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Back Pain: A Study of Twins

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Abstract. To evaluate the relationship between genetic factors and back pain, 5029 MZ and 7876 DZ twin pairs were investigated by a questionnaire. The data were analyzed with regard to physical symptoms, eg, back pain, and certain work conditions. Pain was reported by about 17% of the male and 13% of the female twins in the material. The occurrence of back pain was strongly associated with work load, especially among the male twins. Twin concordance regarding back pain was considerably higher in MZ than in DZ twins. Of four groups who were studied, statistically significant differences between the two twin categories were observed in three cases. This result supports the assumption that a relationship exists between genetic factors and the occurrence of back pain. Official registrations for sick-leave pay in a sample of 247 twins confirmed the interview information on back pain. Just a few cases were wrongly classified, ie, they were sick-listed because of back pain but had stated no back pain in the questionnaire.

Key words: Back pain, Genetic factors, Twins, Concordance

INTRODUCTION

Many previous studies have shown that the frequency of back pain is especially high among people who do physically heavy work [12-14,16-19,24-25]. However, the importance of heavy work for the occurrence of back pain is difficult to estimate as genetic factors had not been taken into account.

The main aim of the present study was to determine whether genetic factors are of importance for the occurrence of back pain. A second aim was to investigate whether physically heavy work results in a higher frequency of back pain than light work, also when the genetic factors are considered.

Twin studies have been used extensively in psychiatry [see, eg, 7,28], as well as in a variety of other conditions. For instance, Tysk et al [29] found genetic factors in inflammatory bowel disease using twins. Other studies with similar aims were carried out for Parkinson's disease [20], rheumatoid arthritis [1] and multiple sclerosis [8]. Twins have also been used to study the relationship between smoking and health [6,9]. No previous twin studies of back pain have apparently been conducted, however.

MATERIALS AND METHODS

The study was based on Swedish twins, aged 15-47. There were 5029 MZ and 7876 DZ pairs [21]. The information about the twins in the registry was collected in 1972 by means of a mailed questionnaire which included a total of 93 questions about health status, physical activity at work, smoking habits, etc.

The following question was a starting point for the present study: "Have you had so much back, shoulder or neck pain during the last few years that you found it difficult to work?" Possible answers were: "No", "Yes, in the back", "Yes, in the shoulders", "Yes, in the neck".

In the present study, only the answer, "yes, in the back", was defined as back pain. It should be noted that only pain of functional importance was asked for. This may have resulted in a higher frequency of pain among those with heavy physical work compared with those with light work. The comparison of back pain frequency between people with different types of work should then be difficult to interpret.

It should also be noted that information from questionnaires is not always valid. Answers on the current question about back pain have some degree of uncertainty and they were not subject to any validity check before the present investigation.

The answers were analysed with methods described by Cederlöf [5]. The occurrence of back pain was first studied among twins with "light" and "heavy" work by one randomly selected twin from each pair (A-series). In a second step, the occurrence of back pain was studied for "light" and " heavy" work among pairs with differing work load (B-series). Finally, concordance among MZ and DZ twins were compared as regards information of back pain. In order to determine the validity of information on the back pain reported in the questionnaire, a supplementary study was performed. This investigation compared the information about back pain in the mailed questionnaire collected in 1972 with information on official registrations for sick-leave pay (sick-listings) from the social insurance office.

The supplementary study started with a sample of 300 twins; 150 twins were randomly selected among the 4,375 twins in the registry who had reported back pain and 150 among the 25,566 who had not reported any pain. Sick-listings were obtained for the years 1968-1972 for the individuals in the two samples.

RESULTS

The Importance of Work Load and Genetic Factors

In the A-series, ie, the random sample of one twin from each pair, 17% of the men and 13% of the women reported back pain. The frequency of back pain was strongly related to work load (Table 1). This result is especially pronounced for men.

The occurrence of back pain was then studied within twin pairs who had reported different work load (B-series). In this study, also the frequency of back pain was higher among those with "heavy" work compared to those with "light" work (Table 2). However, the difference between the two types of work was not as large as in the A-series. This result is especially clear for the MZ pairs.

Table 1 - Age-standardized prevalence rates (%) of "pain in the back", distributed by sex and work load

Sex	No. of twins		Percent with "Pain in the back"		Ratio (b/a)	P-value
	"Light" work	"Heavy" work	"Light" work (a)	"Heavy" work (b)		
Men	2,985	2,738	11.2	22.8	2.0	***
Women	3,798	2,713	10.0	16.1	1.6	***

Table 2 - Age-standardized prevalence rates (%) of "pain in the back" among twins in pairs discordant for work load (B-series)

Sex	Zygosity	No. of twins	Percent with "Pain in the back"		Ratio (b/a)	P-value
			"Light" work (a)	"Heavy" work (b)		
Men	MZ	542	13.5	19.3	1.4	*
	DZ	1,183	13.7	21.1	1.5	***
Women	MZ	736	11.9	15.1	1.3	—
	DZ	1,466	10.0	16.4	1.6	***

Differences in prevalence between "light" and "heavy" work are smaller among MZ than among DZ twins, which suggests that genetic factors are of importance for back pain.

A closer comparison of concordance between MZ and DZ pairs was thus of interest. In order to reduce the effect of the formulation of the question, a closer comparison was limited to pairs who were concordant with regard to "light" or "heavy" works.

This analysis concerned the concordance of back pain within pairs (Table 3). In all four groups there were higher concordance rates among MZ than among DZ twins. The differences between MZ and DZ twins were statistically significant, except for the males with "light" work. The result of the analysis in Table 3 is a strong indication of the fact that genetic factors are of importance for back pain.

Table 3 - Twin concordance[a] for "pain in the back"

	Men		Women	
	"Light" work	"Heavy" work	"Light" work	"Heavy" work
MZ twins	11.2	27.8	16.6	25.3
DZ twins	8.2	16.9	8.3	14.8

[a] Percentage of pairs in which both members reported back pain related to all pairs in which at least one member reported pain.

The Validity of Information on Back Pain

In 53 cases out of a total of 300 in the supplementary study on the validity of the back pain question, no information was found at the social insurance office. These twins were not included in the study. Thus, the supplementary study was finally based on 247 twins. The result of the analysis is shown in Table 4.

The comparison was limited to those individuals for whom information was received from the social insurance office. It showed that 44% of those who reported pain in the questionnaire were sick-listed for back pain. In the other group, only 7% were sick-listed. Thus, sick-listing was considerably more frequent among those who had reported back pain than among those who did not report pain ($p < 0.001$).

Table 4 - The information on back pain in mailed questionnaires compared to information about sick-listing from the social insurance office

Sick-listed for back pain according to social insurance office	Information in the questionnaire	
	No back pain	Back pain
Yes	7 (6%)	51 (38%)
No	88 (78%)	65 (65%)
No answer[a]	18 (16%)	18 (13%)
Total	113 (100%)	134 (100%)

[a] The social insurance office did not answer the questionnaire.

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Among the seven individuals who had been sick-listed without reporting back pain in the questionnaire, only one case was a long-term one (126 days). The other cases were sick-listed for 2, 3 and 5 days. Those who had reported pain in the questionnaire and who had been on the sick list had considerably longer sick-listings: 80% of these individuals had been sick-listed for 7 days or more. The average time of these sick-listings was 59 days.

DISCUSSION

Material and Methods

The study was based on information in the Swedish twin registry which had been collected before the present study was planned. Consequently, the information available about the twins was not directly related to this study. However, in spite of this, the registry seemed to provide useful information for the aims of the study.

The supplementary study on the validity of answers on the question concerning back pain showed that the frequency of sick-listing was considerably different between the two groups. Of course, 7% of those who did not report back pain in the questionnaire were sick-listed for back pain. However, the error was quantitatively and qualitatively small: those who did not report back pain in the questionnaire suffered substantially less back pain than those who did report pain.

The statements about back pain in the registry were subject to one evaluation before the present one. Before the mailed questionnaire was sent to the twins, it was tested on a sample [21]. The answers from individuals in the sample were in some cases compared to statements obtained in personal interviews. Out of 140 individuals, 29 reported pain in the back on the mailed questionnaire. In the same group, 33 individuals reported back pain at the personal interview. Pain was reported on both occasions by 26 individuals.

Statements about back pain were examined by Hirsch et al [10] in an investigation of 123 randomly selected women. These women were interviewed on two occasions after an interval of one year. On the first occasion, 45 individuals reported pain, and on the second 51. These results do not indicate any considerable error in the diagnosis of back pain by questionnaire methods. Certainly, some of those with only slight symptoms probably did not report pain until the second occasion. Some of the individuals who did not report pain at first, however, might not have had any until after the first interview.

Severity of pain is probably of importance for the reporting of the symptom. A study on injuries caused by traffic accidents found that severe pains were almost always reported, while functionally slight pains were under-reported, if mailed questionnaires or telephone interviews were used [27]. A similar observation was made by Westrin [30] concerning low back pain.

Zygosity diagnoses are important for estimates of twin concordance. Using serological methods, the correct zygosity can be determined with a high degree of probability. This method, however, is expensive and impractical for thousands of individuals. Thus, zygosity of the pairs in the twin registry was determined by means of a questionnarie. However, the questionnaire method seems to be of high reliability [4,22,26].

One important question connected to twin studies is whether the results can be applied to the general population. The main reason for the assumption that twins are different from the rest of the population is their peculiar prenatal environment, expressed, or exemplified, by a high prenatal mortality [15,23]. However, it is doubtful if there are any differences between full-grown twins and singletons with regard to morbidity. Investigations by Cederlöf [5] provide no proof for such a hypothesis. Nor did he show any consistent differences between twins and singletons with regard to some sociological background variables. Also it might be questioned whether social and other factors are very much the same for DZ vs MZ twins [6]. Hopper et al [11] have given a review of methodologies to deal with this problem.

Results

The main aim of the present study was to determine the importance of genetic factors for the occurrence of back symptoms. However, first the frequencies of symptoms and their relation to work load will be discussed.

The prevalence rates for "pain in the back" were about 17% for male and 13% for female twins according to the results of the A-series analysis. These rates were considerably lower than those observed in other studies [2,18,19]. However, the prevalence rates depend on many factors: the age-distributions and the techniques for diagnosing the symptoms are two determining factors besides exposure to environmental factors. Consequently, prevalence rates observed in different studies are seldom comparable.

Lumbar back pain at least seems to be most common among those aged 40-50 [3]. In the present study the mean age is relatively low: the oldest twins were 47, and the youngest 15 years old, when they answered the mailed questionnaire in 1972. Consequently, only a small part of the twins in this material exceeded the age in which pain is most likely to occur.

Another important reason for the relatively low rates of pain reported by the twins might be the formulation of the question. Consequently, only pain that was of functional importance for work was reported.

Also, the sources of twin samples are of importance for estimating hereditary influence. According to Torgersen [28], patients from mental hospitals had higher MZ/DZ concordance proportions than corresponding subjects from out- or inpatient clinics with respect to mental diseases. Selection is probably correlated with hereditary determinants of different strengths.

The mechanisms through which genetic factors affect back symptoms are probably not easy to identify. Such an investigation lay beyond the scope of this study. An analysis of the physical characteristics of the twins, eg, weight and muscle strength, would probably have provided some information on this point. However, the genetic influence on back symptoms is certainly not limited to physical factors. The pain threshold may be affected by genetic factors. In this case, the genetic factors may have an influence on the tendency to take note of the pain. It is of course also possible that back pain increases the tendency to complain of other symptoms.

REFERENCES

1. Aho K, Koskenvou M, Touminen J, Kaprio J (1986): Occurrence of rheumatiod arthritis in a nationwide series of twins. J Rheumatol 13:899-902.
2. Anderson JAD, Duthie JJR (1963): Rheumatic complaints in dockyard workers. Ann Rheum Dis 22:401-409.
3. Arbetarskyddsfonden (1976): Back Injuries and Work (in Swedish). Rapport 1976:1. Stockholm.
4. Cederlöf R, Friberg L, Jonsson E, Kaij L (1961): Studies on similarity diagnosis in twins with aid of mailed questionnaires. Acta Genet 11:338-362.
5. Cederlöf R (1966): The Twin Method in Epidemiological Studies on Chronic Disease. Stockholm: Esselte AB.
6. Cederlöf R, Friberg L. Lundman T (1977): The interactions of smoking, environment and heredity and their implications for disease etiology. Acta Med Scand Suppl 612.
7. Dworkin RH, Lenzenweger MF, Moldin SO, Skillings GF, Levick SE (1988): A multidimensional approach to the genetics of schizophrenia. Am J Psychiatry 145:1077-1083.
8. Ebers GC, Bulman DE, Sadovnick AD, Paty DW, Warren S, Hader W, Murray TJ, Seland TP, Duquette P, Grey T, Nelson R, Nicolle M, Brunet D (1986): A population-based study of multiple sclerosis in twins. N Engl J Med 315:1638-1642.
9. Floderus B, Cederlöf R, Friberg L (1988): Smoking and mortality: A 21-year follow-up based on the Swedish twin registry. Int J Epidemiol 17:332-340.
10. Hirsch C, Jonsson B, Lewin T (1969): Low back symptoms in Swedish female population. Clin Orthop 63:171-176.
11. Hopper JL, Derrik PL, Clifford CA (1987): Innovations in the statistical analysis of twin studies. Acta Genet Med Gemellol 36:21-27.
12. Hult L (1954): Cervical, dorsal and lumbar spinal syndromes. Acta Orthop Scand Suppl 17.
13. Hult L (1954): The Munkfors investigation. Acta Orthop Scand Suppl 16.
14. Ikata T (1965): Statistical and dynamic studies of lesions due to overloading of the spine. Shikoku Acta Med 40:262-286.
15. Kauppila A, Jouppila P, Koivisto Å, Moilanen I, Ylikorkala O (1975): Twin pregnancy. A clinical study of 355 cases. Acta Obstet Gyn Scand Suppl 44.
16. Kogstad O, Gudmundsen J (1973): Back pain in Skien 1971-1972 (in Norwegian). Telemark Sentralsjukehus, Skien.
17. Kogstad O, Gudmundsen J (1978): Back pain. An epidemiological study (in Norwegian). Tidskr Nor Laegefor 98:1076-1078.
18. Lawrence JS (1955): Rheumatism in coal miners. Part III: Occupational factors. Brit J Industr Med 12:249-261.
19. Magora A, Taustein I (1969): An investigation of problem of sick-leave in patients suffering from low back pain. Industr Med Surg 38:398-408.
20. Marttila RJ, Kaprio J, Koskenvuo M, Rinne UK (1988): Parkinsons disease in a nationwide twin cohort. Neurology 38:1217-1219.
21. Medlund P, Cederlöf R, Floderus-Myrhed B, Friberg L, Sörensen S (1976): A new Swedish twin registry. Acta Med Scand Suppl 600.
22. Myrhed M (1974): Alchohol consumption in relation to factors associated with ischaemic heart disease. Acta Med Scand Suppl 567.
23. Peller S (1944): Studies on mortality since the renaissance, twins and singletons. Bull Hist Med 16:362.
24. Rowe ML (1969): Low back pain in industry. J Occup Med 11:161-169.
25. Sabroe S, Olsen J (1978): Back symptoms and environmental factors among bricklayers in Denmarck (in Danish). Ugeskr Laeger 140:1299-1304.
26. Sarna S, Kaprio J, Sistonen P, Koskenvuo M (1978): Diagnosis of twin zygosity by mailed questionnaire. Hum Hered 28:241-254.
27. Thorson J (1975): Long-Term Effects of Traffic Accidents. Lund: Håkan Ohlssons.

28. Torgersen S (1987): Sampling problems in twin research. J Psychiat Res 21:385-390.
29. Tysk C, Lindberg E, Järnerot G, Floderus-Myrhed B (1988): Ulcerative colitis and Chrons disease in an unselected population of monozygotic and dizygotic twins. A study of heritability and the influence of smoking. Gut 29:990-996.
30. Westrin C-G (1973): Low back sick-listing. A nosological and medical insurance investigation. Scand J Soc Med Suppl 7.

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