Clinical Study

Are people with chronic low back pain meeting the physical activity guidelines? A co-twin control study

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Abstract

BACKGROUND: Despite a large amount of research investigating physical activity (PA) levels in people with chronic low back pain (LBP), no study has investigated whether people with chronic LBP are meeting the World Health Organization (WHO) PA guidelines. Furthermore, with genetics and the early shared environment substantially influencing the presence of LBP and PA engagement, these factors could confound the association between LBP and PA and need to be controlled for.

PURPOSE: This study aimed to investigate the association between chronic LBP and meeting the PA guidelines, while controlling for the effects of genetics and early shared environment.

DESIGN: This is a cross-sectional co-twin control study.

PATIENT SAMPLE: A cross-sectional analysis was performed on 1,588 twins from the Murcia Twin Registry in Spain with available data on LBP and PA from the 2013 data collection wave.

OUTCOME MEASURES: The exposure and outcome variables in our study were self-reported. Twins reporting a history of chronic LBP were asked follow-up questions to inform on the presence of recent LBP (within the past 4 weeks), previous LBP (no pain within the past 4 weeks), and persistent LBP (no pain-free month in the last 6 months). These were our exposure variables. Our outcome variable was meeting the WHO PA guidelines, which involved at least 75 minutes of vigorous-intensity PA, or at least 150 minutes of moderate-intensity PA per week.

METHODS: To investigate the association between chronic LBP and meeting the PA guidelines, we first performed a multivariate logistic regression on the total sample of twins. Co-variables entered the model if the univariate association between the co-variable, and both the exposure and the outcome reached a significance of $p<.2$. Second, to adjust for the influence of genetics and early shared environment, we performed a conditional multivariate logistic regression on complete twin pairs discordant for LBP. The Murcia Twin Registry is supported by Fundación Séneca, Regional Agency for Science and Technology, Murcia, Spain (08633/PHCS/08 and 15302/PHCS/10) and the Ministry of Science and Innovation, Spain (PSI11560-2009). Funding for this project has also been received from Fundación MAPFRE (2012). The authors declare that there are no conflicts of interest.

RESULTS: There was a significant inverse association between recent LBP and meeting the PA guidelines (odds ratio [OR]=0.71, $p=.034$). When controlling for genetics and early shared environment, this association disappeared. There was no association between previous (OR=0.95, $p=.779$) or persistent LBP (OR=0.78, $p=.192$) and meeting the PA guidelines.

FDA device/drug status: Not applicable.


The Murcia Twin Registry is supported by Fundación Séneca, Regional Agency for Science and Technology, Murcia, Spain (08633/PHCS/08 and 15302/PHCS/10) and the Ministry of Science and Innovation, Spain (PSI11560-2009). Funding for this project has also been received from Fundación MAPFRE (2012).

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CONCLUSION: Twins with recent LBP are less likely to meet the PA guidelines than those with no history of chronic LBP, highlighting the importance of incorporating PA promotion in the treatment of these individuals. Genetics and early shared environment appear to be confounding the association between LBP and PA, although this needs to be further tested in larger twin samples. © 2017 Elsevier Inc. All rights reserved.

Keywords: Early shared environment; Genetics; Low back pain; Murcia Twin Registry; Physical activity guidelines; Twin study

Introduction

Low back pain (LBP) is a worldwide problem, contributing to the highest number of years lived with disability among all musculoskeletal conditions [1]. LBP has a large financial impact, significantly burdening economies throughout the world [2,3], with the estimated cost being as high as €300 billion for Europe [2]. Physical activity (PA) is one of the most important aspects for maintaining optimal health [4-6] and is also recommended in evidence-based clinical guidelines for the management of chronic LBP [7]. Recent guidelines outline PA recommendations to improve cardiorespiratory fitness and reduce the risk of non-communicable diseases (e.g., cardiovascular disease) [8]. These guidelines recommend a minimum of 150 minutes of moderate-intensity PA, or 75 minutes of vigorous-intensity PA per week, accumulated in multiple bouts. However, an astonishing one in four adults worldwide are failing to meet these guidelines [8], with individuals experiencing chronic conditions, such as knee and hip osteoarthritis, even less likely to meet the guidelines [9]. Considering the high prevalence and associated disability of chronic LBP [1], it is important to determine what proportions of individuals with chronic LBP are meeting these guidelines. This information will have important implications for incorporating PA promotion into the treatment of these individuals.

Despite numerous studies investigating the relationship between LBP and PA, no study to date has investigated whether individuals with chronic LBP are more or less likely to meet the PA guidelines than the pain-free population [10]. Furthermore, there appears to be a considerable amount of confusion in the literature regarding activity levels in individuals with chronic LBP. Some studies report that individuals with chronic LBP have reduced levels of PA (e.g., sports participation, recreational exercise) compared with the pain-free population and hip osteoarthritis, even less likely to meet the guidelines in the literature regarding activity levels in individuals with chronic LBP. Some studies report that individuals with chronic LBP are more or less likely to meet the PA guidelines than the pain-free population

In addition, the importance of adjusting for genetics and early shared environment has been highlighted in a previous study investigating the relationship between LBP and PA [16]. The aim of this cross-sectional study is to investigate what proportion of individuals with various presentations of chronic LBP are meeting the PA guidelines, and to investigate the association between these variables using a co-twin control design to adjust for the effects of genetics and early shared environment.

Methods

Participants and data collection

Data for this study were derived from a sample of adult twins born between 1940 and 1966 from the Murcia Twin Registry (MTR). The MTR has gathered information from the twins in three waves: 2007, 2009–2011, and 2013. Detailed information regarding the data collection procedures and registry characteristics can be found elsewhere [21]. Participants completed a health-related questionnaire via face-to-face or telephone interview, capturing information on anthropometrics, demographics, health history, and health behaviors (e.g., PA, smoking).

Of the 2,148 adult twins registered in the MTR, there were 1,613 twins who participated in the 2013 data collection wave, which included a detailed assessment of LBP and PA. Of these twins, 1,588 (98.5%) provided data on LBP and PA and were included in our cross-sectional analyses. Assessors were blinded to the exposures and outcome of this study, and the Committee of Research Ethics of the University of Murcia approved all registry and data collection procedures used in the MTR.

Zygosity ascertainment

When DNA testing was not performed, twin zygosity was ascertained through a 12-item questionnaire focusing on the similarities between twins’ eye color, hair color, face color, and face form, as well as mistaken identity between twins. This questionnaire has demonstrated agreement with zygosity determined through DNA testing in nearly 96% of cases [21].
Assessment of LBP

A comprehensive self-reported assessment of LBP was conducted in 2013 with questions regarding LBP derived from standardized definitions aimed to facilitate uniformity across observational studies [22]. The presence of activity limiting chronic LBP was assessed by the following questions. First, participants were asked: “Have you ever suffered from chronic LBP?” Chronic LBP was described to participants as pain in the lower back lasting for 6 months or longer, including seasonal and recurrent episodes. Participants responding “yes” were asked a follow-up question: “Was this pain bad enough to limit your usual activities or change your daily routine for more than 1 day?” There were 442 twins who responded “yes” and 1,146 twins who responded “no” (total n=1,588). Participants responding “yes” were considered to have experienced activity limiting chronic LBP (hereafter referred to as chronic LBP), and were asked additional follow-up questions, forming the LBP variables for this study.

Recent LBP

“When was the last time you experienced LBP?” Participants selecting the response “within the past 4 weeks” were considered to have recent LBP.

Previous LBP

Participants who did not experience LBP “within the past 4 weeks” were considered to have previous LBP.

Persistent LBP

“How long has it been since you have had a whole month pain free?” Participants selecting the response “7 months to 3 years,” or “greater than 3 years” were considered to have persistent LBP.

These variables were dichotomized with the comparison being twins who had never experienced any chronic LBP (n=1,005).

Assessment of meeting the physical activity guidelines

The World Health Organization PA guidelines for adults aged 18–64 (at the time data were collected for this study) recommend a minimum of either 150 minutes of moderate-intensity PA, 75 minutes of vigorous-intensity PA, or a combined 150 minutes of moderate or vigorous-intensity PA per week, accumulated in multiple bouts lasting at least 10 minutes [8]. A detailed assessment of PA for this study was conducted in 2013, with questions adapted from the Active Australia Survey [23]. Engagement in vigorous-intensity PA was determined by participants’ response to the following questions: “In the last week, how many times did you do any vigorous PA for at least 10 minutes which made you breathe harder or puff and pant? (e.g., running, cycling)” and “what do you estimate was the total time that you spent doing this vigorous physical activity in the last week?” Engagement in moderate-intensity PA was determined by participants’ response to the following set of questions: (1) “In the last week, how many times have you walked continuously, for at least 10 minutes (to get to or from places, for recreation or exercise)?” and “what do you estimate was the total time that you spent walking in this way in the last week?”; (2) “In the last week, how many times did you do any other more moderate physical activities for at least 10 minutes that you have not already mentioned? (e.g., gentle swimming, social tennis, golf)” and “what do you estimate was the total time that you spent doing these activities in the last week?” The order in which participants were asked these questions indicates “moderate physical activities” would exclude walking, as this was asked in a prior question. Because it is likely walking is a common form of exercise in the Spanish population of this age, we included walking as a type of moderate-intensity PA despite being unable to assess intensity. Participants who engaged in at least 75 minutes of vigorous-intensity PA, or at least 150 minutes of moderate-intensity PA, or at least 150 minutes of combined moderate and vigorous-intensity PA per week, on at least two separate occasions, were considered to have met the PA guidelines.

Assessment of co-variables

We investigated potential confounding variables based on previous studies in the field and data availability. The
co-variables included age, gender, zygosity, body mass index (BMI), smoking, and symptoms of depression or anxiety. Data on BMI were based on self-reported height and weight. Data on smoking were based on the Spanish National Health Survey Questionnaire [21] and was dichotomized as (1) ex-smoker or never smoked or (2) current smoker. Symptoms of depression or anxiety were based on the depression or anxiety domain of the EuroQol-5 dimension and were assessed by participants selecting one of the following options: (1) I am not anxious or depressed; (2) I am moderately anxious or depressed; and (3) I am extremely anxious or depressed. Responses were dichotomized as not depressed or anxious (1) and moderately or extremely depressed or anxious (2 and 3).

Analysis

We conducted descriptive analyses for all study variables, describing continuous variables with means and standard deviations (SD), and nominal variables with percentages. The exposure variables were recent LBP, previous LBP, and persistent LBP, whereas the outcome variable was meeting the PA guidelines (Fig. 1).

Total sample analysis

We conducted univariate and multivariate logistic regression analyses in the following sequence. First, we performed an unadjusted total sample analysis, including all complete and incomplete twin pairs, to explore the univariate associations between LBP and meeting the PA guidelines. To determine which co-variables should be included in the adjusted total sample analysis (multivariate model), we performed a univariate logistic regression between the co-variables, and both the exposure and the outcomes. If the univariate association between co-variables, and both the exposure and the outcomes reached a significance level of $p < .2$, these variables were adjusted for in the multivariate logistic regression models. This is a widely used method to identify confounding variables for inclusion in the multivariate models [24–26]. Age and gender were forced into the multivariate models to facilitate comparison between the total sample analysis and the within-pair case-control analysis, in which age (all case-control analyses) and gender (analysis of identical twins only) are naturally adjusted for. To account for the non-independence of twins, we used a robust sandwich estimator (cluster command in STATA), allowing us to control for observations that are independent across groups, but not necessarily within groups.
Within-pair case-control analysis

If the association from the adjusted total sample analysis reached a significance level of <.2, we performed a within-pair case-control analysis to adjust for the influence of genetics and early shared environment. The within-pair case-control analysis included complete twin pairs discordant for LBP status (i.e., one twin reported LBP but the co-twin did not). We adjusted for potential confounding variables as described above, with gender forced into analyses including only dizygotic (DZ) twins. The adjustment for confounding variables determined whether the analysis was univariate or multivariate. Because it is assumed twin pairs share similar environments during childhood, all within-pair case-control analyses allow us to adjust for early shared environmental factors. First, we considered DZ and monozygotic (MZ) twin pairs in the same analysis, to adjust for the influence of genetics and early shared environment. Second, to better understand the role of genetics, we stratified analyses by zygosity. DZ and MZ twin pairs share approximately 50% and 100% of their segregating genes, respectively [27]. Therefore, considering only DZ twins allows us to adjust for 50% of genetics, whereas considering only MZ twin pairs allows us to completely adjust for genetic factors. In theory, when the association between two variables (LBP and PA) maintains or increases in magnitude as we adjust for a greater proportion of genetics (particularly in MZ twins where the highest level of adjustment is implemented), this is likely consistent with a more direct association between the two variables. Conversely, if the magnitude of the association decreases, this is more likely consistent with confounding. Analyses were conducted using STATA statistical software (StataCorp. 2013, Stata Statistical Software: Release 13, Version 13.1, StataCorp LP, College Station, TX, USA) with the significance level set at .05. Odds ratios (OR) and 95% confidence intervals (CI) were calculated from the regression models.

Results

There were 1,588 twins with data available on LBP and PA from the 2013 data collection wave. Of these twins, there were 442 twins who reported chronic LBP at some point in their life that limited their daily activities for more than 1 day (27.8%), with 228 twins experiencing recent LBP (pain with the past 4 weeks) and 209 twins reporting previous LBP (no pain within the past 4 weeks). Five twins failed to report when they experienced their most recent episode of LBP. There were 155 twins who reported having persistent LBP (no pain-free month for 7 months or longer). All of them had recent LBP. On the other hand, 73 twins experienced recent but not persistent LBP. The mean age (SD) of twins included in this study was 56.7 (7.1), with 877 females (55.2%) and 554 MZ twins (34.9%). Further details regarding sample characteristics can be found in Table 1. Zygosity was not adjusted for in any analysis as it was not identified as a confounding variable using the methods previously described (see Assessment of co-variables section).

Meeting the PA guidelines

There were 962 twins (60.6%) who met the PA guidelines, which is comparable with the estimate from the Spanish population in 2011–2012 for adults aged between 18 and 69 years (66.4%) [28]. There were 243 twins (55.0%) who reported a history of chronic LBP and met the PA guidelines (Table 2). When we considered the various phenotypes of chronic LBP, there were 111 twins with recent LBP (48.7%), 128 twins with previous LBP (61.2%), and 79 twins with persistent LBP (51.0%) who met the PA guidelines (Table 2).
Recent LBP

Individuals reporting a history of chronic LBP, and experiencing LBP within the past 4 weeks \( (n = 228) \), were significantly less likely to meet the PA guidelines (compared with those with no history of chronic LBP, \( n = 1,005 \)) in the unadjusted total sample analysis (OR = 0.57, 95% CI: 0.42–0.76, \( p < .001 \)) (Table 3) (Fig. 2). When we adjusted for the influence of genetics and early shared environment in the within-pair case-control analysis of DZ and MZ twins, the association between recent LBP and meeting the PA guidelines was no longer statistically significant (OR = 0.71, 95% CI: 0.34–1.51, \( p = .379 \)) (Table 3). In addition, there was no significant association when the within-pair case-control analysis was performed separately for DZ (OR = 0.93, 95% CI: 0.37–2.34, \( p = .875 \)) and MZ twins (OR = 0.43, 95% CI: 0.11–1.66, \( p = .220 \)) (Fig. 3). The analyses of DZ and MZ twins, and DZ twins only were adjusted for gender.

Previous LBP

Individuals reporting a history of chronic LBP, but without symptoms over the past 4 weeks \( (n = 209) \), were not less likely to meet the PA guidelines (compared with those with no history of chronic LBP, \( n = 1,005 \)) in the unadjusted total sample analysis (OR = 0.94, 95% CI: 0.70–1.28, \( p = .713 \)) (Fig. 2). Because the \( p \)-value of the association in the adjusted total sample analysis was not < .2, we did not proceed with a within-pair case-control analysis.

Persistent LBP

Individuals reporting a history of chronic LBP, without a pain-free month in the past 6 months \( (n = 155) \), were significantly less likely to meet the PA guidelines (compared with those with no history of chronic LBP, \( n = 1,005 \)) in the unadjusted total sample analysis (OR = 0.62, 95% CI: 0.44–0.88, \( p = .008 \)) (Table 3). In the within-pair case-control analysis of DZ and MZ twins (OR = 0.92, 95% CI: 0.37–2.26, \( p = .848 \)), and DZ twins only (OR = 1.44, 95% CI: 0.49–4.24, \( p = .505 \)) we did not find a significant association (Fig. 3). The analyses of DZ and MZ twins, and DZ twins only were adjusted for age, gender, BMI, and depression.

Table 2

<table>
<thead>
<tr>
<th>Subtype of LBP</th>
<th>Total sample ( n = 1,588 )</th>
<th>Chronic LBP ( n = 442 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects meeting the PA guidelines (%)</td>
<td>962 (60.6)</td>
<td>243 (55.0)</td>
</tr>
</tbody>
</table>

Chronic LBP phenotypes

<table>
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<tr>
<th>Subtype of LBP</th>
<th>Recent LBP ( n = 228 )</th>
<th>Previous LBP ( n = 209 )</th>
<th>Persistent LBP ( n = 155 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subjects meeting the PA guidelines (%)</td>
<td>111 (48.7)</td>
<td>128 (61.2)</td>
<td>79 (51.0)</td>
</tr>
</tbody>
</table>

Table 3

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Analysis</th>
<th>Sample</th>
<th>OR</th>
<th>95% CI</th>
<th>( p )</th>
<th>( n )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent LBP</td>
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<td>Unadjusted</td>
<td>0.57</td>
<td>0.42–0.76</td>
<td>&lt;.001</td>
<td>1233</td>
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<td></td>
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<td>Adjusted*</td>
<td>0.71</td>
<td>0.52–0.97</td>
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<td>Within-pair case-control analysis</td>
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<td>0.71</td>
<td>0.34–1.51</td>
<td>0.379</td>
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<td></td>
<td>DZ twins\†</td>
<td>0.93</td>
<td>0.37–2.34</td>
<td>0.875</td>
<td>156</td>
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<tr>
<td></td>
<td></td>
<td>MZ twins</td>
<td>0.43</td>
<td>0.11–1.66</td>
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<td>Previous LBP</td>
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<td>0.713</td>
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<td></td>
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<td>0.69–1.33</td>
<td>0.779</td>
<td>1134</td>
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<tr>
<td>Persistent LBP</td>
<td>Total sample analysis</td>
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<td>.008</td>
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<td>.25</td>
<td>.03–2.24</td>
<td>.215</td>
<td>26</td>
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</tbody>
</table>

LBP, low back pain; PA, physical activity; OR, Odds ratio; CI, confidence interval; \( n \), number of individual twins.

Notes: This value includes the number of twins with each subtype of LBP (incident cases), plus the number of twins who have never experienced chronic LBP (comparison). Statistically significant results (\( p < 0.05 \)) are in bold.

\* Adjusted for age, gender, BMI, and depression.

\† Adjusted for gender.

\‡ Adjusted for gender and smoking.
unadjusted total sample analysis (OR=0.62, 95% CI: 0.44–0.88, p=.008) (Table 3). The magnitude of this association was similar when adjusting for age, gender, BMI, and depression (OR=0.78, 95% CI: 0.53–1.14, p=.192) (Table 3) (Fig. 2), although not statistically significant. When we adjusted for the influence of genetics and early shared environment in the within-pair case-control analysis, there were no statistically significant results (Table 2) (Fig. 4). The analyses of DZ and MZ twins, and DZ twins only were also adjusted for gender and smoking.

Discussion

Our results show that 55% of individuals with chronic LBP met the PA guidelines, although this varies depending on the phenotype of chronic LBP assessed. Individuals with recent LBP were significantly less likely to meet the PA guidelines compared with those with no history of chronic LBP. After adjusting for the influence of genetics and early shared environment, the association between recent LBP and meeting the PA guidelines was no longer statistically significant despite remaining in the same direction. This suggests that the effects of genetics and early shared environmental factors may be confounding the association between LBP and PA.

Proportion of individuals with chronic LBP meeting the PA guidelines

The proportion of individuals who met the PA guidelines in this study (60.6%) was similar to the estimate for adults aged between 18 and 69 years old from the Spanish National Health Survey (66.4%) [28]. Although the sample of twins in our study was older (mean age [SD]: 56.7 [7.1]) compared with the overall Spanish population (median age: 41.8), it is unlikely age would significantly affect our estimate because approximately 68% of the Spanish population between 60 and 69 years old met the PA guidelines [28]. Questions regarding PA in our study were adapted from the Active Australia Survey, whereas data from the Spanish population were captured through the International Physical Activity Questionnaire [29]. These questionnaires capture very similar PA data so are unlikely to impact the comparison between estimates.

Our results showed that 55.0% of individuals with chronic LBP met the PA guidelines, which does not appear to be
significantly lower than the total sample (60.6%). However, a lower proportion of individuals met the PA guidelines if they reported recent LBP (48.7%) (Table 2). Furthermore, individuals with recent LBP were significantly less likely to meet the PA guidelines compared with those with no history of chronic LBP (OR=0.71, p=.034), whereas there was no association between LBP and PA for those with persistent (OR=0.78, p=.192) or previous LBP (OR=0.95, p=.779). This suggests that once an individual recovers from a recent episode of LBP, he or she is just as likely to meet the PA guidelines as the pain-free population, highlighting the importance of considering the presentation of an individual’s LBP when deciding how it may impact his or her PA engagement.

Comparison with previous literature

Despite an abundance of research investigating the relationship between LBP and PA, different definitions of LBP and methods of assessing PA may be producing conflicting results between studies. This highlights the need to consider a definition of PA, which has broader implications for health promotion when investigating LBP. Many studies have failed to find an association between LBP and PA [16–18], whereas others show that individuals with LBP are more physically active than pain-free individuals [14,15]. Our study is the first to investigate the relationship between chronic LBP and meeting the PA guidelines, showing that individuals with recent LBP are less likely to meet the PA guidelines compared with those with no history of chronic LBP (OR=0.71, p=.034). This is consistent with research demonstrating that individuals with recent LBP are less likely to engage in regular PA [30], sporting activities [31], strength training [14], vigorous-intensity PA [32], or even more than 1 hour of PA per week [33]. Therefore, using the PA guidelines as a meaningful cutoff for promotion and maintenance of optimal health, and may help future studies obtain more consistent results.

Genetics and early shared environment

The results of our study highlight the importance of considering the influence, and potentially confounding effects, of genetics and early shared environment. Genetics and early shared environment have been shown to substantially contribute to the variance of LBP [19], and the engagement in PA [20], with twin studies supporting the importance of adjusting for these factors to better understand the relationship between LBP and PA [34]. Twins are considered representative of the non-twin population [35], with the sample of twins in our study being comparable with reference population surveys [21]. The results from our within-pair case-control analyses showed no association between chronic LBP (recent or persistent) and meeting the PA guidelines, even when the adjusted total sample analysis demonstrated a strong association for recent LBP (Fig. 3). This suggests that the relationship between LBP and meeting the PA guidelines may be confounded by genetic or shared environmental factors that influence both the presence of LBP and PA engagement. However, the findings from the within-pair case-control analysis may have simply been the result of a reduction in power (sample size), limiting our ability to find statistically significant results. Therefore, although genetics and early shared environment may be confounding the association between LBP and PA, higher powered twin studies are needed before definite conclusions are reached.

Strengths and limitations

The present study demonstrated considerable strengths in its design. First, using a sample of twins allowed us to adjust for the influence of genetics and early shared environment. Because these factors explain a significant amount of variance for the presence of chronic LBP [19], and the engagement in PA [20], failure to adjust for these factors may be considered a limitation of previous studies investigating the relationship between LBP and PA. Second, a comprehensive assessment of LBP allowed us to explore the association between PA and various phenotypes of chronic LBP, a common limitation of previous observational studies [10]. This limitation is particularly relevant for existing twin studies that have often analyzed simplistic definitions of LBP (eg doctor diagnosed, self-reported lifetime prevalence) because of the broad use of twin registries for research [34].

This study also has some limitations that need to be considered when interpreting the results. First, we included walking as a form of moderate-intensity PA, despite being unable to determine whether it was a brisk walk, which noticeably increased the participant’s heart rate [36]. This may have overestimated the number of individuals meeting the PA guidelines. However, it is likely that walking is one of the most common forms of PA in the adult Spanish population, so excluding walking as a form of moderate-intensity PA activity may have resulted in a very small amount of individuals who met the PA guidelines through moderate-intensity PA (eg gentle swimming, social tennis, golf). Furthermore, including walking as a means to meeting the PA guidelines would only reduce the effect size of our results, because individuals with LBP may be more likely to engage in low-intensity PA compared with the pain-free population. Second, we were unable to investigate the relationship between pain-intensity and PA levels, an interesting area where more research is needed [37,38]. In addition, questions regarding LBP and PA status were self-reported and would inevitably result in a degree of recall bias. Third, the presence of different chronic LBP phenotypes was compared with individuals with no history of chronic LBP, defined as the presence of pain in the lower back lasting for 6 months or longer, including seasonal and recurrent episodes. Therefore, it is possible that some individuals with no history of chronic LBP had experienced LBP of shorter duration (<6 months), although this would only serve to underestimate the results we obtained. Finally, we acknowledge there are numerous variables that could influence
PA levels in individuals with LBP, such as the presence of sciatica [39], previous spinal surgery [40], and occupation [41]. However, because of the lack of available data, we were unable to control for these and many other factors. This is a common limitation in large observational studies as the burden of collecting an exhaustive list of variables from participants needs to be considered, and there are also many unknown factors likely to influence PA levels in individuals with LBP. Despite this, our within-pair case-control analysis allowed us to adjust for several variables and, importantly, for the influence of genetic factors, as well as numerous known and unknown factors shared within twin pairs.

**Clinical implications**

Because of the numerous health benefits associated with meeting the PA guidelines, these results have significant implications for PA promotion in people with chronic LBP. Individuals with recent chronic LBP are less likely to meet the PA guidelines compared with those who have never had chronic LBP, and would benefit from incorporating PA promotion into their treatment. Furthermore, PA levels appear to normalize following a recent episode of chronic LBP. This information may be used to reassure patients with chronic LBP who are concerned they will not return to their previous levels of PA. Our results appear to suggest genetic and early shared environmental factors are driving the association between LBP and PA, as these associations disappeared after adjusting for genetics and early shared environment. However, these results will need to be confirmed in a larger sample of twins before definite conclusions are reached.

**Conclusion**

Individuals with recent LBP are less likely to meet the PA guidelines when compared with those with no history of chronic LBP. However, a history of chronic LBP in individuals who are currently pain free does not influence meeting the PA guidelines. This highlights the importance of incorporating PA promotion in the treatment of individuals with a recent episode of chronic LBP. Whether genetics and early shared environment could affect the association between recent LBP and meeting the PA guidelines should be further tested in larger samples of twins discordant for LBP.

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**References**


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