. Table 1 summarizes the socio-demographic characteristics of the sample. The majority of the sample was aged 26 years and more,

married, had higher education, were non-immigrants, and urban residents. Table 2 reports on the past three months leisure time PA status. Men, in comparison to women, were significantly more likely to be physically active in the past three months. Table 3 shows the past-year prevalence of mental disorders. The prevalence of any kind of mental disorders assessed in this survey was 9.9% in men and 11.4% in women. Men were more likely to have alcohol dependence, illicit drug dependence, and any substance dependence than women. Women were more likely to be affected by major depressive episode, suicidal attempts, panic disorder, social phobia, agoraphobia, any mentioned mood disorder, any mentioned anxiety disorder, any mentioned mood and anxiety disorder, and also any kind of mental disorders (including any substance dependence). There were no significant differences between men and women in terms of manic episode and suicidal thoughts.

Table 4 presents the adjusted odds ratios (ORs) and PAFs for mental disorders associated with PA in total. *Physical inactivity* was a major risk factor for most mental disorders, except for manic episode. We calculated that about 20.4% (more than 91,000) of major depressive episode cases among males are potentially attributable to *physical inactivity*. The sum of all mental disorders cases that are potentially attributed to physical inactivity is about 780,000 (this number may be overestimated because of comorbidity between mental disorders). Increasing PA was more beneficial for men than women, in decreasing potential prevalence of mental disorders (Table 6). If the prevalence of *physical inactivity* of the total Canadian population was 10% lower than at present, we estimated that there would be more than 167,000 fewer mental disorder cases in Canada, whereas a 25% reduction could reduce prevalence by more than 389,000 cases (Table 5).

## Discussion

To the best of our knowledge, this is the first paper to provide quantitative evidence on the projected reduction of mental disorders cases that are potentially attributable to the level of PA in a national community population. Around 1 in 10 Canadians reported past-year mental disorders in 2002. Women were more likely to suffer mood and anxiety disorders and men with substance dependence. Almost half of Canadians reported being physically inactive. *Physical inactivity* was a major

**Table 4**  
Mental disorders and physical activity status among Canadians in 2002.

Past 12-month mental disorders	Physical activity status			
	Moderate <sup>a</sup>		Inactive <sup>a</sup>	
	AOR <sup>b</sup> (95%CI)	PAF (95%CI)	AOR <sup>b</sup> (95%CI)	PAF (95%CI)
Major depressive episode	1.07 (0.87–1.30)	NS	1.15 (0.97–1.37)	NS
Manic episode	0.79 (0.53–1.16)	NS	0.70 (0.49–0.99)	NS
Panic disorder	1.23 (0.89–1.69)	NS	1.10 (0.82–1.47)	NS
Social phobia	1.13 (0.91–1.42)	NS	1.41 (1.15–1.74)	16.21 (6.61–25.89)
Agoraphobia	0.79 (0.48–1.31)	NS	0.79 (0.51–1.23)	NS
Any selected mood disorder	1.02 (0.85–1.23)	NS	1.09 (0.92–1.28)	NS
Any selected anxiety disorder	1.16 (0.96–1.39)	NS	1.24 (1.04–1.48)	10.18 (1.85–18.47)
Any selected mood and anxiety disorder	1.15 (0.99–1.33)	NS	1.21 (1.06–1.39)	9.02 (2.75–15.55)
Alcohol dependence	1.11 (0.87–1.42)	NS	0.97 (0.79–1.20)	NS
Drug dependence	1.21 (0.71–2.06)	NS	1.10 (0.74–1.65)	NS
Any substance dependence	1.10 (0.86–1.40)	NS	0.97 (0.80–1.19)	NS
Any selected disorders/substance dependence	1.13 (0.99–1.29)	NS	1.15 (1.01–1.29)	6.61 (0.47–12.04)
Suicidal thoughts	1.21 (0.98–1.49)	NS	1.49 (1.22–1.82)	18.78 (9.41–27.90)
Suicidal attempts	1.13 (0.65–1.99)	NS	1.33 (0.82–2.16)	NS

AOR = adjusted odds ratio; CI = confidence interval; PAF = population attributable fraction; and NS = non-significant.

<sup>a</sup> The reference group was individuals being physically active.

<sup>b</sup> Simultaneously adjusted for age, gender, marital status, education, income, immigrant status, place of residence, and a measure of chronic medical condition (including asthma, arthritis, osteoporosis, back problems, high blood pressure, migraine headaches, chronic bronchitis, emphysema, chronic obstructive pulmonary disease, diabetes, heart diseases, cancer, intestinal or stomach ulcers, stroke, urinary incontinence, bowel disorder, Alzheimer's disease or other dementia, Parkinson's disease, cataracts, glaucoma, and thyroid condition).

**Table 5**  
The projected potential reduction of past-12 month mental disorders cases given selected reductions in *physical inactivity*, Canada 2002.

Past 12-month mental disorders	10% deduction of <i>physical inactivity</i> prevalence	25% deduction of <i>physical inactivity</i> prevalence
<i>Total</i>		
Numbers of potential mental disorders cases	167,709	389,326
Social phobia	23,124	59,609
Any selected anxiety disorder	22,249	58,734
Any selected mood and anxiety disorders	37,090	95,764
Any selected disorders/substance dependence	53,306	92,220
Suicidal thoughts	31,939	82,999
<i>Males</i>		
Numbers of potential mental disorders cases	128,359	341,451
Major depressive episode	17,229	46,322
Social phobia	10,797	28,781
Any selected mood disorder	15,635	41,333
Any selected anxiety disorder	11,825	31,047
Any selected mood and anxiety disorder	24,297	64,163
Any selected disorders/substance dependence	27,611	71,642
Suicidal thoughts	20,965	58,162

significant risk factor for the most of the selected mental disorders, except manic episode. About 780,000 cases of mental disorders were potentially attributable to *physical inactivity* in 2002. Increasing PA was more beneficial for men, than for women, in decreasing potential prevalence of mental disorders. A 10% reduction in the prevalence of physical inactivity could potentially prevent more than 167,000 mental disorders cases, whereas 389,000 cases could be prevented if there was a 25% reduction in *physical inactivity*.

Our results are consistent with previous literature on PA and physical and mental disorders. We found that *physical inactivity* was the major risk factor for all mentioned mental disorders, except manic episode. Persons with mania are more likely to have excessive behaviors such as excessive PA (Goodrich and Kilbourne, 2010).

Several meta-analytic studies have evaluated the effects of exercise as a treatment for mental disorders, and their findings support exercise protecting against mental disorders, and the behavioral and neurobiological consequences of exercise may explain the mechanism(s) of action (Barbour et al., 2007; Blumenthal et al., 2007; Dunn et al., 2005; Smith and Lynch, 2012).

In addition to confirming previous findings, our study quantitatively measured the potential magnitude of PA effect on the prevalence of mental disorders. Notably, being physically active can alleviate depressive and anxious symptoms but not manic behaviors. Theoretically *physical inactivity* influences approximately 780,000 cases of mental disorders. Increasing PA was more beneficial for men, than for women, in decreasing prevalence of mental disorders. Some findings in the literature support gender differences in the

**Table 6**  
Population attributable fractions for associations between mental disorders and physical activity status among Canadians in 2002, by gender.

Past 12-month mental disorders	Physical activity status			
	Moderate <sup>a</sup>		Inactive <sup>a</sup>	
	AOR <sup>b</sup> (95%CI)	PAF (95%CI)	AOR <sup>b</sup> (95%CI)	PAF (95%CI)
<i>Males</i>				
Major depressive episode	1.17 (0.83–1.63)	NS	1.57 (1.16–2.13)	20.38 (6.70–33.66)
Manic episode	0.71 (0.43–1.16)	NS	0.81 (0.49–1.34)	NS
Panic disorder	1.76 (0.98–3.13)	NS	1.53 (0.93–2.52)	NS
Social phobia	1.06 (0.76–1.48)	NS	1.48 (1.05–2.09)	17.73 (2.20–32.86)
Agoraphobia	0.97 (0.36–2.59)	NS	0.91 (0.46–1.80)	NS
Any selected mood disorder	1.08 (0.80–1.45)	NS	1.41 (1.07–1.85)	15.55 (3.05–27.62)
Any selected anxiety disorder	1.21 (0.90–1.63)	NS	1.36 (1.01–1.83)	13.91 (0.45–27.15)
Any selected mood and anxiety disorder	1.20 (0.95–1.51)	NS	1.42 (1.14–1.77)	15.87 (5.91–25.69)
Alcohol dependence	1.26 (0.94–1.70)	NS	0.98 (0.75–1.28)	NS
Drug dependence	1.32 (0.69–2.55)	NS	1.08 (0.64–1.83)	NS
Any substance dependence	1.25 (0.93–1.68)	NS	1.00 (0.77–1.29)	NS
Any selected disorders/substance dependence	1.22 (1.00–1.50)	NS	1.28 (1.07–1.53)	11.17 (3.05–19.22)
Suicidal thoughts	1.27 (0.93–1.75)	NS	1.85 (1.38–2.48)	27.62 (14.58–39.92)
Suicidal attempts	1.80 (0.73–4.49)	NS	2.04 (0.94–4.45)	NS
<i>Females</i>				
Major depressive episode	0.97 (0.75–1.26)	NS	0.90 (0.73–1.12)	NS
Manic episode	0.85 (0.46–1.56)	NS	0.59 (0.37–0.93)	– <sup>c</sup>
Panic disorder	0.97 (0.66–1.43)	NS	0.85 (0.59–1.21)	NS
Social phobia	1.13 (0.83–1.54)	NS	1.29 (0.97–1.70)	NS
Agoraphobia	0.69 (0.38–1.24)	NS	0.68 (0.40–1.17)	NS
Any selected mood disorder	0.96 (0.75–1.23)	NS	0.88 (0.71–1.08)	NS
Any selected anxiety disorder	1.06 (0.83–1.35)	NS	1.08 (0.86–1.36)	NS
Any selected mood and anxiety disorder	1.06 (0.88–1.28)	NS	1.03 (0.87–1.22)	NS
Alcohol dependence	1.03 (0.66–1.61)	NS	1.29 (0.86–1.92)	NS
Drug dependence	1.23 (0.55–2.72)	NS	1.76 (0.87–3.57)	NS
Any substance dependence	1.03 (0.69–1.55)	NS	1.25 (0.87–1.70)	NS
Any selected disorders/substance dependence	1.05 (0.87–1.26)	NS	1.03 (0.87–1.22)	NS
Suicidal thoughts	1.13 (0.84–1.52)	NS	1.19 (0.87–1.61)	NS
Suicidal attempts	0.80 (0.38–1.70)	NS	0.95 (0.51–1.77)	NS

AOR = adjusted odds ratio; CI = confidence interval; PAF = population attributable fraction; and NS = non-significant.

<sup>a</sup> The reference group was individuals being physical active.

<sup>b</sup> Simultaneously adjusted for age, marital status, education, income, immigrant status, place of residence, and a measure of chronic medical condition (including asthma, arthritis, osteoporosis, back problems, high blood pressure, migraine headaches, chronic bronchitis, emphysema, chronic obstructive pulmonary disease, diabetes, heart diseases, cancer, intestinal or stomach ulcers, stroke, urinary incontinence, bowel disorder, Alzheimer's disease or other dementia, Parkinson's disease, cataracts, glaucoma, and thyroid condition).

<sup>c</sup> AOR less than 1; PAF not calculated.

association between PA and mental disorders: 1) Valentine et al. (2009) found that PA was independently associated with fatigue in women, but not in men; 2) a recent US study reports that gender has different roles in behavioral domains. Females are more likely to have depression, and gender has a significant direct effect on depression severity (Ryba and Hopko, 2012); and 3) depression may be an additional risk factor for exercise noncompliance, as females are more likely to stop exercising (Craft and Perna, 2004).

We also found that there was no added benefit for being 'Active' vs. being 'moderately active', which is consistent with prior data (Dunn et al., 2005; Hamer et al., 2009). It is evidenced that exercise alleviates symptoms of depression and may be useful to treat depression with a requirement of a minimum amount of exercise. A lower amount of exercise is not effective.

Our study strongly suggests that greater attention should be given to increasing the amount of physical activity in mental health prevention and promotion strategies. Exercise can be used by public health campaigns targeting the general population to prevent a significant proportion of future mental disorders. Increasing PA is more likely beneficial for men than women from a population preventive perspective. Physical inactivity is a modifiable risk factor. General practitioners and specialists (i.e. psychiatrists) should be encouraged to make exercise a routine supplemental treatment and provide adequate psychological support to their patients based on the individual patient's condition.

Limitations of the study are noted. Because of the cross-sectional nature of the study, we cannot make any causal inference. Exercising cannot be guaranteed to prevent the occurrence of any mental disorder. However, evidences from systematic reviews are supported by randomized clinical trials that increasing PA in patients with mental disorders and healthy populations experience significant improvements of their psychiatric symptoms and psychological well-being, respectively (Daley, 2008; Trivedi et al., 2011). Again, because of the cross-sectional nature of our study, it is possible that participants who experienced a mental disorder may have subsequently become less physically active. Second, the prevalence of any mental disorder was assessed by the WMH-CIDI according to the DSM-IV criteria for the past-12 months mental health status, whereas the physical activity was evaluated over the past three months. Third, it should be noted that the PAFs and projected reduction in the prevalence is likely to underestimate the association between PA and mental disorders, because individuals with severe mental disorders were more likely to report less physical activity (Ussher et al., 2007). Those with severe mental disorders are likely to be no longer physically active at the time of the survey.

The current study represents the first evidence of the potential quantitative effect of PA modification on the prevalence of mental disorders in a national population and the projected reduction of mental disorders that results from decreasing *physical inactivity* in a population.

#### Conflict of interest statement

The authors declare that there are no conflicts of interest.

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