BMC Public Health

RESEARCH

Open Access

The association of previous and current non-chronic low back pain with daily physical activity in middle- and older-aged adults

Tatiana Rehder Gonçalves[1,2*], Diana Barbosa Cunha[1], Mauro Felippe Felix Mediano[2,3], Amal A. Wanigatunga[2,5], Eleanor M. Simonsick[4] and Jennifer A. Schrack[2,5]

Abstract

Background Low back pain (LBP) is a leading cause of years lived with disability. However, the association of non-chronic LBP with levels of daily physical activity (PA) remains poorly explored. This study investigated the association between previous and current non-chronic LBP with daily PA and compliance with PA recommendations in middle and older-aged adults.

Methods This is a cross-sectional analysis including volunteers from the Baltimore Longitudinal Study of Aging who answered questions about LBP and wore an Actiheart accelerometer for 7days. Generalized linear models and logistic models were used and adjusted for potential confounders.

Results 662 volunteers were included (50.8% women, 68.1% white), aged 68.0 (±11.4) years. Previous non-chronic LBP was reported by 240 (36.3%) participants with mean pain intensity of 3.5 ± 2.0 (ranging from 0 to 10). Current non-chronic LBP was reported by 5.7% ($n = 38$) with mean pain intensity of 4.1 ± 2.3. Participants reporting current non-chronic LBP had lower levels of total (β -0.18, 95% CI -0.34 to -0.02) and vigorous (β -0.29, 95% CI -0.56 to -0.007) daily PA and lower odds of meeting PA recommendations (OR 0.20, 95% CI 0.05 to 0.92) compared to those reporting no LBP. No association was observed for LBP intensity. Conversely, previous non-chronic LBP showed no statistically significant association with daily PA levels.

Conclusion The presence of current non-chronic LBP seems to be negatively associated with PA levels driven mainly by lower engagement in vigorous PA. No association was observed for pain intensity.

Keywords Epidemiology, Musculoskeletal health, Physical activity, Public health

*Correspondence:
Tatiana Rehder Gonçalves
tatianarehder@gmail.com
[1]Department of Epidemiology, Institute of Social Medicine Hésio Cordeiro, State University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil
[2]Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, USA
[3]Evandro Chagas National Institute of Infectious Disease, Oswaldo Cruz Foundation, Rio de Janeiro, RJ, Brazil
[4]National Institute on Aging, National Institutes of Health, Baltimore, MD, USA
[5]Center on Aging and Health, Johns Hopkins University, Baltimore, MD, USA

Background

Low back pain (LBP) is a leading cause of years lived with disability and disability-adjusted life-years [1–3]. The aetiology of LBP is multifactorial including biological, psychological, and social components that may affect physical function and quality of life and decrease the ability to perform daily activities [3–7]. Previous studies suggested that individuals with chronic LBP (persistent LBP for ≥ 12 weeks) may develop fear-avoidance behaviour due to the belief that movement would be harmful, potentially worsening injury and increasing pain [8]. Despite this behaviour may initially provide a short-term pain relief, it can decrease participation on overall daily activities, exacerbating muscle deconditioning, promoting disability, and facilitating pain chronification [9–11]. However, despite the evidence of an association between chronic LBP and reduced participation in daily activities, studies examining this relationship in individuals with non-chronic LBP (LBP lasting < 12 weeks) are scarce [12].

Physical activity (PA) is any bodily movement produced by skeletal muscles that result in energy expenditure, and commonly classified according to the intensity as light, moderate, and vigorous [13, 14]. The World Health Organization (WHO) published in 2020 a new guideline on PA suggesting all adults to undertake 150–300 min of moderate-intensity, or 75–150 min of vigorous-intensity PA per week [15] in order to improve health and increase longevity. Moreover, numerous studies have demonstrated a beneficial effect of increased PA levels on prevention and management of LBP [16, 17]. PA has been described as a pivotal intervention strategy for managing chronic LBP, to improve physical function and decrease pain, breaking up this deleterious vicious cycle [17, 18]. However, the other direction of this association, in which LBP may impact different levels of daily PA, particularly including objective measurements of PA, is underreported. The few studies that examined this direction of association mostly included individuals with chronic LBP, presenting inconclusive results [19–23]. The investigation of this relationship in non-chronic LBP is scarce and of special importance since low levels of PA increases the risk of pain chronification, disability, incidence of chronic diseases and death [14, 24, 25]. The purpose of this study is to investigate the association between previous and current non-chronic LBP with daily PA levels and compliance with PA recommendation in middle and older-aged adults. We hypothesized that both previous and current non-chronic LBP would be negatively associated with daily PA.

Methods

Study design

This is a cross-sectional analysis that included volunteers from the Baltimore Longitudinal Study of Aging (BLSA - https://www.blsa.nih.gov/), a continuously enrolled cohort study of normative human aging run by the National Institute on Aging (NIA) Intramural Research Program that began in 1958 and has been described in detail previously [26]. For the current study, participants underwent clinical evaluation between January 2007 and August 2015 (period when the Actiheart accelerometer was used). BLSA participants are community-dwelling adults who must be free of major chronic conditions and cognitive and functional impairment and must undergo 2.5 days of comprehensive health and functional screening evaluations at the time of the enrolment [26]. The Internal Review Board of the National Institutes of Health Intramural Research Program approved the study protocol. All participants provided informed consent at each study visit.

Eligibility criteria

For the present study, those who underwent a clinical evaluation and performed accelerometer measurement were selected to participate. Participants with missing values in exposure variables (presence of LBP), younger than 40 years, those who did not achieve a minimum of three valid days of accelerometer measurements, and those who reported chronic LBP (lasting more than 12 consecutive weeks) were excluded from the analysis. The exclusion of participants with chronic LBP was due to their specific characteristics, particularly in terms of pain sensitization mechanisms [27].

Exposure

LBP

The presence and intensity of LBP over the preceding year and at the moment of the study evaluation were assessed using an interviewer-administered questionnaire. The question referring to the presence of LBP over the preceding year was "In the past year, have you had any LBP?", with a yes/no answer options. Those who answered "yes" to this question were asked to rate the previous LBP intensity as follow: "Please rate your usual back pain over the past year using a scale from 0 to 10, where 0 indicates no pain and 10 indicates extremely intense pain" [28]. The question referring to presence of LBP at the moment of study evaluation was "Do you currently have LBP?" with a yes/no answer options. Participants who answered "yes" to this question were asked to rate current LBP as follow: "Please rate your pain over the past week, using the scale below (from 0 to 10, where 0 indicates no pain and 10 indicates extremely intense pain)" [28].

Participants were classified into categories based on their experiences with LBP as follows: No LBP (who had no episodes in the previous year); Previous LBP (who reported experiencing LBP in the past year but not at the time of the interview); Current LBP (who reported experiencing LBP at the moment of the study interview).

Outcomes

Physical activity was captured by a unidirectional chest worn Actiheart accelerometer (CamNtech, Cambridge, UK). On the last day of the BLSA clinical visit participants were fitted with this device positioned horizontally at the chest (at the third intercostal space) using two standard electrocardiogram electrodes. Participants were asked to wear the device at all times for the next seven days in a free-living environment. The equipment was returned to the clinic by express mail and data was transferred to the computer using commercial software (Actiheart version 4.0.32) to derive activity counts in 1-minute epochs. Days with more than 5% of data missing were considered invalid and excluded, and for inclusion in this analysis, a minimum of three valid days was required. Missing values were imputed with the average activity count per minute (cpm) for each participant (during the same time period of the others complete days for the remaining valid days) [29]. To calculate the average counts per minute for every minute of the day (12:00 am to 11:59 pm), a minute-level activity count was averaged across all valid days. For each participant, a log transformed total volume activity count was created due to highly skewed distribution of the original variable ("LTAC"- log of total daily activity counts) [29, 30].

The sum of the accumulated counts was generated according to minute-level activity counts and classified as light (10 cpm < light ≤ 95 cpm), moderate (95 cpm < moderate ≤ 234 cpm) and vigorous (> 234 cpm). Those cut-off points to determine whether an individual was engaged in, light, moderate, or vigorous intensity activities for each minute of the day were generated according to the distribution of activity counts in the BLSA population and using the Karvonen formula for heart rate reserve [(maximum heart rate - resting heart rate) x % effort] [30, 31].

A dichotomic variable was calculated based on the recommendation of the WHO 2020 physical activity guidelines: performing at least 150 min of moderate or 75 min of vigorous or 150 min of a combination of moderate and vigorous activity during the week.

Covariates

Sociodemographic, clinical, and lifestyle covariates were considered to characterize the study population and to address the potential confounding for the associations between non-chronic LBP and PA. Age (years) was used as continuous variable and self-reported race was dichotomized into white or non-white. Obesity was classified based on body mass index (BMI ≥ 30 kg/m^2). History of smoking was self-reported and categorized as "ever" or "never" smoker. Self-reported depression was categorized as a dichotomous variable. Any pain or discomfort on different body sites including head, neck, shoulder, wrists, hands, legs, hip, knee, feet, toes and ankles was used to generate the number of painful sites and this sum was categorized as 0, 1, 2 and ≥ 3 painful sites.

Data analyses

Descriptive statistics for categorical variables comprised frequency distribution and for continuous variables, means and standard deviations. Association between presence and intensity of previous and current non-chronic LBP were analyzed separately as different exposures with the following outcomes: [1] log of total daily physical activity counts (LTAC) [2], time spent in light (min/day) [3], moderate (min/day) and vigorous (min/day) daily PA, and [4] compliance with PA guidelines. Unadjusted models were generated and then adjusted by age, sex, race, obesity, number of painful body sites, smoking history, and self-reported depression. Generalized linear models (GLM) with identity link with gaussian distribution were performed for LTAC outcome, GLM with log link and gamma distribution were utilized for the continuous outcomes to account for potentially skewed distributions, and logistic models were performed for the dichotomic outcome meeting PA guidelines. Statistical significance was set at a 2-tailed p-value of < 0.05 for all analyses. All analyses were performed using Stata 13.0.

Results

Between January 2007 and August 2015, 867 volunteers underwent clinical evaluation and were fitted with the accelerometer. Of those, 13 participants were excluded due to missing values in exposure variables: 33 due to age < 40 years, 109 having < 3 valid days of accelerometer data, and 50 due to presence of chronic LBP (≥ 12 weeks) (Fig. 1). Therefore, 662 participants were included in the data analysis and their characteristics, overall and stratified by non-chronic LBP status, are presented in Table 1. Participants' mean age was 68.0 ± 11.4 years, 50.8% were female and white (68.1%), with an average of 17.5 ± 2.7 years of education. Obesity was observed in 23.3% of the participants, history of smoking was reported by 37.0%, self-reported depression by 15.6%, and one site of pain in the body (other than LBP) by 25.5%. Previous non-chronic LBP was reported by 36.3% of participants, with a mean pain intensity of 3.5 ± 2.0, and current non-chronic LBP was reported by 5.7%, with a mean pain intensity of 4.1 ± 2.3. Participants without LBP were older (68.9 ± 11.7) than participants with previous non-chronic LBP (66.5 ± 10.7). Those who reported previous non-chronic LBP had a more frequently history of smoking (43.9%) and self-reported depression (21.7%) than

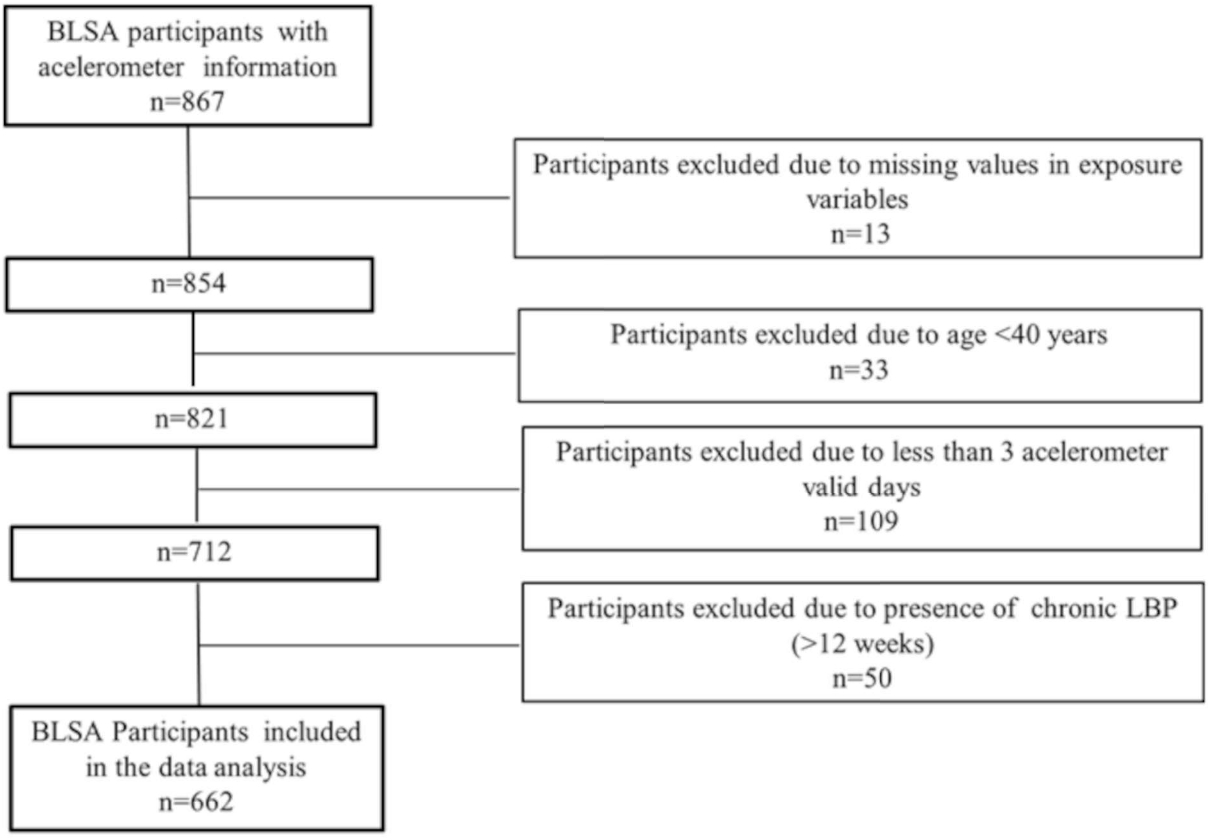

Fig. 1 Participant flow diagram
BLSA– Baltimore Longitudinal Study of Aging; LBP– low back pain

participants without LBP (32.6% and 11.8%, respectively). Participants with either previous non-chronic LBP (29.5%) and current non-chronic LBP (42.1%) reported a higher number of painful sites in the body than the ones without LBP (10.8%). Percentage of participants meeting PA recommendations was higher for those without LBP (96.5%) and with previous non-chronic LBP (97.5%) when compared to those with current non-chronic LBP (89.5%) (Fig. 2).

Table 2 shows the association between presence of previous and current non-chronic LBP with LTAC, light PA, moderate PA, vigorous PA and meeting PA recommendations. Current non-chronic LBP was inversely associated with LTAC (β -0.18, 95% CI -0.34 to -0.017), minutes per day in vigorous PA (β -0.29, 95% CI -0.56 to -0.007), and with a lower odd of meeting the PA recommendations (OR 0.20, 95% CI 0.05 to 0.92) (Table 2). No statistically significant association for the presence of previous non-chronic LBP with LTAC, light PA, moderate PA, vigorous PA and meeting PA recommendations and for current non-chronic LBP with light PA and moderate PA were observed.

Table 3 presents the association between previous and current non-chronic LBP intensity with LTAC, minutes per day in light PA, moderate PA and vigorous PA. No significant associations were found between non-chronic LBP intensity and these outcomes.

Discussion

The present study found that participants reporting current non-chronic LBP had lower levels of objectively measured total and vigorous daily PA and also lower odds of complying with the PA recommendation compared to those without LBP, with no association with pain intensity. Conversely, non-chronic LBP in the previous year was not found to be associated with daily PA levels. These results partially confirm our hypotheses and indicates that the presence of current non-chronic LBP seems to be inversely associated with PA levels, making it difficult to comply with the PA guidelines recommendation. The lower total PA levels seem to be driven by lower levels of vigorous PA, with no association with moderate and light PA.

While some studies suggested that individuals with chronic LBP tend to have lower total PA levels compared

Table 1 Characteristics of participants according to low back Pain status in the past 12 months.

	Overall (*n* = 662)		**No LBP** (*n* = 384; 58.0%)		**Previous LBP** (*n* = 240; 36.3%)		**Current LBP** (*n* = 38; 5.7%)		***p*-value** [ǂ]
	Mean / *n*	**SD / %**	**Mean / *n***	**SD / %**	**Mean / *n***	**SD / %**	**Mean / *n***	**SD / %**	
Age (Years)	68.0	±11.4	68.9	±11.7	66.5	±10.7	68.2	±12.0	**0.04***
Male sex	326	49.2%	193	50.3%	119	49.6%	14	36.8%	0.29
White	451	68.1%	257	66.9%	168	70.0%	26.0	68.4%	0.73
Education level (Years)	17.5	±2.7	17.6	±2.7	17.4	±2.6	17.6	±2.4	0.70
Obesity	154	23.3%	80	20.8%	63	26.3%	11	29.0%	0.21
Ever smoked (*n* = 660)	244	37.0%	125	32.6%	105	43.9%	14	36.8%	**0.02***
Depression (*n* = 661)	103	15.6%	45	11.8%	52	21.7%	6	15.8%	**0.004***
Number of painful sites in the body (*n* = 656)									
0	221	33.7%	157	41.2%	57	24.1	7	18.4%	**< 0.001***
1	167	25.5%	101	26.5%	61	25.7%	5	13.2%	
2	141	21.5%	82	21.5%	49	20.7%	10	26.3%	
≥ 3	127	19.4%	41	10.8%	70	29.5%	16	42.1%	
LBP intensity (*n* = 278)	-	-	-	-	3.5	±2.0	4.1	±2.3	
Total daily activity (counts)	35776.7	±18357.1	35617.2	±17078.9	36700.1	±19487.0	31556.0	±22885.6	0.27
Light PA (min/day) (*n* = 648)	287.3	±73.5	287.0	±73.0	288.6	±73.7	281.4	±78.4	0.85
Moderate PA (min/day) (*n* = 648)	66.2	±35.6	65.4	±34.1	67.8	±36.1	65.1	±46.9	0.70
Vigorous PA (min/day) (*n* = 648)	28.5	±22.6	28.4	±20.8	29.5	±24.4	23.6	±26.9	0.32
Number of valid accelerometer days	5.1	±1.1	5.2	±1.1	5.1	±1.1	5.1	±1.2	0.57

[ǂ] One Way ANOVA

[*] Bonferroni test

Age - No LBP vs. Previous LBP $p = 0.031$

Ever smoked - No LBP vs. Previous LBP $p = 0.014$

Depression - No LBP vs. Previous LBP $p = 0.003$

Number of painful sites in the body - No LBP vs. Previous LBP $p = \leq 0.001$; No LBP vs. Current LBP $p = \leq 0.001$

LBP– low back pain; PA– physical activity; ASTP - Active to Sedentary Transition Probability

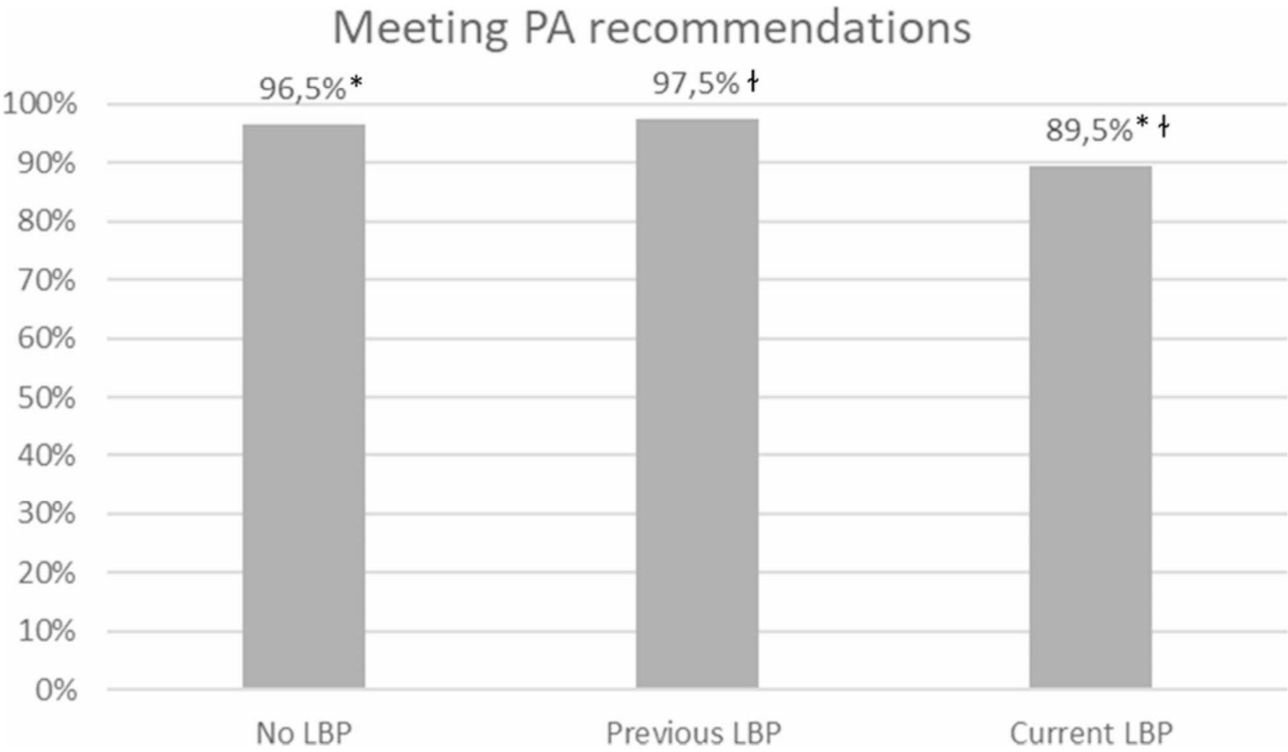

Fig. 2 Percentage of participants meeting physical activity recommendations by LBP status (p-value -*No LBP X Current LBP = 0.037; ƚ Previous LBP X Current LBP = 0.014)
LBP– low back pain; PA– physical activity

Table 2 Regression analyses on the association between presence of previous and current LBP in the last 12 months with physical activity outcomes

	No LBP (*n* = 384; 58.0%)	**Previous LBP (*n* = 240; 36.3%)**		**Current LBP (*n* = 38; 5.7%)**	
		Crude	**Adjusted***	**Crude**	**Adjusted***
LTAC **β (95% CI)** Crude (*n* = 662); Adjusted(*n* = 653)	Reference	-0.02 (-0.07 to + 0.10)	+ 0.002 (-0.079 to + 0.083)	**-0.21 (-0.39 to -0.028)**	**-0.18 (-0.34 to -0.017)**
Light PA (min/day) **β (95% CI)** Crude (*n* = 648); Adjusted(*n* = 639)	Reference	+ 0.006 (-0.04 to + 0.05)	+ 0.003 (-0.04 to + 0.05)	-0.02 (-0.11 to + 0.07)	-0.03 (-0.11 to + 0.06)
Moderate PA (min/day) **β (95% CI)** Crude (*n* = 648); Adjusted(*n* = 639)	Reference	+ 0.04 (-0.05 to + 0.12)	+ 0.03 (-0.07 to + 0.11)	-0.004 (-0.18 to + 0.18)	-0.05 (-0.23 to + 0.13)
Vigorous PA (min/day) **β (95% CI)** Crude (*n* = 648); Adjusted(*n* = 639)	Reference	+ 0.04 (-0.09 to + 0.17)	+ 0.02 (-0.12 to + 0.16)	-0.19 (-0.45 to + 0.08)	**-0.29 (-0.56 to -0.007)**
Meting PA recommendations **OR (95%CI)** Crude (*n* = 648); Adjusted(*n* = 639)	Reference	1.38 (0.52 to 3.68)	1.11 (0.36 to 3.49)	**0.31 (0.10 to 0.99)**	**0.20 (0.05 to 0.92)**

*Model adjusted by age, sex, race, obesity, number of painful body sites, smoking history, self-reported depression

LBP– low back pain; LTAC - log of total daily activity counts; PA– physical activity; ASTP - Active to Sedentary Transition Probability; OR– Odds ratio; CI– Confidence interval

to those without pain, other studies have not confirmed these findings [12, 32]. A cross-sectional study involving 30 adults (15 with chronic LBP and 15 healthy controls matched for age, gender, and occupation) found that participants with chronic LBP had lower levels of PA compared to the healthy controls [33]. Moreover, a large cross-sectional study of 1,588 twins with chronic LBP, who self-reported their pain status and PA levels, found that recent LBP (over the last month) was significantly associated with a 30% lower odds of meeting PA

Table 3 Regression models on the association between LBP intensity with PA outcomes

	Previous LBP intensity (*n* = 240; mean = 3.5, ± 2.0)		Current LBP intensity (*n* = 38; mean = 4.1, ± 2.3)	
	Crude	**Adjusted***	**Crude**	**Adjusted***
LTAC - β (95% CI)	-0.002 (-0.04 to + 0.03) *n* = 240	+ 0.009 (-0.03 to + 0.04) *n* = 236	-0.05 (-0.14 to + 0.05) *n* = 38	+ 0.003 (-0.08 to + 0.09) *n* = 38
***Light PA (min/day)* -β (95% CI)**	0.0015 (-0.016 to + 0.02) *n* = 236	-0.004 (-0.02 to + 0.01) *n* = 232	-0.00004 (-0.40 to + 0.41) *n* = 38	+ 0.02 (-0.03 to + 0.06) *n* = 38
***Moderate PA (min/day)* -β (95% CI)**	+ 0.03 (-0.06 to + 0.07) *n* = 236	0.04 (-0.003 to + 0.07) *n* = 232	-0.006 (-0.11 to + 0.10) *n* = 38	+ 0.04 (-0.03 to + 0.12) *n* = 38
***Vigorous PA (min/day)* -β (95% CI)**	-0.002 (-0.06 to + 0.05) *n* = 236	+ 0.02 (-0.04 to + 0.08) *n* = 232	-0.05 (-0.20 to + 0.10) *n* = 38	+ 0.01 (-0.12 to + 0.15) *n* = 38
Meeting PA recommendations– OR (95%CI)	1.00 (0.65 to 1.52) *n* = 236	0.82 (0.44 to 1.50) *n* = 163	0.63 (0.38 to 1.03) *n* = 38	0.65 (0.33 to 1.27) *n* = 38

*Model adjusted by age, sex, race, obesity, number of painful body sites, smoking history, self-reported depression

LBP– low back pain; LTAC - log of total daily activity counts; PA– physical activity; ASTP - Active to Sedentary Transition Probability; OR– Odds ratio; CI– Confidence interval

guidelines compared to those without LBP. Although these results were primarily observed in a population with chronic LBP, they are consistent with our findings in a non-chronic LBP population, demonstrating that a reduction in daily activities, especially those requiring vigorous intensity, can be a short-term adaptive behaviour or a coping strategy to the pain onset. The lack of association between pain intensity and PA levels may suggest that adaptive strategies are primarily initiated in response to the pain onset, regardless of intensity, as a strategy to minimize spinal movements rather than interfering with the amount of PA performed during the day, confirming the results from previous studies [34, 35]. Studies including measures of fear-avoidance behaviour could provide a deeper understanding of the mechanisms by which non-chronic LBP is associated with PA levels.

Besides the potential impact of current LBP on daily activities, studies have shown that individuals with previous episodes of LBP may also develop fear-avoidance behaviour, potentially leading to a decrease in their PA levels [24, 36–38]. However, contrary to our hypothesis, no significant associations between previous LBP and lower PA levels were observed among those with previous LBP in our study. Similarly, a cross-sectional study enrolling 13 middle-aged participants found no significant difference in total energy expenditure (assessed using doubly-labelled water) between those with chronic LBP and healthy controls [21]. These results are consistent with those observed in a larger cohort study demonstrating that participants returned to their previous self-reported PA levels after an acute episode of LBP 12 months earlier [39]. Moreover, a systematic review with meta-analysis including seven observational studies found no differences in total PA levels of adolescents and adults with chronic LBP in comparison to controls without pain. However, contrary to our study - which primarily included older adults (approximately 65% of our sample) - the review found evidence that older adults with LBP were less active than controls [19].

A possible explanation for the lack of association between previous LBP and PA levels is the exclusion of chronic LBP participants, since chronic pain has specific characteristics regarding pain sensitization, which may have reduced the influence of the fear avoidance behaviour in our sample. In addition, considering that the fear avoidance behaviour is associated with several aspects of health, the inclusion of BLSA participants that are a relatively healthy sample may partially explain the lack of association between previous LBP and PA levels [26, 40, 41].

The present study has some limitations. Although PA was measured in the week after the interview, the cross-sectional study design precluded us from establishing temporal associations, specially between current LBP and PA. There is a possibility that low levels of PA are causing deconditioning and subsequent pain. Moreover, the number of participants that reported current LBP was small, which may raise the possibility of spurious association. Despite we included all eligible participants, the lack of a sample size calculation could impact the statistical robustness of the findings. Recall bias may have influenced participants' self-reports of previous LBP (in the last 12 months) and its intensity, potentially increasing the risk of measurement errors. In addition, the lack of detailed information on the moment and frequency of LBP pain episodes in the previous 12 months may have introduced some residual confounding. Strengths of this study includes the high-quality of BLSA data, the objectively measured levels of PA, and the measurement of LBP intensities.

Conclusion

Results indicate that current non-chronic LBP, but not pain intensity, was associated with decreased levels of PA, mostly in vigorous activities, and a lower odd of complying the WHO's PA recommendations in a healthy middle- and older-aged adults. This underscores the importance of addressing LBP early, even when non-chronic, to maintain PA levels and potentially prevent the cascade of health issues associated with low levels of PA in aging populations.

Abbreviations

LBP	Low back pain
PA	Physical activity
WHO	World Health Organization
BLSA	Baltimore Longitudinal Study of Aging
NIA	National Institute on Aging
LTAC	Log of total daily activity counts
cpm	Count per minute
BMI	Body mass index
GLM	Generalized linear models

Acknowledgements

The authors would like to thank all the participants in the Baltimore Longitudinal Study of Aging during the conduction of this research.

Author contributions

TRG, DBC, MFFM, and JAS contributed to the conception and design of the work. AAW, SEM, and JAS contributed to the acquisition of the dataset. TRG, DBC, MFFM, and JAS performed the analysis, and TRG, DBC, MFFM, AAW, EMS, and JAS participated in the interpretation of the data. TRG wrote the original draft, and all authors—TRG, DBC, MFFM, AAW, EMS, and JAS—substantively revised it. All authors approved the submitted version, agreed to be personally accountable for their contributions, and ensured that any questions related to the accuracy or integrity of any part of the work would be appropriately investigated, resolved, and documented in the literature.

Funding

This research was supported by the Research Program of the National Institute of Aging (NIA) of the National Institutes of Health (NIH)– USA, by grant R21AG053198. The first author in this study received a doctoral scholarship from the National Council for Scientific and Technological Development– CNPq.

Data availability

The data that support the findings of this study are available from the BLSA website [https://www.blsa.nih.gov/blsa-data-use] but restrictions apply to the availability of these data, which were used under license for the current study, and are not publicly available. Data are available from the corresponding author upon reasonable request, and with permission of the BLSA Data Sharing Proposal Review Committee.

Declarations

Ethics approval and consent to participate

The data used in the analyzes of this manuscript were obtained and approved for use by the Baltimore Longitudinal Study of Aging (BLSA), a study carried out by the National Institute on Aging (NIA). The BLSA study protocol was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and approved by the National Institutes of Health Intramural Institutional Review Board.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 4 October 2024 / Accepted: 14 January 2025
Published online: 30 January 2025

References

1. Wu A, March L, Zheng X, Huang J, Wang X, Zhao J, et al. Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the global burden of Disease Study 2017. Ann Transl Med. 2020;8(6):299.
2. Disease GBD, Injury I, Prevalence C. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of Disease Study 2017. Lancet. 2018;392(10159):1789–858.
3. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. Lancet. 2018;391(10137):2356–67.
4. Maher C, Underwood M, Buchbinder R. Non-specific low back pain. Lancet. 2017;389(10070):736–47.
5. Maniadakis N, Gray A. The economic burden of back pain in the UK. Pain. 2000;84(1):95–103.
6. Anema JR, Schellart AJ, Cassidy JD, Loisel P, Veerman TJ, van der Beek AJ. Can cross country differences in return-to-work after chronic occupational back pain be explained? An exploratory analysis on disability policies in a six country cohort study. J Occup Rehabil. 2009;19(4):419–26.
7. Swinkels-Meewisse IEJ, Roelofs J, Oostendorp RAB, Verbeek ALM, Vlaeyen JWS. Acute low back pain: pain-related fear and pain catastrophizing influence physical performance and perceived disability. Pain. 2006;120(1–2):36–43.
8. Vlaeyen JWS, Kole-Snijders AMJ, Boeren RGB, van Eek H. Fear of movement/(re)injury in chronic low back pain and its relation to behavioral performance. Pain. 1995;62(3):363–72.
9. Swinkels-Meewisse IE, Roelofs J, Schouten EG, Verbeek AL, Oostendorp RA, Vlaeyen JW. Fear of movement/(re)injury predicting chronic disabling low back pain: a prospective inception cohort study. Spine (Phila Pa 1976). 2006;31(6):658–64.
10. Bunzli S, Singh N, Mazza D, Collie A, Kosny A, Ruseckaite R et al. Fear of (re) injury and return to work following compensable injury: qualitative insights from key stakeholders in Victoria, Australia. BMC Public Health. 2017;17(1).
11. Vlaeyen JWS, Crombez G, Linton SJ. The fear-avoidance model of pain. Pain. 2016;157(8):1588–9.
12. Berger M, Bertrand AM, Robert T, Chèze L. Measuring objective physical activity in people with chronic low back pain using accelerometers: a scoping review. Front Sports Act Living. 2023;5.
13. Strath SJ, Kaminsky LA, Ainsworth BE, Ekelund U, Freedson PS, Gary RA, et al. Guide to the assessment of physical activity: clinical and research applications: a scientific statement from the American Heart Association. Circulation. 2013;128(20):2259–79.
14. Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The physical activity guidelines for americans. JAMA. 2018;320(19):2020–8.
15. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54(24):1451–62.
16. Roren A, Daste C, Coleman M, Rannou F, Freyssenet D, Moro C, et al. Physical activity and low back pain: a critical narrative review. Annals Phys Rehabilitation Med. 2023;66(2):101650.
17. Alzahrani H, Mackey M, Stamatakis E, Zadro JR, Shirley D. The association between physical activity and low back pain: a systematic review and meta-analysis of observational studies. Sci Rep. 2019;9(1).
18. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH et al. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. 2017.
19. Griffin DW, Harmon DC, Kennedy NM. Do patients with chronic low back pain have an altered level and/or pattern of physical activity compared to healthy individuals? A systematic review of the literature. Physiotherapy. 2012;98(1):13–23.

20. Zadro JR, Shirley D, Amorim A, Perez-Riquelme F, Ordonana JR, Ferreira PH. Are people with chronic low back pain meeting the physical activity guidelines? A co-twin control study. Spine J. 2017;17(6):845–54.
21. Verbunt JA, Westerterp KR, van der Heijden GJ, Seelen HA, Vlaeyen JW, Knottnerus JA. Physical activity in daily life in patients with chronic low back pain. Arch Phys Med Rehabil. 2001;82(6):726–30.
22. Heneweer H, Vanhees L, Picavet HS. Physical activity and low back pain: a U-shaped relation? Pain. 2009;143(1–2):21–5.
23. Heneweer H, Staes F, Aufdemkampe G, van Rijn M, Vanhees L. Physical activity and low back pain: a systematic review of recent literature. Eur Spine J. 2011;20(6):826–45.
24. Hanney WJ, Kolber MJ, Beekhuizen KS. Implications for physical activity in the Population with Low Back Pain. Am J Lifestyle Med. 2008;3(1):63–70.
25. Kyu HH, Bachman VF, Alexander LT, Mumford JE, Afshin A, Estep K et al. Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose-response meta-analysis for the global burden of Disease Study 2013. BMJ. 2016:i3857.
26. Kuo PL, Schrack JA, Shardell MD, Levine M, Moore AZ, An Y, et al. A roadmap to build a phenotypic metric of ageing: insights from the Baltimore Longitudinal Study of Aging. J Intern Med. 2020;287(4):373–94.
27. Chimenti RL, Frey-Law LA, Sluka KA. A mechanism-based Approach to Physical Therapist Management of Pain. Phys Ther. 2018;98(5):302–14.
28. Haefeli M, Elfering A. Pain assessment. Eur Spine J. 2006;15(Suppl 1):S17–24.
29. Schrack JA, Zipunnikov V, Goldsmith J, Bai J, Simonsick EM, Crainiceanu C, et al. Assessing the physical Cliff: detailed quantification of age-related differences in daily patterns of physical activity. Journals Gerontol Ser A: Biol Sci Med Sci. 2013;69(8):973–9.
30. Schrack JA, Leroux A, Fleg JL, Zipunnikov V, Simonsick EM, Studenski SA, et al. Using Heart Rate and Accelerometry to define quantity and intensity of physical activity in older adults. Journals Gerontology: Ser A. 2018;73(5):668–75.
31. Karvonen MJ, Kentala E, Mustala O. The effects of training on heart rate; a longitudinal study. Ann Med Exp Biol Fenn. 1957;35(3):307–15.
32. Grabovac I, Dorner TE. Association between low back pain and various everyday performances. Wiener Klinische Wochenschrift. 2019;131(21–22):541–9.
33. Ryan CG, Margaret Grant P, Dall PM, Gray H, Newton M, Granat MH. Individuals with chronic low back pain have a lower level, and an altered pattern, of physical activity compared with matched controls: an observational study. Australian J Physiotherapy. 2009;55(1):53–8.
34. Damato TM, Oliveira CB, Franco MR, Silva FG, Gobbi C, Morelhão PK, et al. Characteristics Associated with people with Chronic Low Back Pain Meeting Physical Activity guidelines and recommendations for sedentary behavior: a cross-sectional study. J Manip Physiol Ther. 2021;44(5):378–88.
35. Huijnen IPJ, Verbunt JA, Peters ML, Delespaul P, Kindermans HPJ, Roelofs J, et al. Do depression and pain intensity interfere with physical activity in daily life in patients with chronic low back Pain? Pain. 2010;150(1):161–6.
36. Verbunt JA, Sieben JM, Seelen HAM, Vlaeyen JWS, Bousema EJ, Heijden GJ, et al. Decline in physical activity, disability and pain-related fear in sub-acute low back pain. Eur J Pain. 2005;9(4):417.
37. Larsson C, Ekvall Hansson E, Sundquist K, Jakobsson U. Impact of pain characteristics and fear-avoidance beliefs on physical activity levels among older adults with chronic pain: a population-based, longitudinal study. BMC Geriatr. 2016;16:50.
38. Elfving B, Andersson T, Grooten WJ. Low levels of physical activity in back pain patients are associated with high levels of fear-avoidance beliefs and pain catastrophizing. Physiother Res Int. 2007;12(1):14–24.
39. Pozzobon D, Nogueira LAC, Ferreira PH, Steffens D, Beckenkamp PR, Blyth FM, et al. Return to self-reported physical activity level after an event of acute low back pain. PLoS ONE. 2019;14(7):e0219556.
40. Altug F, Unal A, Kilavuz G, Kavlak E, Citisli V, Cavlak U. Investigation of the relationship between kinesiophobia, physical activity level and quality of life in patients with chronic low back pain1. J Back Musculoskelet Rehabil. 2016;29(3):527–31.
41. Bilgin S, Cetin H, Karakaya J, Kose N. Multivariate analysis of risk factors predisposing to Kinesiophobia in persons with chronic low back and Neck Pain. J Manipulative Physiol Ther. 2019;42(8):565–71.

Publisher's note