J Rehabil Med 2008; 40: 359–365

ORIGINAL REPORT

AEROBIC FITNESS IN PATIENTS AT WORK DESPITE RECURRENT LOW BACK PAIN: A CROSS-SECTIONAL STUDY WITH HEALTHY AGE- AND GENDER-MATCHED CONTROLS

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Objective: **The aims of this study were to compare the aerobic fitness level of working patients who have recurrent low back pain with those of healthy age- and gender-matched controls, and to investigate the relationship of aerobic fitness level with pain intensity, general health, perceived disability, fear-avoidance beliefs and self-efficacy.**

Subjects and methods: **A total of 57 patients with recurrent low back pain, with a mean of 10 years' pain duration and 57 healthy controls performed a sub-maximal Åstrand cycle test. Predicted maximum oxygen consumption was calculated and compared. Correlations between the low back pain patients' predicted aerobic fitness level and the assessed variables were calculated.**

Results: **The women with low back pain had lower predicted aerobic fitness levels than the healthy women ($p < 0.05$). For the men there was no such difference. Multiple regression analysis showed that age, gender, body mass index and self-efficacy were associated with the predicted aerobic fitness level.**

Conclusion: **This study suggests no overall difference in predicted aerobic fitness level for a sample of subjects with recurrent low back pain compared with healthy controls. This is perhaps because all the patients were still at work despite the pain. The results indicate, however, that the factors associated with aerobic fitness differ between men and women.**

Key words: low back, aerobic fitness level, physical activity level, disability.

J Rehabil Med 2008; 40: 359–365

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Submitted March 16, 2007; accepted December 19, 2007

INTRODUCTION

Low back pain (LBP) remains a serious problem in society. As many as 55% of the Nordic population experience LBP within a 12-month period, incurring large costs for treatment and sick leave (1). There is recent evidence supporting an active approach to the treatment of LBP (2). Physical activity in general is considered important for health, depression and pain experience, and greater aerobic fitness may increase tolerance of physical activity and contribute to better mood, sleep and relaxation (3, 4). Patients with LBP reportedly have lower physical activity levels (5, 6). They describe how pain prevents them from performing normal activities, and they report disability, low self-esteem and fear-avoidance behaviour (7–9). A factor contributing to the recurrence or chronicity of LBP, it has been suggested, is physical "disuse" or "deconditioning" (10, 11). Bortz (10) was the first to describe the disuse syndrome. He focused on the consequences of long-term inactivity as a syndrome rather than a symptom, and described how inactivity could have both physiological and psychological consequences. It has also been reported that some patients with LBP may catastrophize their pain, thus making them afraid of normal activity, which they think might lead to re-injury (11).

Several studies of LBP and aerobic fitness report conflicting results (12–17). There is no clear evidence that patients with LBP are less physically fit than healthy controls, or that lower levels of fitness contribute to recurrence of LBP. Some studies report no difference compared with normative values (13, 14), while others report a lower predicted aerobic fitness level (12, 15–17). There are also gender differences. While some studies report significantly lower predicted aerobic fitness for men (12, 16), only one reports such results for women (17). Verbunt et al. (18) conclude that existing studies have very little in common regarding aerobic fitness levels in LBP, and controversy exists among the studies regarding patients, controls and test methods. Work status could be an important factor in interpreting aerobic fitness in chronic LBP (18). Unfortunately, information on work status is not available in all studies. To date, as far as we know, few studies (17, 19) have reported aerobic fitness levels in working LBP patients' who are not sick-listed, jobless or receiving disability payment.

We studied a group of patients with ongoing recurrent LBP, all working despite the pain, seeking care at an outpatient physiotherapy clinic. Our hypothesis was that this sample would be less fit than healthy gender- and age-matched controls. We also hypothesized that the LBP patient's level of

doi: 10.2340/16501977-0176

ISSN 1650-1977

aerobic fitness related to pain, perceived disability, physical activity level, general health, and self-efficacy and fear-avoidance beliefs.

MATERIALS AND METHODS

Subjects and setting

This study was conducted at a private outpatient physiotherapy clinic. The enrolment period was 7 months. Working subjects (who were not on sick leave, disability payment or jobless) with recurrent ongoing LBP (> 8 weeks period) seeking care at the clinic, and who matched the inclusion criteria, were asked consecutively to participate in the present study, which is a part of a randomized clinical trial evaluating 2 different active treatments for LBP. Physiotherapists working at the clinic with an international certification in orthopaedic manual therapy, with 21 (mean) years of clinical experience, examined the patients.

LBP was defined as pain arising from the first lumbar vertebra as upper border to the gluteal fold as lower border (20). The patients had LBP with active movement (e.g. extension pain, flexion pain, and lateral flexion pain), palpated para-vertebral tenderness at lower lumbar levels, and positive springing test of lower lumbar segment(s) (21). The clinical tests used in the present study have been tested for inter-examiner reliability (21). A total of 57 eligible patients (28 women, 29 men) were included. None of the patients declined to participate. An age- (born-same-year) and gender-matched control group comprising 57 healthy, working persons was recruited consequently.

Inclusion criteria. Men and women aged 18–60 years at work despite ongoing recurrent LBP, but with a least one pain-free episode during the previous year.

Exclusion criteria. First-time LBP, radiating pain to the leg or legs with overt neurological signs, pregnancy, known lumbar disc hernia or fracture, back surgery, diagnosed inflammatory joint disease, known severe osteoporosis, or known malignant disease, known heart or pulmonary disease, medication that influences heart rate (e.g. beta-blockers). All individuals in the patient- and control groups gave their informed consent to participate in the study. The study was approved by the ethics committee at the Karolinska Institutet (D.nr. 100/01/02) in Stockholm.

Demographic data and clinical characteristics

Before the tests, the patients with LBP ($n = 57$) and controls ($n = 57$) completed questionnaires about demographic data. All test persons (TP, $n = 114$) answered a question regarding exercise physical activity level. Physical activity was graded in 4 steps; 1: I never perform physical activities; 2: I perform physical activities a few times every month; 3: I perform physical activities once a week; 4: I perform physical activities more than once/week. The LBP patients completed questionnaires regarding duration of back pain, medication and assessment instruments regarding pain, general health, perceived disability, fear avoidance and self-efficacy. They also answered the written question: Do you think your aerobic fitness level is important for your health? (Yes/no).

Pain assessment

A visual analogue scale (VAS), was used to assess pain (22). The VAS used was a 100-mm horizontal line anchored on the left "no pain" and on the right "unbearable pain". Validity and reliability have been sufficiently tested for LBP patients (23).

Perceived disability

The Oswestry Low Back Pain Questionnaire (OSW) covers 10 domains (24). The instrument is designed to assess how pain affects various activities of daily living (pain level, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and travelling). Higher scores mean greater activity limitation. The total possible score is 100. The scale is designed to assess disability in LBP patients and is recommended as a functional scale for back pain (25).

Health assessment

The Short Form-36 Health Survey (SF-36) is a generic health survey not designed for any special patient category, but recommended in studies of back pain (26). The results are presented as sum scores (0–100) for 8 subscales each with a different number of questions. Two subscales were used; general health (GH) and physical functioning (PF). A high score means better health or better physical functioning.

Perceived self-efficacy

The self-efficacy scale (SES) assesses self-efficacy beliefs specifically related to 8 basic physical activities: walking, running, carrying bags, standing (in line), cycling, sitting in an armchair, sitting at a table, and working in a bent-forward position (27). A high score indicates a strong belief in one's self-efficacy. The total possible score is 64.

Fear-avoidance beliefs

The fear-avoidance beliefs questionnaire (FABQ) (8) is a 16-item, 2-factor, self-report questionnaire developed to focus on patients' beliefs about how work (7 items; sum score 42) and physical activity (4 items; sum score 24) affect their pain. The FABQ shows good psychometric properties. Higher sum scores indicate more fear-avoidance beliefs.

The submaximal Åstrand bicycle test

To predict maximum oxygen consumption ($\dot{V}O_2$max) a submaximal Åstrand bicycle test was performed (28). All the test persons ($n = 114$) underwent 2 tests on 2 occasions with an interval of 2 days, it having been reported that the reliability of the test can vary. The limits of agreement between the 2 tests in the present study were considered clinically acceptable (29). It has been reported recently that the reliability of the test is good (30). Test 1 was used in the statistical analysis.

Before the test, height, weight and body mass index (BMI) were recorded. One test leader, a physiotherapist, was responsible for all tests. The TP cycled on a calibrated cycle ergometer with a fitness computer (Monarch Ergomedic 829E, Sweden) for 6 min or until steady-state was achieved. The test leader asked the TPs to try their hardest, but to take their pain and fatigue into account. The TPs started cycling with a workload of 0.5 W/kg at a constant rate of 60 rpm. The resistance was gradually increased. The resistance was based on the TP's heart rate during the first 2 min, to achieve a steady-state heart rate of at least 120 beats, a value which represents the limit for possible calculation of $\dot{V}O_2$max (28, 31). Maximum oxygen consumption ($\dot{V}O_2$max) was estimated from the known linear relationship between heart rate and oxygen consumption at sub-maximal workloads. The test result for $\dot{V}O_2$max was expressed as $ml \times kg^{-1} \times min^{-1}$. The TP was instructed not to eat or smoke, or to perform excessive physical activity for at least 2 h before the test.

The TP rated their perceived exertion and fatigue during the test using Borg's RPE Scale (32). Before and after each test the patients rated their perceived pain using Borg's CR-10 Scale (32). This category scale is used for ratings of pain intensity with certain ratio properties. It has 10 scale steps plus an additional possibility to rate "maximal pain" (= 11–12). If the TP perceived serious pain or symptoms from cardiovascular or pulmonary difficulties, the test was stopped. Time, perceived pain, exertion and reason for stopping the test were recorded.

Statistical analysis

For the descriptive analyses (age, height, weight, BMI, duration of pain), mean and standard deviation (SD) were calculated. Differences between the groups regardning demographic data were analysed with student *t*-test. The Borg ratings and assessments regarding pain, health, physical function, disability, FABQ and SES were presented as median (md) and range or percentiles (25th–75th). The normative values of physical functioning (PF) and general health (G) were presented as median (md) and percentiles (25th–75th). Differences between men and women in the LBP group regarding assessed variables were analysed with Mann-Whitney *U*-test.

To compare predicted aerobic fitness ($\dot{V}O_2$max) between the patient group and the control group, Student's *t*-test for unpaired observations with a normal distribution of the data was used. To compare physical activity level between the patients with LBP and the controls, the χ^2 test was used. Women and men were analysed separately in all analyses.

In the patient group the relationship between predicted aerobic fitness level ($\dot{V}O_2$max) and the investigated variables gender, age, pain, disability, physical activity level, general health, fear-avoidance beliefs and self-efficacy, was investigated with regression analysis. Spearman's rank correlation coefficient (*r*s) was used, with the following descriptive terms: 0.00–0.25 = little if any correlation; 0.26–0.49 = low correlation, 0.50–0.69 = moderate correlation; 0.78–0.89 = high correlation; and 0.90–1.0 = very high correlation.

A multiple linear regression analysis was performed to define the contribution of independent variables investigated to the dependent variable, level of aerobic fitness. The most related variables were used in the multiple regression analysis; 5 in the overall analysis and 3 in the gender analysis. Standardized beta coefficients and significance were tested using the null hypothesis that the coefficient did not differ from zero. The significance level was set at $p \leq 0.05$. All statistical analyses were calculated with the Statistica software 2004.

RESULTS

Demographic data and clinical characteristics

There were no statistically significant differences regarding demographic data between the patient group and the age- and gender-matched control group except for weight and height ($p < 0.001$) between men and women in both groups (Table I). Thirty-five percent of the patients with LBP and 39% of the controls had an active working situation. There was a baseline significant difference ($p = 0.04$) between the men and women in the LBP group regarding FABQ activity score. Baseline data for the 2 groups, specified for men and women, is presented in Table I.

Aerobic fitness level and physical activity level

There was a significant group difference in $\dot{V}O_2$max for the women ($p = 0.029$), but no overall difference between the groups (Table II). All TPs ($n = 114$) in both the patient group ($n = 57$) and the control group ($n = 57$) completed the 2 submaximal cycle tests. The LBP group rated higher exertion than the controls ($p = 0.004$) on the Borg RPE scale in the cycle test and the female patients with LBP separately rated higher exertion ($p = 0.03$) than the female controls (Table II).

Concerning perceived pain (Borg's CR-10 scale), all the patients with recurrent LBP rated less pain ($p = 0.004$)

Table I. *Demographic data and clinical characteristics for the low back pain and control groups (n = 57), women and men separately. Minimum and maximum scores on questionnaires are given. For physical functioning and general health (SF-36) the norm of the general Swedish population (n = 8930) is given*

	LBP group			Control group		
	All (*n*=57)	Women (*n*=28)	Men (*n*=29)	All (*n*=57)	Women (*n*=28)	Men (*n*=29)
Age (years), mean (SD)	38 (11)	37 (11)	39 (11)	38 (11)	37 (11)	39 (11)
Height (cm), mean (SD)	175 (9)	168 (6)	182 (6)	175 (9)	168 (4)	182 (6)
Weight (kg), mean (SD)	76 (16)	68 (16)	86 (10)	73 (14)	62 (8)	83 (10)
BMI (kg/m^2), mean (SD)	25 (4)	24 (5)	26 (3)	24 (4)	22 (3)	25 (3)
Work active/sedentary (% of group)	36			39		
Physical activity level (PAL) (% of group)						
Never	16	18	15	5	4	7
Once/month or less	23	14	33	16	7	24
Once/week	32	46	19	57	67	45
More than once/week	30	22	33	19	22	24
Decline in PAL after onset of LBP (% of group)	68	60	76			
				Healthy reference group (SF-36)		
Physical functioning (0–100) md (25th/75th)	80 (60/90)	75 (70/90)	83 (60/90)	92 (90/100)	91 (90/100)	93 (90/100)
General health (0–100) md (25th/75th)	67 (55/87)	74 (68/87)	66 (47/87)	78 (67/95)	77 (67/95)	78 (70/92)
Pain (VAS) (0–100) md (25th/75th)	35 (20/60)	36 (18/60)	34 (24/56)			
Pain duration (years), mean (SD)	10 (8)	11 (9)	10 (8)			
Pain duration (*n*)						
> 8 weeks/ > 12 weeks	19/38	10/18	9/20			
Perceived disability OSW (0–100) md (25th/75th)	22 (12–28)	21 (12–38)	20 (14–32)			
Self-efficacy beliefs						
SES (0–64) md (25th/75th)	49 (39–56)	49.5 (41–53)	46.5 (35–56)			
Fear-avoidance beliefs (FABQ)						
Work (0–42) md (25th/75th)	11.5 (5–17.5)	11.5 (4–17)	11.5 (5–19)			
Activity (0–24) md (25th/75th)	12 (8–15.5)	9 (5–14)	14 (10–17)			

LBP: low back pain; md: median; SD: standard deviation; OSW: Oswestry Low Back Pain Questionnaire; FABQ: fear-avoidance beliefs questionnaire; SF-36: Short Form-36 Health Survey; VAS: visual analogue scale; BMI: body mass index; SES: self efficancy scale.

Table II. *Predicted aerobic fitness ($\dot{V}O_2$max) and self-estimated exertion (Borg's RPE-scale) in the low back pain (LBP) group and control group; men and women separately*

	n	$\dot{V}O_2$max ($ml \times kg^{-1} \times min^{-1}$) mean (SD) (range)	p	Borg's RPE scale (6–20) median (range)	p
LBP-group all	57	35.8 (10.8) (13.5–61.7)		15.0 (12–16)	
			0.09		0.004*
Control-group all	57	39 (9.0) (22.1–64.9)		14.0 (12–15)	
LBP-group women	28	33.6 (10.6) (13.5–53)		15.0 (13–16)	
			0.029*		0.03*
Control-group women	28	39.8 (9.7) (22.1–64.9)		13.5 (12–15)	
LBP-group men	29	38.1 (10.6) (20.9–61.7)		14.0 (12–15)	
			0.20		0.43
Control-group men	29	38.2 (8.5) (22.7–52.1)		14.0 (12–15)	

*≤0.05.
SD: standard deviation.

after the test than before (women $p=0.034$, men $p=0.050$) (Table III).

There was a difference in physical activity level between the LBP group and the control group regarding the activity level once/week ($p<0.001$) (Table I). The patients with LBP exercised less frequently than the controls. Sixty-eight percent of the patients with LBP reported a decline in physical activity level after the onset of LBP.

Correlation and regression analysis in the LBP group

Overall, correlations between predicted aerobic fitness ($\dot{V}O_2$max) and the variables indicated were low (Table IV). Some variables showed moderate correlation: age (all $r=-0.53$, men $r=-0.70$), and beliefs in the importance of a good level of aerobic fitness (men $r=0.60$). Low-to-moderate correlations were shown for the women with LBP; predicted aerobic fitness level and disability (OSW $r=-0.49$) and self-efficacy (SES $r=0.44$). Pain duration showed an overall low correlation (all $r=-0.23$; women $r=-0.22$; men $r=-0.27$). There was a divergent gender-specific trend in correlations between predicted aerobic fitness level and fear-avoidance-beliefs (both work and activity sub-scores) (women $r=-0.36$; $r=-0.30$ and men $r=0.24$; $r=0.26$).

Table III. *Self-assessed pain (CR-10 scale) before and after the Åstrand sub-maximal cycle test in the low back pain group (n = 57); men and women separately*

	CR-10 before test (0–10) median (25th–75th)	CR-10 after test (0–10) median (25th–75th)	p
All ($n=57$)	3 (2–3)	2 (2–3)	0.004*
Women ($n=28$)	3 (2.5–3)	3 (2–3)	0.034*
Men ($n=29$)	2.5 (2–3)	2.25(2–3)	0.050*

*≤0.05.

Table IV. *Correlations between predicted aerobic fitness level ($\dot{V}O_2$max) and self-assessed variables pain, perceived disability, general health, self-efficacy, fear-avoidance and belief in the importance of aerobic fitness for health; in the low back pain group (n = 57), men and women separately. Moderate correlations in bold (r = 0.50–0.74)*

	Predicted aerobic fitness level $\dot{V}O_2$max ($ml \times kg^{-1} \times min^{-1}$)		
	All ($n=57$)	Women ($n=28$)	Men ($n=29$)
Age	**–0.53**	–0.42	**–0.70**
Gender	–0.19		
Pain duration	–0.23	–0.22	–0.27
Body mass index	–0.15	–0.39	–0.15
Physical activity level	0.07	–0.01	0.11
Physical function	0.16	0.31	0.09
Pain	–0.20	–0.22	–0.27
Perceived disability	–0.28	–0.49	–0.08
General health	0.04	0.08	0.10
Self-efficacy beliefs	0.33	0.44	0.47
Fear-avoidance beliefs (FABQ)			
Work	–0.07	–0.36	0.24
Activity	0.001	–0.30	0.26
Belief in the importance of a good level of aerobic fitness for health	0.42	0.31	**0.60**

FABQ: fear-avoidance beliefs questionnaire.

The multiple regression analysis for all LBP patients ($n=57$) showed that the dependent variable, aerobic fitness level, was significantly associated with age ($\beta=-0.38$, $p=0.001$), gender ($\beta=-0.30$, $p=0.006$), BMI ($\beta=-0.24$, $p=0.04$) and self-efficacy ($\beta=-0.34$, $p=0.032$) (Table V). Gender aspects were investigated with age, BMI and self-efficacy as independent variables. Men strongly associated age with the dependent variable aerobic fitness ($\dot{V}O_2$max) ($\beta=-0.62$, $p=0.001$) while women associated BMI ($\beta=-0.40$, $p=0.007$) and self-efficacy ($\beta=0.50$, $p=0.001$) (Table V).

DISCUSSION

We hypothesized that a group of working patients with ongoing recurrent LBP had lower levels of aerobic fitness than healthy age- and gender-matched individuals. No overall difference in aerobic fitness was shown between the patients with LBP and the controls. However, lower levels of predicted aerobic fitness ($\dot{V}O_2$max) were shown in the women with LBP than in the healthy female controls ($p=0.029$). The difference in mean in predicted $\dot{V}O_2$max was 6.2 ($ml \times kg^{-1} \times min^{-1}$), which is comparable to that in a recent report (16). To date there are inconclusive reports concerning LBP, aerobic fitness levels, physical activity levels and gender differences. Hoch et al. (17) reported lower levels of aerobic fitness in a sample of women with LBP and proposed a decline in exercise frequency after the onset of LBP as a possible explanation. Theirs is the only study apart from ours that reports women with LBP having a lower level of aerobic fitness. Other studies have reported that men with LBP show poorer aerobic fitness than normative

Table V. *Multiple linear regression analysis for predicted aerobic fitness level ($\dot{V}O_2max$) as dependent variable and gender, age, pain (VAS), perceived disability (OSW), self-efficacy beliefs (SES) and body mass index (BMI) as independent variables in the LBP group (n = 57); men and women separately*

	F-ratio	Gender	Age	VAS	OSW	SES	BMI
All (*n* = 57)	F(6.47) = 8.36						
Standardized β		–0.30	–0.38	–0.05	–0.05	–0.34	–0.24
Significance (*p*)		0.006*	0.001*	0.671	0.732	0.032*	0.040*
Women (*n* = 28)	F(3.25) = 9.87						
Standardized β			–0.26			0.50	–0.40
Significance (*p*)			0.077			0.001*	0.007*
Men (*n* = 29)	F(3.21) = 9.29						
Standardized β			–0.62			0.24	0.03
Significance (*p*)			0.001*			0.144	0.857

*≤0.05.

OSW: Oswestry Low Back Pain Questionnaire; LBP: low back pain; SES: self-efficacy scale; VAS: visual analogue scale.

values (12, 16). Smeets et al. (16) gave no clear explanation of why men were less fit, but postulated that maybe the intensity, duration and frequency of their patients' activities were lower even before the LBP started. Nielens & Plaghki (12) discussing men's lower levels of aerobic fitness hypothesized that women had better aerobic capacity for social and cultural reasons such as housework and care of children. Because of the lack of homogeneity regarding samples studied, control groups and tests in the above-mentioned studies it is difficult to compare the results and to reach any real conclusions. Clearly, more studies with more defined samples are needed.

One of the most important factors where lower levels of aerobic fitness ($\dot{V}O_2max$) are found in LBP could be work status (18). It is reasonable to believe that for patients with recurrent LBP who are still at work; at least the aerobic fitness level would be sufficient to meet the physical demands of the job. Unique features of the present study are that all subjects in the LBP group were still at work despite their pain. Thirty-six percent of the subjects with LBP also reported having an active working situation, which was comparable to the controls. Few studies have investigated samples of working LBP patients (17, 19). Instead, many studies present samples comprising both sick-listed, jobless and working patients (12, 14, 16, 18). One study (16) reported a sample of patients of whom 53% were on sick leave, on disability payment or jobless. Another study investigated a sample, where more men than women were not working (14). The choice of cohort represents a problem in studies of LBP. Very few trials separate between subjects with LBP still at work or not, which makes it difficult to draw any real conclusions from the results presented.

Although our subjects worked despite their pain, 68% reported that they had reduced their physical activity level after the onset of LBP. To date, reported physical activity levels in LBP remain inconclusive (12, 13). Both Brennan et al. (15) and Hoch et al. (17), however, propose that a decline in physical activity may account for a decreased aerobic fitness level. Verbunt et al. (33) conclude that the decline rather than the current physical activity level might be an important variable in the evaluation of activity levels related to disability in LBP. In the present study the controls exercised more frequently than did the patients. A high percentage of the patients reported physical activity once per week. A limitation of the study, however, is that the duration, intensity and frequency of the activities were not assessed in detail. An activity could, for example, mean a walk. Levels of assessed PF showed that the LBP group, the women more than the men, had lower levels than the normative values for the Swedish population (34). One must assume that their LBP had affected their activity level. In future studies more detailed evaluation of physical activity level should be considered.

We investigated how aerobic fitness levels in recurrent LBP related to several assessed clinical outcome variables. Perhaps, as the subjects with LBP were all working despite their pain, the overall correlations with the dependent factor aerobic fitness level were low-to-moderate. The multiple regression analyses showed that neither pain nor disability was associated with level of aerobic fitness, which is comparable with other recent findings (16). Activity level was not associated with aerobic fitness level, which might be surprising. However, only modest correlations between physical activity levels and aerobic fitness have been reported previously (35). The women with LBP, more than the men, related several of the assessed variables to the aerobic fitness level in the regression analysis: disability, pain, self-efficacy and fear-avoidance beliefs. In the multivariate analysis, self-efficacy beliefs in women with LBP were associated with the dependent variable aerobic fitness. Since self-efficacy is believed to be an important mediator of pain-related disability (27), the findings indicate that the women with LBP were at risk regarding aerobic fitness level.

Even so, the women with LBP did not seem to exercise less than the men, and reported a smaller decrease in activity levels than the men after the onset of LBP. Did "our" women endure LBP better than the men and continue exercising despite pain? Nielsen & Plaghki (36) proposed that the exercise capacity of female patients is, on average, less frequently affected by chronic pain than that of male patients. However, gender differences have implications in response to pain: women have lower pain thresholds (37). As the present groups were small, the outcome results must be seen as indications only; but they raise questions about gender differences in aerobic fitness.

For the test of predicted aerobic fitness ($\dot{V}O_2max$), we used an Åstrand sub-maximal cycle test. The reliability of the test is considered good (30). Even so, performing the test on a bicycle ergometer might under- or over-estimate predicted aerobic fitness ($\dot{V}O_2$max) by 10–15% in normal subjects (31). Taking into account our clinical experience, we judged that patients with LBP would perform a test more easily on an ergometer cycle than, for example, a treadmill. Unexpectedly, all patients with LBP were able to perform the test without stopping due to pain or for other reasons. Recent studies report 22–50% of patients stopping the test for one reason or another (14, 16). Both the LBP group and the controls performed the same type of sub-maximal Åstrand test, which is important when comparing 2 groups.

One factor that generally contributes to aerobic fitness is body size and composition (38). The women with LBP had a higher level of BMI than the controls. The women with LBP also rated higher exertion at the end of the cycle test. If $\dot{V}O_2$ max ($ml \times kg^{-1} \times min^{-1}$) is related to bodyweight, as in the present study, the predicted value is higher than if fat-free bodyweight is calculated. Han et al. (39) examined the association of LBP with BMI and concluded that women who are overweight have a significantly increased likelihood of LBP. However, we do not know whether the level of BMI was related to the women's LBP.

One commonly accepted hypothesis is that aerobic fitness in LBP is a consequence of exercise-increased pain that might lead the LBP subject to avoid activities or exercise; thus leading to "deconditioning". In the present study the patients with LBP reported less pain after the ergometer cycle test, which could mean that the activity was beneficial. For all patients with LBP, a submaximal Åstrand cycle test might be a good introduction to a discussion of activity level and might get the patient to exercise more regularly. As the test is carried out in a controlled situation, the patient might find that the activity does not aggravate the LBP, which could be one way of diminishing fear-avoidance behaviour. Approaches that encourage patients with LBP to continue exercising are important knowledge for clinicians in their daily work.

An intriguing, but difficult to answer, question is whether the patients with LBP, i.e. the women, were less fit before the LBP started or whether this was a cause of the LBP. Women with both work and family might not give priority to exercise, while men have a different tradition. Moreover, there might be gender differences concerning kind of activity, intensity and duration. The men showed a higher correlation between the believed importance of aerobic fitness for health and their predicted aerobic fitness level.

As the present study has some limitations, the results might not be generalizable. The sample of subjects investigated was small, though defined, as all the subjects were working despite the pain. Another potential weakness of the study could be the size and the composition of the control group, which was consequently chosen. Its level of aerobic fitness ($\dot{V}O_2$max) was, however, within normative levels (38).

Aerobic fitness and activity levels are important for the clinician to consider in the rehabilitation process of LBP in general. In the rehabilitation of patients with recurrent and chronic LBP who are still at work despite their pain, level of aerobic fitness might be a very important variable to maintain or improve in order to maintain a working status and thus good health.

In conclusion, this study suggests no overall difference in a sample of patients with long-term recurrent LBP, compared with healthy controls, in predicted aerobic fitness level ($\dot{V}O_2$max). This is perhaps because all the patients with LBP were still at work despite the pain. The study, however, indicates a difference between men and women. No real explanation can be given as to why the women with LBP had lower levels of aerobic fitness than the healthy women. More studies of aerobic fitness and also of activity levels in LBP are needed with better-defined samples.

ACKNOWLEDGEMENTS

The authors wish to thank the physiotherapists at the Ortoped Medicinskt Center in Stockholm, for contributing patients to the study. This study was financially supported by the Ann-Mari and Ragnar Hemborg Foundation.

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