Eur Spine J (1997) 6:181–186

ORIGINAL ARTICLE

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Low back pain and physical exercise in leisure time in 38-year-old men and women: a 25-year prospective cohort study of 640 school children

Received: 21 September 1996
Revised: 4 December 1996
Accepted: 17 December 1996

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Abstract A cohort of 38-year-old men and women were studied for leisure time physical exercise in relation to low back pain (LBP), education, work, social class and smoking by a self-administered questionnaire. At the age of 14 years, the subjects had been interviewed by their school doctor regarding history of LBP and radiographs of the thoracic and lumbar spine were taken. The results show no positive correlation between radiographic changes and LBP in the adolescent period and decreased physical activity in adulthood. Physical activity for at least 3 h/week reduces the risk of LBP measured as lifetime, 1-year and point prevalence. Eighty-five percent of the subjects who reported taking physical exercise for at least 3 h/week had participated in sports activity almost constantly since their school days and these reported being in better condition than the rest of the cohort. Otherwise they did not have a healthier mode of life. No physical exercise during leisure time was associated with a short school education, unskilled work, unemployment and sickness, low social class, divorce, living in an apartment and smoking. Sixty percent had never or not for many years been interested in participating in sports. Badminton and tennis were the most common sports practised (36%), followed by gymnastics (32%), ball games – soccer and team handball – (25%), running (20%) and swimming (18%). Gymnastics and swimming seem to reduce LBP significantly. Our results show a falling interest in participating in sports activities over time, with 68% of the subjects being members of an athletic association previously, but only 29% currently. Women were more physically inactive during leisure time, probably because of their dual role. Logistic regression analysis indicates that physical activity is related to a long school education, high social class and regular sports activity over time.

Key words Low back pain · Physical activity during leisure time · Sports activity · Cohort study

Introduction

During the last 10 years several studies have investigated the effects of different exercise programmes in the treatment of acute and chronic low back pain (LBP). The results show that regular back exercise reduces back pain and improves the ability to function for subjects with chronic LBP. Back exercise may reduce the back pain episode and thus the period of sickness absence for patients with acute LBP and partially decrease the risk of developing chronic LBP in the future [12, 14, 17–20]. The favourable effect of back exercise may be due to a combination of physical and psychological factors [1, 21]. There is an increased frequency of LBP in subjects with a minimum of physical activity during leisure time [2, 7], and a

positive correlation between poor physical fitness and LBP [3, 4]. So far there are only a few reports concerning sports activities and LBP. However, some sports such as water skiing, athletics, weight-lifting and wrestling may cause micro-fractures and lesions in the vertebrae and an increased frequency of spondylolisthesis and thus a higher risk of LBP [6, 22, 24]. One report showed a positive correlation between aerobics and LBP [16] and another a connection between frequent exercise and sciatica [25].

The aim of this study is to clarify the relation between physical activity in leisure time, including sports activities, and LBP, education, work and smoking.

Materials and methods

Population

This prospective study is based on a cohort of 640 school children. In 1965, all 14-year-old pupils in the county of Helsingør underwent a radiological examination of the thoracic and lumbar spine and their history of LBP was registered by the school doctor. A more detailed description of the radiological changes and their correlation with LBP has been given in an earlier publication [8].

Design

In 1990, 578 of the total cohort participated in a self-administered questionnaire with LBP as the main topic. The former pupils were now 38 years old and in the middle of their working life. The questionnaire was based on a standardized Nordic questionnaire for analysing musculoskeletal symptoms [13], together with content-related groups of questions. LBP was defined as pain or discomfort in the lower part of the spine, which was illustrated by a drawing. The first part of the questionnaire dealt with questions about familial occurrence of back disease, anthropometric items, education, working conditions, military service for men, gynaecological issues for women, social conditions, physical activity at work and leisure time, and smoking. The second part dealt with LBP in relation to severity, morbidity, contact with the health care system and influence on work and leisure time. A more detailed description of the low back problems in this cohort was given in an earlier publication [9]. In this study we wanted to examine the influence of physical exercise, including sports activity, during leisure time on LBP. Various kinds of sports activity are defined, but not in detail. This means, for instance, that "gymnastics" covers different forms of gymnastic exercise, "ball games" indicates soccer or team hand ball, and "running" signifies various forms of this discipline. Regarding physcial activity we separated out two different study groups from the cohort:

1. All those taking minimal physical exercise in their leisure time, meaning sedentary activities such as reading and watching TV (n = 102: 39 M, 63 F; 22%)
2. All those taking physical activity for at least 3 h/week, i.e. sports and/or garden work (n = 107: 68 M, 39 F; 23%)

Statistical methods

All data were registered in a new data program (CyberLine, CyberResearch, Copenhagen) and later transferred to the BMDP system [5]. We performed an univariate analysis of new independent variables using Pearson's χ^2 test with or without Yates control for qualitative variables, and the Mann-Whitney and Kruskal-Wallis tests for quantitative variables. Five percent was chosen as the level of statistical significance. Stepwise logistic regression analysis was carried out with the BMDP system. The analysis included all known independent variables during the school year and the first part of adulthood. These variables were gender, familial occurrence of back disease (e.g. disk herniation and spondylosis), radiological changes in the thoracic and lumbar spine and LBP in the adolescent period, height at school age, school education and social class (on a scale of 1–5). These early independent variables were examined against the dependent variable "leisure time physical exercise" in adulthood. In each step, we excluded variables on a 15% level of significance and included variables on a 10% level of significance. The importance of the excluded variables was tested with current control. The utility of the statistical model was confirmed by the Hosmer-Lemeshow test [10].

Results

After 0–2 reminders, 481 subjects (222 M and 259 F) returned the questionnaires, corresponding to 83% of all possible responders.

Our results show that 85% (90/106) of the subjects taking physical exercise in leisure time for at least 3 h/week at the time the questionnaire was anwered had participated in sports regularly since their school days. Of the subjects with minimal physical exercise in leisure time, 60% (58/97 had never, or not for many years, participated in sports activity since their school days. On this background we estimated the lifetime, 1-year and point prevalence of LBP for the two groups (Table 1). There were no differences concerning the severity of LBP, morbidity and use of the health care system because of LBP (hospitalization, X-ray examination, treatment and analgetics) between the two groups. Table 2 illustrates significant differences between subjects with no physical exercise in leisure time and subjects with physical exercise for at least 3 h/week. Twenty percent (21/101) of the subjects were physically inactive at work as well as in leisure time.

Table 1 Low back pain prevalence among 38-year-old participants in relation to leisure time physical exercise

	Prevalence					
	Life-time[a] (%)	P-value	1-Year[b] (%)	P-value	Point[c] (%)	P-value
No exercise[d] (n = 102)	75	NS	68	NS	20	NS
Physical exercise[e] (n = 107)	60	0.0335	50	0.0059	10	0.0397
Total (n = 474)	70		63		19	

[a] Low back pain (LBP) ever
[b] LBP in the previous year
[c] LBP the day the questionnaire was answered
[d] No physical exercise in leisure time
[e] Physical exercise in leisure time at least 3 h/week

Table 2 Significant differences between subjects taking no physical exercise in leisure time and subjects taking physical exercise for more than 3 h/week

	Physically inactive		*P*-value	Physically active		Total	
	No.	%		No.	%	No.	%
Female (n = 255)	63	25	***	39	15		
Male (n = 220)	39	18	***	68	31		
Short school education[a]	52/101	52	**	33/107	31	163/474	34
Further education (vocational training)	35/ 84	42	*	45/ 90	50	153/409	37
Salaried worker	42/102	41	*	55/107	51	247/475	52
Low social class[b]	66/ 85	78	*	56/102	55	254/419	61
Sick and unemployed	15/101	15	*	3/106	3	45/472	10
Heavy physical work (men)	3/ 39	8	*	13/ 68	19	22/220	10
Decreased work capacity (men)	8/ 37	22	*	2/ 66	3	25/215	12
Living alone (men)	12/ 38	32	*	7/ 68	10	42/218	19
Apartment	42/102	41	*	23/107	22	134/474	28
Smokes cig. daily	68/102	67	**	50/107	47	255/474	54
Smokes 16 or more cig/day	33/ 65	51	*	14/ 49	29	94/245	38
LBP the last month[c]	57/102	56	***	33/107	31	233/474	49
LBP the last week[d]	32/102	31	**	22/107	21	157/474	33

$*P < 0.05$; $**P < 0.01$; $***P < 0.001$
[a] Ninth grade
[b] Social class 4 or 5
[c] LBP in the month prior to answering the questionnaire
[d] LBP in the week prior to answering the questionnaire

Table 3 The participants' estimation of their own physical fitness in relation to their contemporaries' according to gender and whether they had suffered LBP, at some point during life ("LBP ever")

	Male		Female	
	No.	%	No.	%
Better	60	27	36	14
The same	138	63	186	74
Worse	22	10	29	12
Total	220		251	

$P = 0.0024$

	LBP ever		The remaining subjects	
	No.	%	No.	%
Better	67	20	30	21
The same	219	67	104	74
Worse	44	13	7	5
Total	330		140	

$P = 0.0274$

Table 3 shows the sex differences and relation to "LBP ever" (LBP at some point in life) concerning responses to the question "How is your physical fitness compared to that of your contemporaries?". Answers to the question "How much time do you use daily for walking and bicycling?" show that men and women use respectively 80 and 70 min and there was no difference concerning subjects with "LBP ever" as to the degree of physical activity.

Sports activity

Table 4 illustrates sex differences with respect to the degree of sports activity, the most common sports discipline,

Table 4 Gender differences in relation to the degree of sports activity over time, kind of sports discipline and membership of an athletic association

	Male		*P*-value	Female	
	No.	%		No.	%
Performs sports today	111/219	51	*	106/257	41
Performs sports at least 3 h/week	83/109	76	****	50/98	51
Gymnastics	9/109	8		58/98	59
Ball game	44/109	40		8/97	8
Tennis/badminton	49/109	45		26/97	36
Swimming	14/109	13		23/98	24
Running	26/109	24		15/97	16
Bicycling	8/109	7		1/97	4
Performs sports					
Frequently	76/218	35	****	40/251	16
Now and then	51/218	23		105/251	42
A long time ago	49/218	23		62/251	25
Never	42/218	19		44/251	18
Member of an athletics association					
Presently	87/217	40	****	47/244	19
(number of years)[a]	14		***	8	
Formerly	152/207	73	*	150/238	63

[a] Median number of years of membership
$*P < 0.05$; $**P < 0.01$; $***P < 0.001$; $****P < 0.0001$

Table 5 Changes in the popularity of sports disciplines over time

	Favourite discipline	
	Previously (%)	Currently (%)
Gymnastics	42	25
Swimming	24	18
Running	7	20
Tennis/badminton	17	36
Bicycling	6	9

Table 6 Significant differences between subjects performing sports at least 3 h/week and all subjects involved in some degree of sports activity

[a] LBP in relation to the first pregnancy

	Sports activity 3 h/week		*P*-value	All with sports activity	
	No.	%		No.	%
LBP ever	83/133	20	0.0310	148/217	32
LBP the last year	72/133	54	0.0264	131/217	60
LBP now	14/133	11	0.0013	38/217	18
LBP in pregnancy (F)[a]	7/ 43	16	0.0065	29/ 92	32

Table 7 Influence of various sports disciplines on LBP

	Improves		Aggravates		No change		*P*-value
	No.	%	No.	%	No.	%	
Gymnastics	27	46	13	22	19	32	0.0070
Ball games	5	12.5	12	30	23	57.5	0.0078
Swimming	17	68	4	16	4	16	0.0001
Running	12	41	6	21	11	38	NS
Tennis/badminton	4	11	11	31	21	58	0.0078
Total no.	58		36		87		

Table 8 The two most important early factors that indicate degree of physical activity in leisure time (stepwise logistic regression analysis)

	Odds ratio	*P*-value	95% confidence limits
Length of school education[a]	2.13	0.0416	1.27 –3.58
Social group[b]	0.486	0.0233	0.269–0.879

[a] Grade nine or less indicates "short school education"
[b] Groups 1–3 are "high", grades 4–5 "low"

Table 9 Observed and predicted outcome for physical activity among the participants according to two early factors (*SE* standard error of predicted probability)

	No	Observed proportion (*P*-value)	Predicted probability (*P*-value)	SE
Short school ed., low social class	78	0.6555	0.6635	0.0416
Short school ed., high social class	17	0.8500	0.8022	0.0516
Long school ed., low social class	110	0.8148	0.8077	0.0322
Long school ed., high social class	129	0.8897	0.8963	0.0233

variation in sports activity over time and current and previous membership of an athletic association. Only a few subjects participated in other kinds of sports discipline such as riding, dancing, sailing, rowing, athletics and golf. Subjects with "LBP ever" ($n = 41$) had a lesser tendency to play tennis/badminton than the rest of the cohort (29%; $P = 0.0005$). A total of 383 subjects (176 M and 207 F) had some time during their adult life performed some kind of sports, corresponding to a lifetime prevalence of 82%. Variations in current and previous interest in different sports disciplines appears in Table 5. Table 6 illustrates a few significant differences in relation to degree of sports activity. The responses to the question "Is your LBP influenced by performing sports?" are seen in Table 7. No sports discipline seems to aggravate the pain of the majority of LBP sufferers, but 17 (36%) of the subjects with a severe degree of LBP have aggravation of their LBP in connection with performing sports ($P = 0.008$). Responses to the question "Have you discontinued or decreased your sports activities because of LBP?" show a positive correlation to subjects with physical inactivity in leisure time, [$n = 9$ (36%), $P = 0.0312$] and subjects with a severe degree of LBP [$n = 17$ (38%), $P = 0.0023$].

Stepwise logistic regression analysis

Tables 8 and 9 describe the results of a stepwise logistic regression analysis of independent variables gathered at school and in early adult life.

Discussion

This investigation shows a reduced risk of LBP, measured as lifetime, 1-year and point prevalence of LBP, in subjects taking physical exercise during leisure time (at least 3 h/week) compared with the rest of the cohort (Table 1). Eighty-five percent of these subjects participated in sports activities regularly since school, in contrast to only 40% of the subjects reporting no physical exercise in their leisure time. Men have a significantly higher level of physical activity during leisure time and are in better condition (self-reported) than women (Tables 2, 3). Like other reports we find that a poor condition increases the risk of LBP [3, 18] (Table 3). Physical inactivity is associated with LBP in the month and week before the questionnaire was answered, short school education, low so-

cial class (4 and 5), living in an apartment, sick leave and unemployment, and it correlated to an unhealthier mode of life, i.e. smoking more than 16 cigarettes per day. Otherwise physical inactivity is not correlated to severe LBP or increased morbidity and use of the health care system. Weber concluded that physical activity during leisure time prevents sciatica, but we do not find this relationship [26]. Twenty percent (n = 21) of the subjects were inactive at work as well as in leisure time, and this percentage is larger than in to previous Danish reports [2, 11]. The degree of sports activity influences the risk of LBP. Performing sports at least for 3 h/week decreases the risk of LBP significantly, measured as lifetime, 1-year and point prevalence, compared with all subjects performing sports (Table 6) [7]. At a younger age women have the same level of sports activity as men; however, with increasing age the activity level decreases in both genders, but especially in women, which may be due to women's dual role (Table 4). The preferred sports discipline changes over time, as seen in Table 5. For 38-year-olds the favourite sports activities are badminton, tennis and running. Due to worldwide health campaigns to improve health through physical activity, running or jogging has become very popular. Gymnastics and swimming seem to improve low back complaints, while the other sports disciplines do not result in any changes (Table 7). The fact that subjects with "LBP ever" play less badminton/tennis may be because these sports disciplines involve irregular movements and sudden twists. We know that heavy physical activity at work increases the risk of LBP [2, 9, 15], but only in subjects with no sports activity during leisure time [23]. Stepwise logistic regression analysis of "early" independent variables confirms that a long school education and high social class (1–3) are important factors for a high level of physical activity in leisure time later in life and therefore a reduced risk of LBP as adults.

Conclusion

Interest in sports and exercise during leisure time is established in the adolescent period. This an other investigations show that continuing physical activity in adulthood may reduce low back problems. Therefore, it seems important to encourage youth to participate in physical activity. This may be more suitable than back exercise when back disability becomes a reality.

Acknowledgement This work is supported by grants from the Health Insurance Fund and Council for Sports Research. The statistical analysis was carried out by the statistical consultant Mr. Erik Henriksen.

References

1. Aastrand PO (1988) From exercise physiology to preventive medicine. Ann Clin Res 20:10–17
2. Bredkjær SR (1989) Back disability and other musculoskeletal disorders in the Danish population (in Danish). Danish Institute of Clinical Epidemiology, Copenhagen
3. Cady LD, Bischoff DP, O'Connel ER, Thomas PC, Allan JH (1979) Strength and fitness and subsequent back-injuries among firefighters. J Occup Med 21:269–272
4. Cady LD, Thomas PC, Karwasky RJ (1985) Program for increasing health and physical fitness of firefighters. J Occup Med 27:110–114
5. Dixon WJ (1983) BMDP statistical software. Berkeley University of California Press, Berkeley
6. Goldstein JD, Berger PE, Windler GE, Jackson DW (1991) Spine injuries in gymnasts and swimmers. An epidemiologic investigation. Am J Sport Med 19:463–468
7. Gyntelberg F (1974) One year incidence of low back pain among male residents of Copenhagen aged 40–59. Dan Med Bull 21:30–36
8. Harreby MS, Neergaard K, Hesselsøe G, Kjer J (1995) Are radiological changes in the thoracic and lumbar spine of adolescents risk factors for low back pain in adults? Spine 21: 2298–2302
9. Harreby MS, Kjer J, Hesselsøe G, Neergaard K (1996) Epidemiological aspects and risk factors for low back pain in 38-year-old men and women. Eur Spine J 5:312–318
10. Hosmer DW, Lemeshow S (1989) Applied logistic regression. John Wiley, New York
11. Jeune B (1980) Three-year incidence of disability pensions among men. Scand J Soc Med Suppl 16:17–27
12. Kellett KM, Kellett DA, Nordholm LA (1991) Effects of an exercise program on sick leave due to back pain. Phys Ther 71:283–291
13. Kourinka I, Jonsson B, Kiilbom A, Vinterberg H, Bireing-Sørensen F, Andersson G, Jørgensen K (1987) Standardised Nordic questionnaire for the analysis of musculoskeletal symptoms. Appl Ergonomics 18:233–237
14. Linton SJ, Bradley LA, Jensen I, Spangfort E, Sundell L (1989) The secondary prevention of low back pain: a controlled study with follow-up. Pain 36:197–207
15. Magora A (1974) Investigation of the relation between low back pain and occupation. 6. Medical history and symptoms. Scand J Rehabil Med 6:81–88
16. Mandel JH, Lohmann W (1987) Low back pain in nurses: the relative importance of medical history, work factors, exercises and demographics. Res Nurs Health 10:165–170
17. Manniche C, Hesselsøe G, Bentzen L, Christen I, Lundberg E (1988) Clinical trial of intensive muscle training for chronic low back pain. Lancet II: 1473–1476
18. McQuade KJ, Turner JA, Buchner DM (1988) Physical fitness and chronic low back pain. Clin Orthop 233:198–204
19. Mitchell RI, Carmen GM (1990) Results of a multicenter trial using an intensive active exercise program for the treatment of acute soft tissue and back injuries. Spine 6:514–521
20. Oland G, Tveiten G (1991) A trial of modern rehabilitation for chronic low-back pain and disability. Spine 4:457–459
21. Petruzzello SJ, Landers DM, Hatfield BD, Kubitz KA, Salazer W (1991) A metaanalysis on the anxiety-reducing effects of acute and chronic exercise. Outcome and mechanism. Sports Med 11:143–182

22. Rossi F (1978) Spondylolysis, spondylolisthesis and sports. J Sport Med 18: 317–340
23. Svensson HO (1982) Low back pain in forty to forty-seven year old men. 2. Socio-economic factors and previous sickness absence. Scand J Rehabil Med 14: 55–60
24. Swærd L, Hellstrom M, Jacobsson B, Nymann R, Peterson L (1991) Disc degeneration and associated abnormalities of elite gymnasts. Spine 16: 437–443
25. Videman T, Nurminen T, Tola S (1984) Low back pain in nurses and some loading factors of work. Spine 9: 400–404
26. Weber H (1983) Lumbar disc herniation. A controlled prospective study with ten years of observation. Spine 8: 131–140