Original Contribution

Sports, Smoking, and Overweight During Adolescence as Predictors of Sciatica in Adulthood: A 28-Year Follow-up Study of a Birth Cohort


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Lifestyle factors such as smoking, obesity, and level of physical activity predict low back pain (LBP) and sciatica. The authors investigated whether participating in sports, smoking, and being overweight or obese at 14 years of age predicted hospitalizations due to LBP or sciatica in adulthood. In 1980, at the age of 14 years, a total of 11,399 members of the 1966 Northern Finland Birth Cohort returned the postal questionnaire. Patients from the 1966 Northern Finland Birth Cohort who were hospitalized because of LBP or sciatica were followed to the end of 2008 through the Finnish Hospital Discharge Register. Data were analyzed using Cox’s proportional hazards multistate model with the Markov clock forward time scale. During follow-up, 119 females (2.7%) and 254 males (5.6%) had been hospitalized at least once because of LBP or sciatica. Among females, overweight was associated with an increased risk of second-time hospitalization for surgical treatment for sciatica (hazard ratio = 7.1, 95% confidence interval: 1.5, 34.4). Among males, smoking was associated with an increased risk of first-time nonsurgical hospitalization (hazard ratio = 1.8, 95% confidence interval: 1.2, 2.7) and second-time surgical hospitalization (hazard ratio = 3.2, 95% confidence interval: 1.2, 8.2). The authors found potentially modifiable risk factors in adolescence that predicted hospital treatments for low back disorders during adolescence and young adulthood.

Abbreviations: CI, confidence interval; HR, hazard ratio; ICD, International Classification of Diseases; LBP, low back pain.
MATERIALS AND METHODS

Study population

The study population was from the 1966 Northern Finland Birth Cohort, which originally included 12,231 children recruited before birth in the 2 northernmost provinces of Finland, Oulu and Lapland (19). The cohort comprised all newborns with an expected date of birth in 1966. In 1980, when the cohort members were, on average, 14 years old, a postal questionnaire was sent to all members of the cohort who were still alive and whose addresses were known \( n = 11,764 \). A total of 11,399 boys and girls returned the questionnaire (97% response rate). Those living in a foreign country when the postal survey was sent \( n = 606 \) or at the end of the follow-up of register data in 2004 \( n = 248 \), as well as those who had died by 1981 \( n = 5 \), were eliminated from the original data. Our final study population included 9,016 adolescents who answered the questionnaire about health behaviors and sports. The personal identification numbers of the data population were replaced with identification codes. The research protocol was reviewed by the ethics committee of the University Hospital of Oulu.

Hospitalizations for LBP

Data on hospitalizations due to conservatively or surgically treated LBP and sciatica were obtained from the Finnish Hospital Discharge Register, which systematically covers all hospitals (private and public) in Finland. The Finnish Hospital Discharge Register contains demographic, administrative, and clinical data, dates of admission and discharge, primary and subsidiary diagnoses, and data on possible surgical procedures. Its diagnoses are based on the International Classification of Diseases (ICD). The diagnoses from 1981 to 1986 were coded according to the Eighth Revision (ICD-8), those from 1987 to 1995 were coded according to the Ninth Revision (ICD-9), and those from 1996 to 2008 were coded according to the Tenth Revision (ICD-10). Hospitalization due to sciatica was specified in the ICD-8 by codes 35399 and 72510, in the ICD-9 by codes 7227C and 7229X, and in the ICD-10 by code M511. Hospitalization due to LBP was specified in the ICD-8 by codes 71700, 72510, and 72870, in the ICD-9 by codes 7224A, 7242A, and 7245A, and in the ICD-10 by codes M543, M544, and M545. Hospitalization for surgical management of sciatica was defined by operation codes 9211, ABC07, ABC16, ABC26, and ABC36.

Health behaviors at 14 years of age

The subjects were asked about the frequency of their participation in sports, participation in different kinds of sports, and membership in a sports club outside school hours. Frequency of participation in sports was elicited by asking the question, “How often are you interested in 1 or more sports outside school?” Originally, the answers were divided into 7 categories: almost never, once a month, every other week, once a week, twice a week, every other day, and every day. We reclassified frequency of participation in sports into 2 categories: \( \leq 1–2 \) times per week and at least every other day. Types of sports were classified into 2 categories on the basis of their risk of injury: sport with a risk of injury and other types of sport. Sports with a risk of injury included the following disciplines: ice hockey, soccer, volleyball, basketball, strength sports, other sports (shooting, sailing, hiking, ski jumping, and some other less common sports), other ball games, gymnastics, track and field, downhill skiing, combat sports, and horseback riding. The no-risk group included endurance sports: walking, running, skating, cross-country skiing, swimming, cycling, dancing, and orienteering. Membership in a sports club was determined by answers to the question, “Are you a member of a sports club?” The answer options were “no” and “yes.” The postal questionnaire also included a question regarding smoking habits with 8 possible responses: “I have never tried,” “I have tried once,” “I have tried twice or more,” “I smoke occasionally,” “I smoke about twice a week,” “I smoke 1–5 cigarettes daily,” “I smoke 6–10 cigarettes daily,” and “I smoke more than 10 cigarettes daily.” Participants were categorized according to smoking status as nonsmokers (never tried, tried once, or tried twice or more) and current smokers (smoke at least occasionally). Body height and weight were both self-reported in the postal questionnaire. Body mass index was calculated by dividing weight in kilograms by height in meters squared. The internationally standardized cutoff points for body mass index in relation to age for overweight and obesity were set according to the standard determined by Cole et al. (20). We first categorized body mass index into categories of normal weight, overweight, and obese, but because of the small number of cases in the obese class, we dichotomized the classification into normal weight and overweight/obese.

Statistical analyses

We used a 3-state Markov model to model the life course of low back disorders from adolescence to adulthood. The states were: no LBP/sciatica (initial state), LBP/sciatica (intermediate state), and operated sciatica (final state). Data were analyzed by using Cox’s proportional hazard multi-state model with the Markov clock forward time scale (21). Every transition was analyzed separately. As endpoints, we used lumbar discectomy, death reported in the Official Cause-of-Death statistics, and the end of the study on December 31, 2008. The explanatory variables were frequency of participation in sports, type of sports in which subjects participated, belonging to a sports club, smoking, and overweight/obesity. Data were analyzed using the statistical program R, mstate package (R Project for Statistical Computing, Vienna, Austria).

RESULTS

During the follow-up period, 119 females (2.7%) and 254 males (5.6%) were hospitalized at least once because of LBP or sciatica (Figures 1–4). In total, 57 females (1.3%) and 146 males (3.2%) were operated on for sciatica. Of these, 8 females (11.4%) and 23 males (17.6%) were first
treated conservatively and were subsequently hospitalized for surgical treatment for sciatica. The risk of discectomy was 2.6 times (95% confidence interval (CI): 1.7, 3.6) higher among males than among females.

Among females, the type of sport played and membership in a sports club were not significant for first-time hospitalization with nonsurgical treatment for LBP or sciatica, whereas frequent participation in sports tended to increase the hazard ratio (hazard ratio (HR) = 1.9, 95% CI: 0.9, 3.9) and smoking (HR = 1.5, 95% CI: 0.9, 2.6) were of borderline significance in increasing the likelihood of first-time hospitalization with nonsurgical treatment for LBP or sciatica, whereas overweight/obesity (HR = 7.1, 95% CI: 1.5, 34.4) was associated with an increased risk of second-time hospitalization with surgical treatment for sciatica (Table 1). Sports with a risk of injury had an over 2-fold increased probability of second-time hospitalization, but it did not reach statistical significance (HR = 2.5, 95% CI: 0.4, 14.1).

Among males, smoking was associated with an increased risk of first-time hospitalization for LBP or sciatica (HR = 1.8, 95% CI: 1.2, 2.7) and the risk of second-time hospitalization with surgical treatment for sciatica (HR = 3.2, 95% CI: 1.2, 8.2). Type of sport played, membership in a sports club, participation in sports, and overweight/obesity did not predict first-time hospitalization with conservative treatment for LBP or sciatica or second-time hospitalization with surgical treatment for sciatica (Table 2). Among both females and males, none of the analyzed risk factors were significant in cases of first-time sciatica operation, that is, cases in which the surgery was performed during the first hospital visit (Tables 1 and 2).

The associations between frequent participation in sports (HR = 1.9, 95% CI: 0.8, 4.9) and participation in sports with risk of injury (HR = 1.3, 95% CI: 0.9, 2.0) and risk of second-time hospitalization were of borderline significance.

We also tested these predictors separately for LBP and sciatica. The predictors for the first hospitalization for LBP were analyzed by using Cox’s regression. No statistically significant results emerged, but smoking tended to be associated with an increased risk among males (HR = 1.6, 95% CI: 0.9, 2.8). The predictors for first hospitalization for non-surgically treated sciatica were also analyzed using Cox’s regression. Among females, smoking tended to be associated with an increased risk (HR = 1.8, 95% CI: 0.8, 3.9), and among males the association was statistically significant (HR = 2.0, 95% CI: 1.1, 3.6). Any hospitalization for sciatica was analyzed by using Cox’s proportional hazards multistate model (Markov clock forward time scale) with nonsurgically treated sciatica as the initial state and surgically treated sciatica as the final state. Among females, no statistically significant associations were found, but smoking tended to increase the hazard ratio for the first-time hospitalization with nonsurgical treatment for sciatica (HR = 1.8, 95% CI: 0.8, 3.9), and high body mass index tended to be associated with increased risk of second-time hospitalization with surgical treatment for sciatica (HR = 5.5, 95% CI: 0.8, 35.7). Among males, smoking was associated with an increased risk of first-time hospitalization due to sciatica (HR = 2.0, 95% CI: 1.1, 3.6) and risk of second-time hospitalization with surgical treatment for sciatica (HR = 1.8, 95% CI: 3.0, 100.8). In addition, frequent participation in sports was associated with an increased risk of second-time hospitalization (HR = 1.1, 95% CI: 1.8, 66.2). Because the results did not essentially change when different models were used, we prefer interpreting them on the basis of the analyses with the originally planned model.

**DISCUSSION**

In the present prospective cohort study, lifestyle factors at 14 years of age predicted hospitalizations due to sciatica or LBP in adulthood. Among females, overweight/obesity was associated with an increased risk of second-time hospitalization for surgical treatment of sciatica. Among males, current smoking was associated with an increased risk of both first-time hospitalization with conservative treatment and second-time hospitalization for surgical treatment of sciatica. Furthermore, the risk of discectomy by 45 years of age was 2.6 times higher among males than among females.

In our study, smoking seemed to increase the risk of first-time hospitalization with conservative care and second-time...
surgical hospitalization among males. A meta-analysis of the association between smoking and LBP showed that former and current smoking were associated with an increased prevalence of LBP in both genders (14). Both the prevalence and incidence of LBP were almost constantly higher among males than among females in both former and current smokers. Furthermore, the association between current smoking and LBP was stronger among adolescents than among adults (14). Some studies have shown a dose-response relation between the number of cigarettes smoked and the occurrence of LBP in adolescence (22–24). In line with our finding, Mattila et al. (18) reported that smoking in adolescence was associated with LBP hospitalizations in adulthood. We performed a systematic review of cardiovascular risk factors in sciatica and found that a long smoking history might be associated with sciatica (13) but the association between smoking and sciatica was weaker than that between smoking and LBP.

Atherosclerosis has been linked to low back symptoms (25, 26), and smoking may impair blood circulation in the neighborhood of the intervertebral discs and thus reduce perfusion to the discs and cause malnutrition (27, 28). This might increase the vulnerability of the intervertebral discs to degenerative cascade (29). In a Hungarian survey among school-aged students (30), however, smoking was associated with psychosomatic symptoms in girls. The association between smoking and increased likelihood of hospitalizations could also be mediated through distress or anxiety.

We found that overweight/obesity was associated with second-time hospitalization for surgical treatment of sciatica among females. This finding is alarming because of the increasing prevalence of overweight and obesity among Finnish adolescents (31). In a meta-analysis, obesity was associated with an increased incidence of LBP (15). In cross-sectional studies, both overweight and obesity were associated with LBP, with a stronger association among women, whereas in cohort studies, men had a similar or even higher likelihood of LBP (15). The observed gender difference in our study might be due to between-gender differences in hormones (32) or the distribution of body fat mass and the proportion of lean body mass (33).

Why were obese females hospitalized more often for LBP or sciatica? They may simply be more disposed to accidental injuries (34) or excessive mechanical load. On the other hand, adipocytes are metabolically active, secreting large amounts of proinflammatory cytokines and adipokines and thereby causing systemic low-grade inflammation (35), both of which may predispose an individual to spinal pain. Being overweight has been found to be associated with disc degeneration (36) and vertebral endplate changes (37), and the latter in particular are associated with LBP (38). Finally, obesity may increase the likelihood of LBP because of decreased spinal mobility (39) or via atherosclerosis (25, 26).

In the present study, we found that the risk of discectomy was 2.6 times higher among males than among females. Similar results have also been found by others; Mattila et al. (40) reported in their longitudinal study of adolescents that males had a 2-fold higher risk of lumbar discectomy than did females. One explanation for the gender difference may be military service, which is obligatory in Finland for males and voluntary for females and is physically strenuous (40). Military service training involves high-intensity physical exercise and lifting, leading to a relatively high spinal load. Up to 1.3% of recruits were hospitalized for LBP during the follow-up of 13 years (41). Kaila-Kangas et al. (3) found in their cross-sectional study that among working and nonworking subjects
aged 30–64 years, men suffered from sciatica more often than did women. A total of 3.8% of working subjects (men, 4.2%; women, 3.5%) and 7.9% of nonworking subjects (men, 9.7%; women, 6.5%) suffered from sciatica. In our study, participating in any sport or belonging to a sports club in adolescence was not significantly associated with the risk of hospitalization due to LBP or sciatica in adulthood. Similarly, Miranda et al. (42) found no

### Table 1. Hazard Ratios for Hospitalization Due to Low Back Disorders Among Females in the 1966 Northern Finland Birth Cohort, Oulu, Finland, 1981–2008

<table>
<thead>
<tr>
<th>Participation in sports</th>
<th>First Hospitalization</th>
<th>Second Hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n = 4,481)</td>
<td>Conservative Care for Low Back Pain or Sciatica (n = 70)</td>
</tr>
<tr>
<td></td>
<td>No. %</td>
<td>HR 95% CI</td>
</tr>
<tr>
<td>1–2 times per week</td>
<td>3,206 72</td>
<td>48 69 1.0</td>
</tr>
<tr>
<td>At least every other day</td>
<td>1,275 28</td>
<td>22 31 1.4</td>
</tr>
<tr>
<td>Types of sports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2,697 60</td>
<td>49 70 1.0</td>
</tr>
<tr>
<td>Sports with risk of injury</td>
<td>1,784 40</td>
<td>21 30 0.7</td>
</tr>
<tr>
<td>Membership in a sports club</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3,103 69</td>
<td>52 74 1.0</td>
</tr>
<tr>
<td>Yes</td>
<td>1,378 31</td>
<td>18 26 0.9</td>
</tr>
<tr>
<td>Body weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal weight</td>
<td>4,196 94</td>
<td>62 89 1.0</td>
</tr>
<tr>
<td>Overweight/obesity</td>
<td>285 6</td>
<td>8 11 1.9</td>
</tr>
<tr>
<td>Smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3,675 82</td>
<td>53 76 1.0</td>
</tr>
<tr>
<td>Yes</td>
<td>806 18</td>
<td>17 24 1.5</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HR, hazard ratio.

a With previous nonsurgical hospitalization due to low back pain or sciatica.

### Table 2. Hazard Ratios for Hospitalization Due to Low Back Disorders Among Males in the 1966 Northern Finland Birth Cohort, Oulu, Finland, 1981–2008

<table>
<thead>
<tr>
<th>Participation in sports</th>
<th>First Hospitalization</th>
<th>Second Hospitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n = 4,535)</td>
<td>Conservative Care for Low Back Pain or Sciatica (n = 131)</td>
</tr>
<tr>
<td></td>
<td>No. %</td>
<td>HR 95% CI</td>
</tr>
<tr>
<td>1–2 times per week</td>
<td>2,315 51</td>
<td>74 57 1.0</td>
</tr>
<tr>
<td>At least every other day</td>
<td>2,220 49</td>
<td>51 44 0.9</td>
</tr>
<tr>
<td>Types of sports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1,507 33</td>
<td>51 39 1.0</td>
</tr>
<tr>
<td>Sports with risk of injury</td>
<td>3,028 67</td>
<td>80 61 0.8</td>
</tr>
<tr>
<td>Membership in a sports club</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>2,711 60</td>
<td>85 65 1.0</td>
</tr>
<tr>
<td>Yes</td>
<td>1,824 40</td>
<td>46 33 0.9</td>
</tr>
<tr>
<td>Body weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal weight</td>
<td>4,165 92</td>
<td>121 92 1.0</td>
</tr>
<tr>
<td>Overweight/obesity</td>
<td>370 8</td>
<td>10 8 0.9</td>
</tr>
<tr>
<td>Smoker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3,798 84</td>
<td>97 74 1.0</td>
</tr>
<tr>
<td>Yes</td>
<td>737 16</td>
<td>34 26 1.8</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; HR, hazard ratio.

a With previous nonsurgical hospitalization due to low back pain or sciatica.

association between physical exercise and self-reported sciatica. Physical activity has been shown to be associated with LBP among adolescents (17) and adults (43), but the outcome in these studies has been self-reported LBP rather than hospitalizations due to low back disorders. However, Mattila et al. (18) found an association between physical activity in adolescence and LBP hospitalization in adulthood among females but not among males. Unfortunately, we have no longitudinal data on the level of physical activity in our cohort. It may well be that those with high persistent physical activity are more prone to hospitalizations for LBP, but this topic requires further study.

Our study was based on a large birth cohort of 11,399 people. Another of its strengths is that the information on low back disorders was based on data from the Finnish Hospital Discharge Register, the accuracy, reliability, and excellent quality of which are well-known (44). We included all lifestyle factors for which data were available for patients at the age of 14 years in our analysis, but those data were based on self-reporting, which could have caused some bias. In particular, the self-reported frequency of participation in exercise as a proxy of physical activity may be inaccurate. Moreover, the availability of hospital treatment may vary, with impaired access to care in rural areas (45, 46). In Finland, there are clear regional variations in surgical rates between hospitals (47, 48), which are due to both individual surgeons’ keenness to operate and the number of surgeons relative to the population (49). The geographic differences in the prevalence of sciatica are much smaller than the health system differences in rates of back surgery (50). Usually, low back symptoms are mild in the majority of patients (51), whereas our study population consisted of patients whose pain and symptom severity led to hospitalization. Therefore, our results cannot be generalized to apply to patients with milder symptoms.

Few adults were hospitalized more than once for low back pain or sciatica, and these small sample sizes may have affected our ability to identify significant associations. In our model, we considered and analyzed only the first conservative hospitalization, and the second counted hospitalization. Therefore, our results cannot be generalized to apply to patients at the age of 14 years in our analysis, but those data were based on self-reporting, which could have caused some bias. In particular, the self-reported frequency of participation in exercise as a proxy of physical activity may be inaccurate. Moreover, the availability of hospital treatment may vary, with impaired access to care in rural areas (45, 46). In Finland, there are clear regional variations in surgical rates between hospitals (47, 48), which are due to both individual surgeons’ keenness to operate and the number of surgeons relative to the population (49). The geographic differences in the prevalence of sciatica are much smaller than the health system differences in rates of back surgery (50). Usually, low back symptoms are mild in the majority of patients (51), whereas our study population consisted of patients whose pain and symptom severity led to hospitalization. Therefore, our results cannot be generalized to apply to patients with milder symptoms.

In conclusion, our study indicated that overweight in adolescence was associated with second-time hospitalization for surgical treatment of sciatica in adulthood among females, and smoking among males in adolescence was associated with hospitalization for LBP or sciatica in adulthood. The background of low back symptoms in adulthood seems to be multifactorial, so more studies are needed to increase our understanding of the role of modifiable lifestyle factors in adolescence. If we can find more information on the risk factors that can cause LBP and probably lead to sciatica, it might be possible to contribute to preventive factors and to minimizing the financial burden that low back disorders cause health services.

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