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Serum lipids in relation to sciatica among Finns

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Abstract

Objectives: Atherosclerosis of arteries supplying the lumbar region has been suggested as a mechanism leading to intervertebral disc degeneration and sciatica. The study described here examined whether serum lipid levels or pharmacologically treated hyperlipidemia were associated with sciatica.

Methods: A nationally representative sample ($n = 8028$) of Finns aged 30 years or over was interviewed and examined. Sciatica was assessed by a physician according to preset criteria. Information for the present purpose was available for 74.8% of the sample.

Results: The prevalence of sciatica was 3.3% for men and 2.2% for women. In men without hyperlipidemia treatment, sciatica was associated with total cholesterol (high vs. low tertile: OR 2.28, 95% CI 1.14–4.55), LDL cholesterol (2.12; 1.11–4.05), and triglycerides (1.92; 1.04–3.55), adjusted for age, BMI, exercise, smoking, heavy physical work, and education. HDL was not associated with sciatica. For men in the highest tertile of both total cholesterol and triglycerides, the OR of sciatica was 3.89 (1.68–8.99) in comparison to men with cholesterol in the lowest tertile and triglycerides in the lowest or the middle tertile. In similar analyses among women no associations were seen. Pharmacologically treated hyperlipidemia was associated with sciatica in women (2.02; 1.01–4.04), but not in men (1.71; 0.83–3.55).

Conclusions: Independent of BMI and other possible confounders, clinically assessed sciatica in men was associated with levels of atherogenic serum lipids. Pharmacologically treated hyperlipidemia was associated with sciatica in women. The findings are in accordance with the atherosclerosis-sciatica hypothesis.

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1. Introduction

The sciatica syndrome is characterized by low back pain with radiation to the lower limb below knee level along the distribution of a spinal nerve root, often accompanied by neurosensory and motor deficits [1]. Sciatica often has a lengthy course and causes prolonged disability [2]. The prevalence estimates in the general population vary between 2 and 5% [3].

The origin of sciatic pain is not thoroughly understood. Mechanical compression and inflammation-related irritation of a lumbar nerve root by nucleus pulposus material herniated through a tear of the anulus fibrosus of a degenerated intervertebral disc are involved in pain causation [4]. The adult disc is an avascular structure that relies on diffusion through the vertebral end plate for nutrition. Failure of nutrient supply to disc cells leads to disc degeneration [5]. The vertebrae and other structures in the lumbar spine are supplied by branches of the lumbar arteries, which originate from the lowest part of the abdominal aorta. This part of

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the aorta often shows the earliest lesions in atherosclerosis. Atheromatous plaques tend to form in or around ostia of branching arteries, and they may obliterate orifices of the segmental lumbar arteries resulting in compromised blood supply of for instance the corresponding vertebrae and nerve root(s) [6,7].

Studies on the risk factors of sciatica have been relatively scarce and knowledge regarding them is insufficient. Smoking [8–10], obesity [10,11], and biomechanical loading of the spine [2,9,12–14] have been reported to increase the risk of sciatica or resulting hospitalization. Evidence on the effects of exercise on sciatica is contradictory [9].

High blood cholesterol is among the most well-known risk factors for atheromatous lesions [15]. An independent role of triglycerides in atherogenesis has been implicated [16]. Smoking is also a risk factor for advanced aortic atherosclerosis [17]. Overweight subjects [18] and regular smokers [19] tend to have elevated blood lipid levels, while physical activity may counteract dyslipidemia [20].

The present study aimed to find out whether high serum cholesterol and triglyceride levels or pharmacologically treated hyperlipidemia were associated with clinically assessed sciatica. The possible confounding effects of overweight, physical activity at work and during leisure, smoking, and socioeconomic status (the level of education) were considered in the analysis. The study sample was representative of the adult Finnish population.

2. Methods

2.1. Study population and sampling

The base population comprised subjects aged 30 years or over and living permanently in Finland. A two-phase stratified cluster sample ($n = 8028$) was obtained [21]. The mean age of the sample was 53.1 years (S.D. 15.2), with the range of 30–95 years. The sampling procedure was designed at Statistics Finland and implemented at the Finnish Social Insurance Institution based on its regularly up-dated register of the insured population. The sampling scheme aimed to obtain a geographically representative sample, and to enhance the feasibility of data collection.

Information was gathered by interviews (held at the subjects' homes and at the examination centers during the day of clinical examination), questionnaires, and clinical examinations. Altogether 6354 persons took part in the clinical examinations (79.1% of the sample). These were carried out at the participants' local health care centers by nurses and physicians trained for the purpose. The examination comprised of a set of clinical, function-related, and laboratory assessments [21]. A physician trained for the purpose and using detailed written instructions interviewed each subject and carried out a standardized clinical examination including assessment of cardiovascular diseases and low back syndromes.

Participation was based on written informed consent. The study protocol was accepted by the ethics committee of the National Public Health Institute and the Ethics Committee for Epidemiology and Public Health in the Hospital District of Helsinki and Uusimaa.

2.2. Sciatica

In cases of current low back complaints lasting for at least 3 months, a diagnosis of definite sciatica was set by the field physician provided there were clinical findings of lumbar nerve root compression (unilateral restricted straight-leg raising test, weakness of ankle or hallux dorsiflexion strength, decreased plantar flexion strength, or diminished Achilles tendon reflex) or documentation of lumbar intervertebral disc disease (e.g. disc surgery or imaging findings).

2.3. Serum lipids and hyperlipidemia medication

Concentrations of total cholesterol (TChol), low density lipoprotein (LDL) cholesterol, high density lipoprotein (HDL) cholesterol, and triglycerides (TG) in the serum after a 4-h fast were analysed at the research unit of the Finnish National Insurance Institution (Olympus, AU400, Germany). The freezed samples were analysed within 6 months of blood sampling. Several quality control measures were employed to ensure the reliability of the results [22].

For the analyses, all measurements were put to tertiles based on gender-specific distributions. The ranges of the tertiles (mmol/l) for men were the following: TChol (low $\leq$ 5.40, middle 5.41–6.30, high $\geq$ 6.31), LDL (low $\leq$ 3.40, middle 3.41–4.30, high $\geq$ 4.31), HDL (low $\leq$ 1.03, middle 1.04–1.30, high $\geq$ 1.31), TG (low $\leq$ 1.10, middle 1.11–1.70, high $\geq$ 1.71). The ranges for women were TChol (low $\leq$ 5.30, middle 5.31–6.30, high $\geq$ 6.31), LDL (low $\leq$ 3.30, middle 3.31–4.10, high $\geq$ 4.11), HDL (low $\leq$ 1.24, middle 1.25–1.57, high $\geq$ 1.58), TG (low $\leq$ 0.70, middle 0.71–1.40, high $\geq$ 1.41).

A combined lipid score was constructed with the following categories: both cholesterol and triglycerides in the highest tertile = 3, cholesterol in the lowest tertile, triglycerides in the lowest or middle tertile = 1 (reference), other combinations = 2.

We also considered the clinical reference values of >6.50 mmol/l for TChol, and >2.00 mmol/l for TG, and their combination.

Information on hyperlipidemia medication ($n = 375$) was based on documentation of the use of regular lipid-lowering medication or right to special reimbursement by the National Insurance Institution for medication for familial hypercholesterolemia or type III dyslipoproteinemia (code 211). In women on lipid-lowering medication, the mean TChol was 6.12 (S.D. 1.15), LDL 3.79 (1.28), HDL 1.40 (0.39), and TG 1.84 (1.02). The values for men were 5.75 (1.27), 3.39 (1.53), 1.11 (0.32), and 2.21 (1.37), respectively.

Table 1
Sciatica by pharmacologically treated hyperlipidemia among Finns aged 30 years or over

	n (cases)	Adjusted for age		Fully adjusted[a]	
		OR	95% CI	OR	95% CI
Men					
Hyperlipidemia					
No	2574 (81)	1.00		1.00	
Yes	185 (11)	1.66	0.80–3.46	1.71	0.83–3.55
Women					
Hyperlipidemia					
No	3070 (62)	1.00		1.00	
Yes	190 (10)	2.05	1.01–4.18	2.02	1.01–4.04

Logistic regression analysis. Odds ratios (OR) and 95% confidence intervals (CI).
[a] Adjusted for age, BMI, exercise, smoking, history of heavy physical work, and education.

2.4. Covariates

Ten-year categories of *age* were considered. *Education* was classified as ≤9, 10–12, or >12 years of formal education. BMI (kg/m^2) was based on self-reported height and measured weight. The frequency of *leisure-time physical activity* causing at least some breathlessness and sweating was classified as four to seven times per week, two to three times per week, or less often. *Smoking* was categorized as 0 = never smoker, 1 = stopped smoking, 2 = occasional smoker or regular smoker with ≤20 pack-years, 3 = regular smoker with >20 pack-years.

The respondents were asked about the duration (years) of the current and previous jobs and about exposure to heavy physical work that entails lifting or carrying heavy items, digging, shovelling, or pounding. The *history of strenuous physical work* denotes the cumulative sum of years of exposure to heavy physical work and was classified as none, 1–10, 11–20, or >20 years of exposure. The current job and five past jobs with the longest duration were considered. Few persons (1%) had held more than five jobs.

Information on all studied variables was available for 6008 subjects (74.8% of the sample). Analyses regarding associations between lipid levels and sciatica were performed with 5644 subjects (2574 men and 3070 women) without medi-

Table 2
Mean and standard deviation (S.D.) of age and serum lipid levels among Finns aged 30 years or over among subjects without pharmacological treatment for hyperlipidemia

	Men, *n* = 2574 Mean (S.D.)	Women, *n* = 3070 Mean (S.D.)
Age	50.7 (13.9)	52.3 (15.2)
fS-Chol (mmol/l)	5.97 (1.10)	5.89 (1.11)
fS-LDL (mmol/l)	3.82 (1.26)	3.79 (1.07)
fS-HDL (mmol/l)	1.20 (0.33)	1.44 (0.38)
fS-Trigly (mmol/l)	1.77 (1.23)	1.39 (0.71)

Table 3
Age-adjusted odds ratios (OR) and 95% confidence intervals (CI) for sciatica by background factors among Finns aged 30 years or over[a]

	Men			Women		
	n (cases)	OR	95% CI	*n* (cases)	OR	95% CI
BMI						
<25	858 (23)	1.00		1307 (19)	1.00	
25–30	1202 (41)	1.18	0.70–1.99	1050 (22)	1.23	0.66–2.29
>30	514 (17)	1.05	0.54–2.04	713 (21)	1.61	0.81–3.21
Smoking						
Never	487 (9)	1.00		1334 (26)	1.00	
Stopped smoking	1203 (38)	1.58	0.78–3.23	1046 (22)	1.12	0.64–1.96
Current smoker, pack-years ≤ 20	509 (13)	1.55	0.59–4.11	548 (9)	1.04	0.46–2.37
Current smoker, pack-years > 20	375 (21)	2.89	1.36–6.12	142 (5)	1.65	0.54–5.06
Exercise						
Four to seven times per week	620 (27)	1.00		801 (17)	1.00	
Two to three times per week	860 (23)	0.68	0.38–1.22	1078 (27)	1.26	0.70–2.30
Less often	1094 (31)	0.69	0.42–1.14	1191 (18)	0.79	0.42–1.48
History of heavy physical work						
None	1131 (23)	1.00		1782 (27)	1.00	
≤10 years	449 (18)	2.19	1.21–3.98	444 (11)	1.68	0.84–3.36
11–20 years	352 (17)	2.69	1.43–5.06	297 (7)	1.39	0.61–3.13
>20 years	642 (23)	1.40	0.72–2.73	547 (17)	1.57	0.79–3.11
Education (years)						
>13	858 (15)	1.00		1177 (17)	1.00	
10–12	760 (24)	1.76	0.87–3.55	773 (17)	1.23	0.63–2.41
≤9	956 (42)	2.16	1.11–4.20	1120 (28)	1.24	0.60–2.58

Logistic regression analysis.
[a] Subjects without hyperlipidemia medication.

Table 4
Sciatica by serum lipid levels among Finns aged 30 years or over[a]

	n (cases)	Adjusted for age		Adjusted for age, BMI, smoking, and exercise		Adjusted for the former, education, and history of heavy physical work	
		OR	95% CI	OR	95% CI	OR	95% CI
Men							
Total cholesterol[b]							
Low	835 (13)	1.00		1.00		1.00	
Middle	843 (32)	2.37	1.24–4.51	2.41	1.26–4.61	2.41	1.26–4.63
High	896 (36)	2.29	1.15–4.58	2.26	1.13–4.51	2.28	1.14–4.55
LDL[b]							
Low	862 (15)	1.00		1.00		1.00	
Middle	872 (30)	1.85	0.95–3.58	1.91	0.99–3.72	1.89	0.98–3.65
High	840 (36)	2.13	1.11–4.08	2.14	1.11–4.12	2.12	1.11–4.05
HDL[b]							
Low	842 (31)	1.00		1.00		1.00	
Middle	879 (25)	0.79	0.47–1.32	0.80	0.47–1.33	0.82	0.49–1.36
High	853 (25)	0.80	0.47–1.37	0.77	0.45–1.32	0.78	0.46–1.32
Triglycerides[b]							
Low	827 (18)	1.00		1.00		1.00	
Middle	939 (28)	1.27	0.69–2.32	1.29	0.69–2.41	1.26	0.68–2.33
High	808 (35)	1.87	1.02–3.43	1.98	1.07–3.69	1.92	1.04–3.55
Women							
Total cholesterol[b]							
Low	1043 (17)	1.00		1.00		1.00	
Middle	1043 (25)	1.07	0.58–2.00	1.04	0.55–1.96	1.04	0.54–1.97
High	984 (20)	0.77	0.36–1.66	0.75	0.36–1.59	0.73	0.34–1.55
LDL[b]							
Low	1076 (19)	1.00		1.00		1.00	
Middle	1035 (24)	1.00	0.55–1.84	0.97	0.53–1.78	0.97	0.53–1.78
High	959 (19)	0.71	0.35–1.44	0.68	0.34–1.38	0.66	0.33–1.35
HDL[b]							
Low	1010 (23)	1.00		1.00		1.00	
Middle	1023 (23)	1.00	0.56–1.80	1.06	0.59–1.90	1.07	0.59–1.95
High	1037 (16)	0.64	0.32–1.27	0.71	0.35–1.41	0.72	0.36–1.43
Triglycerides[b]							
Low	1160 (17)	1.00		1.00		1.00	
Middle	986 (18)	1.13	0.55–2.33	1.06	0.51–2.23	1.09	0.52–2.31
High	924 (27)	1.80	0.92–3.50	1.63	0.82–3.25	1.62	0.81–3.25

Logistic regression analysis. Odds ratios (OR) and 95% confidence intervals (CI).
[a] Subjects without hyperlipidemia medication.
[b] Tertiles.

cation for hyperlipidemia and with information on all study variables.

2.5. Statistical methods

Logistic regression analysis was used to estimate associations of cardiovascular diseases, hyperlipidemia, and serum lipid levels with sciatica, with adjustment for covariates. The statistical software packages SAS (Version 8.0; SAS Institute, Inc., Cary, North Carolina) and SUDAAN (Version 8.0; RTI International, Research Triangle Park, North Carolina) were used. Population weights were applied in the analyses to correct the distributions of the cluster sample regarding age, gender, geographical area, and mother tongue, to correspond with those of the Finnish population.

3. Results

The prevalence of sciatica was 2.7% (3.3% in men and 2.2% in women) and that of pharmacologically treated hyperlipidemia 6.2% (6.7% in men and 5.8% in women). In women an association of pharmacologically treated hyperlipidemia with sciatica was found, but not in men (Table 1).

We then studied associations of serum lipid levels (Table 2) with sciatica among subjects without pharmacologically treated hyperlipidemia. The covariates used were BMI, smoking, exercise, history of heavy physical work, and length of education. Table 3 shows the age-adjusted relationships of the covariates with sciatica.

TChol was associated with sciatica in men (Table 4). The age-adjusted odds ratios of sciatica for subjects in the middle

Table 5
Sciatica by a combination of levels of total cholesterol and triglycerides (1) and LDL cholesterol and triglycerides (2), among Finnish men aged 30 years or over[a]

	n (cases)	Adjusted for age		Adjusted for age, BMI, smoking, and exercise		Adjusted for the former, education, and history of heavy physical work	
		OR	95% CI	OR	95% CI	OR	95% CI
Combined lipid score 1[b]							
1	693 (9)	1.00		1.00		1.00	
2	1466 (50)	2.47	1.19–5.16	2.55	1.22–5.35	2.55	1.21–5.36
3	415 (22)	3.81	1.66–8.76	3.96	1.71–9.15	3.89	1.68–8.99
Combined lipid score 2[c]							
1	486 (6)	1.00		1.00		1.00	
2	1708 (56)	2.35	0.96–5.72	2.46	1.00–6.03	2.43	0.99–5.98
3	380 (19)	3.49	1.26–9.68	3.67	1.32–10.17	3.55	1.28–9.81

Logistic regression analysis. Odds ratios (OR) and 95% confidence intervals (CI).
[a] Subjects without hyperlipidemia medication.
[b] 3 = both total cholesterol and triglycerides in the highest tertile, 1 = total cholesterol in the lowest tertile, triglycerides in the lowest or middle tertile, 2 = other combinations.
[c] 3 = both LDL cholesterol and triglycerides in the highest tertile, 1 = LDL cholesterol in the lowest tertile, triglycerides in the lowest or middle tertile, 2 = other combinations.

and the highest tertile of TChol compared with subjects in the lowest tertile were above 2. The estimates were little affected by the addition of the covariates in the model. Particularly, those in the highest tertile of LDL were in an increased risk of sciatica compared with those in the lowest tertile. There was no relationship between HDL and sciatica. An association was also observed between the concentration of TG and sciatica.

In men, the combined lipid scores indicated a relationship between sciatica and increased concentrations of both TChol/LDL and TG (Table 5).

Among women, no associations between lipid levels and sciatica were found when subjects with hyperlipidemia medication were screened out. The use of the conventional clinical reference values for lipids did not lead to statistically significant associations with sciatica in this sample of the normal population.

4. Discussion

The present study found that high measured TChol, LDL, and TG in men and pharmacologically treated hyperlipidemia in women increased the risk of clinically assessed sciatica. The study sample was representative of the Finnish population aged 30 years or over.

Our results are in line with several previous studies. In a large follow-up study of nurses, self-reported high TChol predicted self-reported physician-diagnosed lumbar disc herniation [23]. In a follow-up of industrial employees high measured TChol and TG increased the risk of new cases of radiating low back pain [24]. Among London civil servants high measured TG levels preceded back-related sickness absence [25]. Another study showed that in patients with long-lasting low back pain those with above normal LDL cholesterol more often suffered from severe pain and neurogenic symptoms than those with normal cholesterol values [26]. An association between serum lipid levels and back pain is not, however, a consistent finding. In random samples of Swedish men aged 50 or 60 years, no associations were found between lipid levels and back or leg pain during the past 3 months [27].

Our findings differ between men and women. In men, sciatica was associated with high lipid concentrations, whereas in women it was associated with pharmacologically treated hyperlipidemia. Women in Finland use health services more frequently than men [28]. Therefore, it is possible that a higher proportion of women with hyperlipidemia get treated than men or that less severe hyperlipidemia is treated with medication in women than in men. There were no differences in the results between pre-menopausal and post-menopausal women in our material. The differences between genders may also be genetically based. The study conducted by Jwahar et al. [23] among female nurses found that the increased risk of lumbar disc herniation connected with high blood cholesterol was of a modest magnitude (multivariate hazard ratio 1.26). The study did not involve comparison with a male population. In the follow-up of industrial employees [24], associations of high cholesterol with radiating low back pain emerged earlier in men (in a 5-year follow-up) than in women (in a 10-year follow-up).

The strengths of our study include the nationally representative sample, adequate participation rate, measured blood lipid concentrations, and clinically ascertained sciatica. Furthermore, in the analyses we were able to control for a number of potential confounders: overweight, smoking, leisure-time physical activity, physical workload, and the level of education. The cross-sectional design could be considered a limitation of the study: the possibility that a lifelong history of high physical activity or otherwise healthy lifestyle could have beneficially influenced lipid levels and been preventive of sciatica was perhaps not sufficiently accounted for. However, reverse causation does not seem likely, as it is improbable that sciatica could have affected lipid levels particularly when lifestyle factors and workload were taken into account. Another limitation relates to the required length (minimum of 4 h) of fasting before blood sampling. This may not be enough for completely reliable results regarding triglycerides.

The lowest lumbar nerve roots, which are most commonly associated with sciatic pain, are supplied by the lowest segmental lumbar arteries, whereas the upper lumbar nerve roots are supplied both by lumbar and spinal cord arteries. The lowest lumbar arteries originate in pairs in the lowest part of the aorta, just above the bifurcation, the most frequent site of atheromatous plaques. Obliteration of these arteries results in compromised nutrient supply to the corresponding lumbar segment, including its nerve root. An insufficient nutrient supply threatens the viability of intervertebral disc cells. As nerve ischemia is known to evoke intensive pain, lumbar nerve root ischemia could also be considered as a possible cause of sciatica.

In a 25-year follow-up of the Framingham cohort, the authors found that calcific atherosclerotic deposits in the posterior wall of the aorta were associated with back pain and also predicted disc degeneration [7]. In another study on patients with sciatica, baseline lumbar artery stenosis was associated with the intensity of back pain at 1 year and leg pain at 2 years of follow-up [29]. Furthermore, in a postmortem study, an association was found between stenotic lumbar arteries and disc degeneration at the matching lumbar levels [30].

To conclude, our results support the hypothesis that atherosclerosis may be a cause of sciatica. High serum cholesterol and triglyceride concentrations are not known to give rise to pain. Thus, there must be another link that connects high serum lipids with sciatica. The most logical link between them is atherosclerosis which, by obliterating one or several lumbar arteries, hampers oxygen and nutrient supply to a corresponding lumbar segment resulting in disc degeneration, ischemic lumbar nerve root pain, or both.

Competing interest statement

All authors declare that they have no competing interests.

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