



# BIDIRECTIONAL ASSOCIATIONS BETWEEN INTERNALIZING PROBLEMS AND PHYSICAL ACTIVITY IN YOUNG ADOLESCENTS: A PROSPECTIVE POPULATION-BASED STUDY



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## BACKGROUND

### Association between physical activity (PA) and internalizing symptoms (depression and anxious symptoms)

PA has been linked to lower internalizing symptoms in adolescents (Field et al., 2001; Gomez-Baya & al., 2017; He & al., 2018; Hrafnkelsdottir & al., 2018; Jerstad & al., 2010; Kirkcaldy & al., 2002; Brière & al., 2018; Nyberg & al., 2018; Ogawa & al., 2019; Raudsepp & Vink, 2019; Sánchez-Oliva & al., 2019).

### However, few studies have tested the directionality of this relationship.

Bidirectional associations have been found between PA, social anxiety symptoms, loneliness and depressive symptoms (Brière & al., 2018; Raudsepp & Vink, 2019).

### What does literature suggest?

PA could influence subsequent internalizing symptoms via two mechanisms:

#### Psychosocial mechanisms

- Distraction from everyday stressors and negative affects
- Experiences of mastery and control
- Positive influence on self-esteem
- Opportunity to learn social skills

#### Physiological mechanisms

- Increase in monoamine circulation
- Increase in endorphin production
- Elevation in body temperature
- Regulation of hormonal response to stress

(Ekeland & al., 2005; Oweis & Spinks, 2001; Sallis & Owen, 1999; Salmon, 2001)

Internalizing symptoms could influence subsequent PA by anhedonia and exhaustion (Jerstad & al., 2010).



### Sex differences are possible

Body dissatisfaction is linked to depressive symptoms among girls (Gomez-Baya & al., 2017). They are at greater risk of depression and anxiety (Middeldorp & al., 2008). Boys tend to be more physically active than girls (Armstrong & Van Mechelen, 1998; Kristjansdottir & Vilhjalmsdottir, 2001).

## OBJECTIVES

Using population-based cohort data, this study examines :

- 1) Bidirectional associations between PA and internalizing symptoms (depressive and anxious symptoms) in early adolescents
- 2) Potential effect of the sex differences.

## METHODS

### Participants.

Participants are from the Quebec Longitudinal Study of Child Development (QLSCD), in Quebec, Canada (N = 1, 596 adolescents).

### Measures.

Internalized symptoms

- ⊗ Depressive symptoms : Center for Epidemiologic Studies-Depression (CES-D) questionnaire
- ⊗ Anxious symptoms : Social behavior Questionnaire

Physical activity: Scale of a multiplication of 3 items on frequency, duration and intensity score (5\*moderate and 9\*strenuous)

### Analysis.

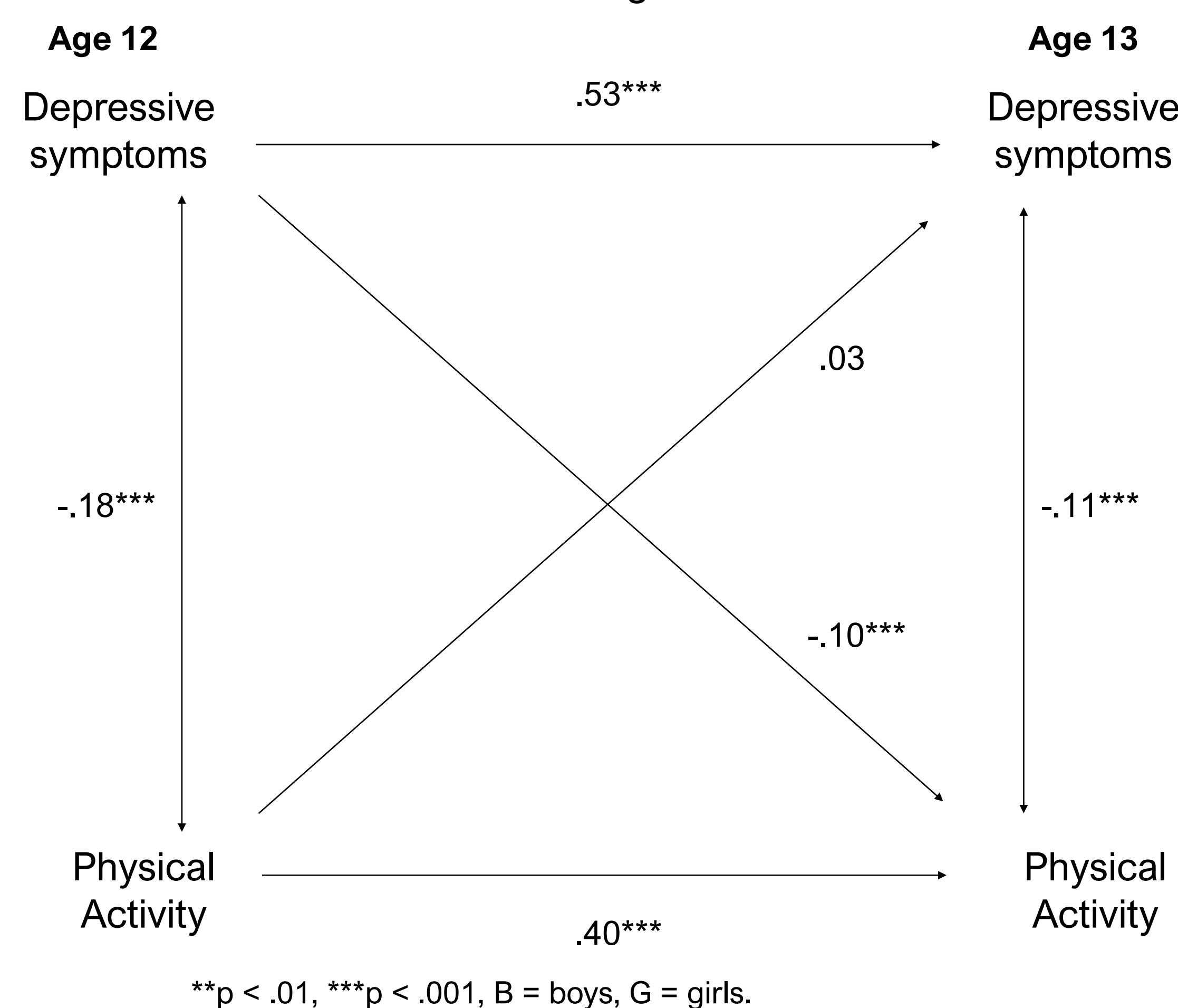
Path analysis was used to investigate bidirectional associations (Mplus 7).

Multigroup analysis was used to test sex differences.

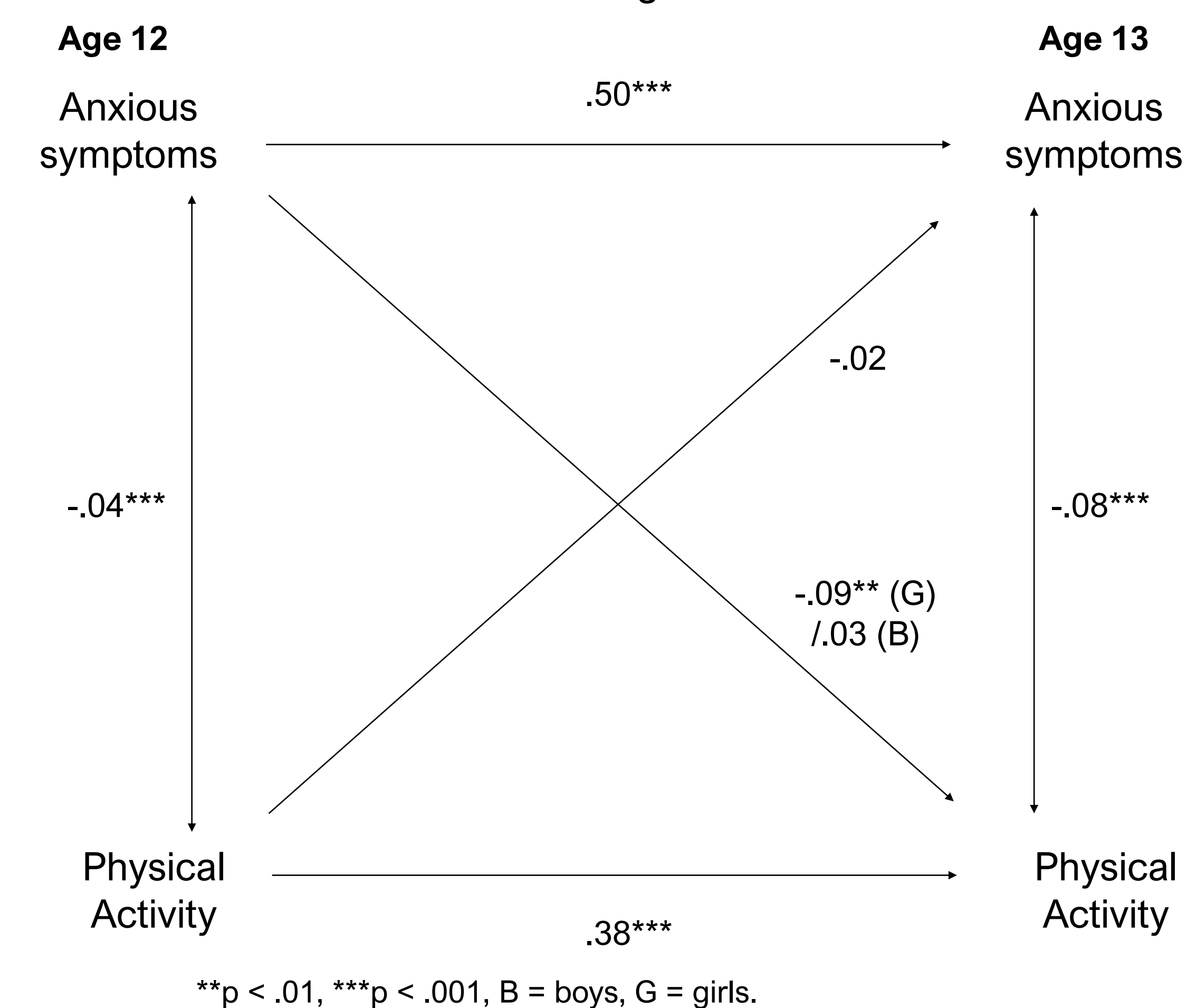
Full information maximum likelihood estimation was used to missing data.

## RESULTS

**Figure 1.** Bidirectional associations between depressive symptoms and physical activity at age 12 and age 13 : The moderating role of sex



**Figure 2.** Bidirectional associations between anxious symptoms and physical activity at age 12 and age 13 : The moderating role of sex



### Internalizing symptoms (depression and anxiety) at age 12 predicted lower subsequent PA at age 13.

- ⊗ Depressive symptoms at age 12 predicted lower PA (B = -.10,  $p < .001$ ), no sex differences were found.
- ⊗ Anxious symptoms at age 12 predicted lower subsequent PA. Girls with greater anxious symptoms participated less to subsequent PA (B = -.09,  $p < .01$ ).

However, PA at age 12 did not predict either depressive or anxious symptoms one year later.

## DISCUSSION

This study clarifies the relationship between internalizing symptoms and PA in early adolescents.

Internalizing symptoms predicted subsequent PA participation.

- 1) Pre-existing symptoms (anhedonia and exhaustion) can lead to decrease of PA.
- 2) The important challenges of early adolescence (multiple biological, social, family and environmental changes) that can potentially increase vulnerability to symptoms of depression and anxiety.

PA did not predict future internalizing symptoms.

- 1) PA is more important for the subclinical sample than for the general population (Carter et al., 2016).

The majority of bidirectional studies obtained contradictory results (Birkeland & al., 2009; Gunnell & al., 2016; Jerstad & al., 2010). Our findings are consistent with some studies. This could be explained by the different measures used for PA.

### Sex differences were found between anxious symptoms and subsequent PA participation.

These findings are consistent with previous studies on sex differences for anxiety. Girls are more vulnerable to anxiety than boys (Bruce & al., 2005; Kessler & al., 1994); This leads to more negative consequences for girls (McLean & al., 2011), such as a decrease in PA.

### Limits.

- ⊗ Objective measures of the PA could lead to stronger conclusions.
- ⊗ The high attrition rate in this study may have affected our findings.

### Conclusion.

- ⊗ Internalizing symptoms may erode lifestyle habits in early adolescents
- ⊗ Reducing anxiety may be a way to improve lifestyle habits.
- ⊗ Targeting anxiety may be more useful in girls than boys.