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Original research

Are flexibility and muscle-strengthening activities associated with a higher risk of developing low back pain?

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ABSTRACT

Objectives: To examine the association between participation in flexibility or muscle-strengthening activities with the development of low back pain.
Design: Observational cohort study.
Methods: The cohort included 4610 adults, 17% female, between 20 and 81 years of age (mean 46.6, standard deviation 4.96). The cohort was followed for a mean of 4.9 years for self-reported low back pain. All participants reported at baseline whether they performed flexibility or muscle-strengthening activities, including specific sub-types.
Results: Neither general performance of flexibility or muscle-strengthening activities were associated with a higher incidence of low back pain compared to those who did not perform these activities. Those who reported stretching, as a specific flexibility activity were at a higher risk of developing low back pain compared with those who performed no flexibility exercises, reported callisthenic flexibility activities, or attended exercise classes. Those who reported using weight training machines, as part of muscle-strengthening activities, had a higher risk of reporting low back pain, compared with those who did not perform muscle-strengthening activities or performed callisthenic or free weight activities.
Conclusions: In this sample, stretching or use of weight training machines is associated with increased risk of developing low back pain compared to use of free weights, callisthenics or exercise classes.

1. Introduction

Low back pain (LBP) is among the most commonly reported health problems in America and up to 80% of people can be expected to consult their physician about it at some point in their lifetime.[1] In spite of its prevalence, LBP is difficult to define. Some consider it actual nociception perceived in the lumbar region, others only consider it relevant if it worries the patient sufficiently to seek care or if it causes a functional impairment in their activities of daily living. To produce a definition of LBP is beyond the scope of this work, however, we recognize that to different people, both patients and physicians, it has different meanings, which can make it challenging to quantify. Dionne et al. met as a panel of back pain experts in 2008 and identified heterogeneity in the definition of back pain and agreed on a minimal and optimal definition, taking into account severity, site and duration of symptoms along with functional limitations.[2] Prevalence estimates vary among different populations ranging from 12% to 38%.[3,4]

Flexibility and muscle-strengthening exercises are core features of many physical training programmes. Guidelines from the UK Department of Health indicate that it is important that all people include flexibility and muscle-strengthening activities at least twice per week.[5] Canadian guidelines recommend that people participate in flexibility exercises four to seven times per week and muscle-strengthening activities two to four times per week.[6] US guidelines also recommend muscle-strengthening exercises at least twice a week[7] and suggest using flexibility exercises, such as stretching, but note that this does not count towards meeting the 150 min per week physical activity target. Whilst these guidelines all suggest incorporating flexibility and muscle-strengthening exercises in a physical activity regimen, there are conflicting data and opinions as to whether these activities may be harmful to the back.[8,9]

A sizable percentage (up to 90%) of LBP sufferers are diagnosed with "non-specific" LBP.[1] There are conflicting reports relating to predictors of LBP. In a study of aircraft workers, higher

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baseline strength was associated with higher risk of developing LBP, however when adjusting for age, this association weakened.[10] Interestingly, in adolescents, reduced strength, poor leg flexibility and smoking are risk factors for developing LBP.[11,12] Another study has shown no association between baseline strength and incidence of LBP.[13] There is evidence that treatment of LBP with regular flexibility exercises can provide symptom relief, when compared with general physical activity regimens,[14] however flexibility does not seem to reduce the risk development of LBP.[15,16]

In this study, we investigated associations between incidence of LBP, and the use of flexibility and muscle-strengthening exercises in the Aerobics Centre Longitudinal Study (ACLS).

2. Methods

Participants were part of the ACLS, a prospective observational study. Study details have been described previously and the current work is a secondary analysis.[17] Study participants came to the Cooper Clinic (Dallas, TX, USA) for periodic preventive health examinations and for counselling regarding diet, physical activity, and other lifestyle factors associated with chronic diseases. The majority of the participants were Caucasian (>95%), had a college education and were from middle and upper socioeconomic strata. After giving informed consent, participants underwent a thorough, physician-led physical examination, gave a blood sample for blood chemistry analyses, had anthropometric measurements taken, had their cardiorespiratory fitness measured by a maximal treadmill test and completed a detailed questionnaire on their personal and family medical history.

In the current analysis, 10,713 participants had at least two medical examinations between 1977 and 2005. We used their last examination to assess status for analysis and excluded those with cardiovascular disease ($n = 109$), cancer ($n = 658$), as well as those reporting a history of bone and joint problems such as swollen/stiff joints, arthritis, and gout ($n = 1764$). In addition, those with missing data on flexibility and muscle-strengthening exercises ($n = 927$), and those with baseline LBP ($n = 2146$) or chronic joint pain ($n = 499$) were excluded. The final analyses were based on a total of 4610 people, comprised of 3843 men and 767 women. This study was reviewed and approved annually by the Cooper Institute Institutional Review Board, which met US government criteria for ethics approval. The senior investigators were certified annually as meeting institutional review board standards.

LBP complaints were obtained from standardized self-report medical history forms that also were reviewed by the physician during the examination. Patients were asked to indicate (yes or no) whether they had ever had a problem with LBP and whether LBP was a current problem.

Muscle-strengthening and flexibility activities were assessed by self-report on the medical history questionnaire. Participants were asked to provide yes/no answers to 4 separate questions:

(1) "Are you currently involved in a muscle-strengthening programme?"
(2) Can you specify the muscle-strengthening activity as "Callisthenics", "Free Weights", "Weight Training Machines" or "Other"?
(3) "Are you currently involved in exercises to maintain or improve your joint flexibility?"
(4) Can you specify the flexibility activity as "Stretching", "Callisthenic", "Exercise Class", "Yoga" or "Other"?

Baseline differences were examined using chi-square tests for categorical variables and *t*-tests for continuous variables across activity and outcome groups. Logistic regression was used to compute odds ratios (ORs) and 95% confidence intervals (CIs) for incident LBP according to categories of flexibility (due to the small numbers of participants who performed Yoga activity, we did not include it in the analysis) or muscle-strengthening activities including each of the four exposures: the muscle-strengthening activities (yes/no), specific-strengthening activity, the flexibility activities (yes/no), and specific-flexibility activity in order to quantify the strength of these associations. Adjusted models controlled for the potential confounding effects of baseline age (years), gender (female/male), aerobic activity (MET-minutes/week), BMI, current smoking (yes/no), hypertension (yes/no), diabetes (yes/no), hypercholesterolemia (yes/no), cardiorespiratory fitness (CRF) (treadmill time duration in minutes), and muscle-strengthening (when flexibility was the exposure) or flexibility activities (when muscle-strengthening was the exposure). Statistical significance was set at $\alpha = 0.05$ level for all analyses. All analyses were conducted using SAS statistical software (V. 9.3, SAS Institute, Inc., Cary, North Carolina).

3. Results

The study population had a mean age of 46.7 ± 9.4 years and were followed for a mean of 4.9 ± 3.8 years. 590 (12.8%) reported new incidence of LBP, whilst 1982 (43.0%) and 1631 (35.4%) reported performing muscle-strengthening and flexibility activities respectively. The distributions of baseline characteristics by muscle-strengthening and flexibility activities are shown in Table 1. Participants who reported muscle-strengthening activities had lower BMI, higher fitness, lower diastolic blood pressure, reduced total cholesterol and fasting blood glucose, reduced prevalence of diabetes or hypercholesterolemia and a lower proportion of smokers than those who did not partake in muscle-strengthening activities. Those who reported performing flexibility activities were older, had a higher proportion of females, reduced BMI, higher fitness, MET-minutes per week, lower cholesterol and fasting blood glucose, lower diastolic blood pressure and lower prevalence of smoking, diabetes, hypertension and hypercholesterolaemia than those who did not.

The independent associations between muscle-strengthening activities, flexibility activities and incidence of LBP are shown in Tables 2 and 3 respectively. The reported use of muscle-strengthening exercises was not associated with incidence of LBP. Table 2 shows specific types of muscle-strengthening activity with the development of LBP. Those who reported using weight training machines were at higher risk of developing LBP (OR = 1.36 (1.08–1.70), $p = 0.009$) than those who did not, and those who reported "other" muscle-strengthening activities were at higher risk of developing LBP (OR = 1.45 (1.03–2.06), $p = 0.04$) than those who did not. Callisthenics and free weight exercises were not associated with incident LBP.

Amongst this group, 9%, 2% and 0.1% of participants reported combinations of 2, 3 or 4 muscle-strengthening activities, respectively. Additional adjustment for other activities did not change the above association with risk of LBP.

Table 3 shows no significant associations in risk of developing LBP among participants who performed flexibility activities in general. However, those who reported specifically stretching ($n = 126$) had a higher risk of developing LBP (OR = 1.26 (1.01–1.58), $p = 0.04$) compared to those who did not. Those who reported using callisthenic exercises or attending exercise classes for flexibility did not have a higher risk of developing LBP ($p > 0.05$ for each) compared to those who did not.

4. Discussion

We examined the risk of developing LBP associated with muscle-strengthening and flexibility activities among white-collar