2. LBP

PTSD

Post-traumatic Stress Disorder Symptoms are Associated With Incident Chronic Back Pain: A Longitudinal Twin Study of Older Male Veterans.

Suri P[1,2,3,4], Boyko EJ[1,5], Smith NL[1,6], Jarvik JG[4,7], Jarvik GP[8,9], Williams FMK[10], Williams R[2,3], Haselkorn J[2,3], Goldberg J[1,6].

STUDY DESIGN:
A longitudinal cotwin control study of the Vietnam Era Twin Registry.

OBJECTIVE:
The aim of this study was to examine the association of post-traumatic stress disorder (PTSD) symptoms with incident chronic back pain (CBP), while controlling for genetic factors and early family environment.

SUMMARY OF BACKGROUND DATA:
It is unknown whether PTSD symptoms are associated with an increased incidence of CBP.

METHODS:
In 2010 to 2012, a baseline survey was undertaken as part of a large-scale study of PTSD. Study participants completed the PTSD Symptom Checklist (PCL) and a self-report measure of CBP. In 2015 to 2017, a follow-up survey was sent to all 171 monozygotic (MZ) twin pairs (342 individuals) where both cotwins had no history of CBP at baseline, but only one cotwin in the pair met criteria for having current PTSD symptoms (one twin with PCL <30 and the cotwin with PCL ≥30). No other inclusion/exclusion criteria were applied. CBP at 5-year follow-up was defined as back pain of duration ≥3 months in the low back or mid/upper back. Covariates included age, race, education, income, Veterans Affairs health care use, disability compensation, smoking, body mass index, and depression. Statistical analysis estimated the cumulative incidence of CBP according to baseline PTSD symptoms. Risk ratios (RRs) and 95% confidence intervals (95% CIs) were estimated in matched-pair cotwin control analyses adjusting for familial factors.

RESULTS:
Among 227 males completing 5-year follow-up, including 91 MZ twin pairs, the mean age was 62 years. Five-year incidence of CBP in those without and with baseline PTSD symptoms was 40% and 60%, respectively. Baseline PTSD symptoms were significantly associated with incident CBP in crude and multivariable-adjusted within-pair analyses (RR 1.6, 95% CI 1.2-2.1; P=0.002).

CONCLUSION:
PTSD symptoms were associated with an increased incidence of CBP, without confounding by genetic factors or early family environment. PTSD symptoms may be a modifiable risk factor for prevention of CBP.

LEVEL OF EVIDENCE:3.

5. SPINAL SURGERY

Worse outcomes with obesity

Does obesity impact lumbar sagittal alignment and clinical outcomes after a posterior lumbar spine fusion?
European Spine Journal

Khan JM, Basques BA, Kunze KN, et al. | August 20, 2019

Via a retrospective cohort study carried out for patients who underwent open posterior lumbar spine fusion (PLSF) from 2011 to 2018, researchers contrasted clinical patient-reported outcomes and radiographic sagittal parameters between obese and non-obese patients after open PLSF.

A total of 569 patients were involved of whom, 290 patients with BMI < 30 (non-obese) and 279 patients with BMI ≥ 30 (obese). A diagnosis of diabetes mellitus, and American Society of Anesthesiologists Physical Status Classification System of ≥ 3 was more likely in patients classified as obese. Significantly longer operative times was noted in obese patients vs non-obese patients. No variation in radiographic measurements, patient-reported outcomes, postoperative complications, or reoperations among groups was observed.

In conclusion, significantly more comorbidities and longer operative time was noted in obese patients vs non-obese patients. Nevertheless, sagittal parameters, patient-reported outcomes, inpatient complications, length of hospital stay, and reoperations were comparable amongst groups. Provided these findings, open PLSF can be acknowledged as a safe and efficient in obese patients following thorough consideration of related comorbidities.

6. PELVIC GIRDLE

Form and force closure

Form and Force Closure of the Sacroiliac Joints.

Vleeming A[1,2], Schuenke M[2].

The principles of form and force closure were introduced to describe the complex mechanism of sacroiliac joint (SIJ) stability. Form closure refers to a theoretical stable state of a joint with close fitting articular surfaces, where no extra forces are needed to maintain the stable state of the system during loading and unloading situations. If the sacrum would fit in the pelvis with perfect form closure, no lateral compressional forces would be needed to maintain stability.

However, such a construction would make mobility practically impossible. Force closure is the theoretical state where lateral force and friction resulting in joint compression, are required for the joint to withstand a vertical load.

Structures that contribute to SIJ stability via "form closure" include (1) the configuration of the interfacing joint surfaces, along with dorsocranial "wedging" of the sacrum into the ilia; (2) the corresponding ridges and grooves of the articular surfaces of the SIJs and resultant high coefficient of friction; and (3) the integrity of the binding ligaments, which are among the strongest in the body.

Shearing forces absorbed in the SIJ occur because of a combination of person-specific anatomical features. This results in unique form and force closure situations that provide effective and tailored joint accommodation that balance both friction and compression in the joint. Force closure occurs because of altered joint reaction force via taut ligaments, fascia, muscles, and the ground reaction force they are reacting to at the moment. In the ideal state, force closure creates a perpendicular compressive reaction force to the SIJ to adapt and overcome the forces of gravity. In order for force closure to be effective, sacral nutation must occur and is considered to be anticipatory for joint loading.

 Sacral nutation results in tensing all of the dorsal SIJ ligaments (interosseous, dorsal sacroiliac) with the exception of one, the long dorsal ligament (LDL). This prepares the pelvis to absorb and increase in load. As a result, the posterior ilium are pressed together causing an increase in SIJ compression. This review will discuss the importance of understanding form and force closure principles because they are related to understanding the relationship of anatomy and function of the SIJ.

7. PELVIC ORGANS/WOMAN'S HEALTH

Preclasmia and minerals

Trace Minerals, Heavy Metals, and Preeclampsia: Findings from the Boston Birth Cohort

Tiange Liu Mingyu Zhang Eliseo Guallar Guoying Wang Xiumei Hong Xiaobin Wang , and **Noel T. Mueller**

Background

Preeclampsia is a leading contributor to maternal and perinatal morbidity and mortality. In mice experiments, manganese (Mn) and selenium (Se) are protective whereas cadmium (Cd) is promotive for preeclampsia. Epidemiologic findings on these chemical elements have been inconsistent. To confirm experimental findings in mice, we examined associations of trace minerals (Mn and Se) and heavy metals (Cd, lead [Pb], and mercury [Hg]) with preeclampsia in a birth cohort.

Methods and Results

A total of 1274 women from the Boston Birth Cohort (enrolled since 1998) had complete data on the exposures and outcome. We measured Mn, Se, Cd, Pb, and Hg from red blood cells collected within 24 to 72 hours after delivery. We ascertained preeclampsia diagnosis from medical records. We used Poisson regression with robust variance models to estimate prevalence ratios (PRs) and 95% CIs. A total of 115 (9.0%) women developed preeclampsia. We observed evidence of a dose–response trend for Mn (P for trend<0.001) and to some extent for Cd (P for trend=0.009) quintiles. After multivariable adjustment, a 1 SD increment in Mn was associated with 32% lower risk of developing preeclampsia (PR=0.68; 95% CI, 0.54–0.86), whereas a 1 SD increment in Cd was associated with 15% higher risk of preeclampsia (PR=1.15; 95% CI, 0.98–1.36). Null associations were observed for Se, Pb, and Hg.

Conclusions

Findings from our cohort, consistent with evidence from mice experiments and human studies, indicate that women with lower blood concentration of Mn or higher Cd are more likely to develop preeclampsia.

Maternal fluoride use affects infants IQ

Association Between Maternal Fluoride Exposure During Pregnancy and IQ Scores in Offspring in Canada

Rivka Green, MA[1]; Bruce Lanphear, MD[2,3]; Richard Hornung, PhD[4]; et alDavid Flora, PhD[1]; E. Angeles MartinezMier, DDS[5]; Raichel Neufeld, BA[1]; Pierre Ayotte, PhD[6,7]; Gina Muckle, PhD[7,8]; Christine Till, PhD[1]
Key Points

Question Is maternal fluoride exposure during pregnancy associated with childhood IQ in a Canadian cohort receiving optimally fluoridated water**indings** In this prospective birth cohort study, fluoride exposure during pregnancy was associated with lower IQ scores in children aged 3 to 4 years.**Meaning** Fluoride exposure during pregnancy may be associated with adverse effects on child intellectual development, indicating the possible need to reduce fluoride intake during pregnancy.

Importance The potential neurotoxicity associated with exposure to fluoride, which has generated controversy about community water fluoridation, remains unclear

Objective To examine the association between fluoride exposure during pregnancy and IQ scores in a prospective birth cohort.

Design, Setting, and Participants This prospective, multicenter birth cohort study used information from the Maternal-Infant Research on Environmental Chemicals cohort. Children were born between 2008 and 2012; 41% lived in communities supplied with fluoridated municipal water. The study sample included 601 mother-child pairs recruited from 6 major cities in Canada; children were between ages 3 and 4 years at testing. Data were analyzed between March 2017 and January 2019.

Exposures Maternal urinary fluoride (MUF_{SG}), adjusted for specific gravity and averaged across 3 trimesters available for 512 pregnant women, as well as self-reported maternal daily fluoride intake from water and beverage consumption available for 400 pregnant women.

Main Outcomes and Measures Children's IQ was assessed at ages 3 to 4 years using the Wechsler Primary and Preschool Scale of Intelligence-III. Multiple linear regression analyses were used to examine covariate-adjusted associations between each fluoride exposure measure and IQ score.

Results Of 512 mother-child pairs, the mean (SD) age for enrollment for mothers was 32.3 (5.1) years, 463 (90%) were white, and 264 children (52%) were female. Data on MUF_{SG} concentrations, IQ scores, and complete covariates were available for 512 mother-child pairs; data on maternal fluoride intake and children's IQ were available for 400 of 601 mother-child pairs. Women living in areas with fluoridated tap water (n = 141) compared with nonfluoridated water (n = 228) had significantly higher mean (SD) MUF_{SG} concentrations (0.69 [0.42] mg/L vs 0.40 [0.27] mg/L; P = .001; to convert to millimoles per liter, multiply by 0.05263) and fluoride intake levels (0.93 [0.43] vs 0.30 [0.26] mg of fluoride per day; P = .001). Children had mean (SD) Full Scale IQ scores of 107.16 (13.26), range 52-143, with girls showing significantly higher mean (SD) scores than boys: 109.56 (11.96) vs 104.61 (14.09); P = .001. There was a significant interaction (P = .02) between child sex and MUF_{SG} (6.89; 95% CI, 0.96-12.82) indicating a differential association between boys and girls. A 1-mg/L increase in MUF_{SG} was associated with a 4.49-point lower IQ score (95% CI, −8.38 to −0.60) in boys, but there was no statistically significant association with IQ scores in girls (B = 2.40; 95% CI, −2.53 to 7.33). A 1-mg higher daily intake of fluoride among pregnant women was associated with a 3.66 lower IQ score (95% CI, −7.16 to −0.14) in boys and girls.

Conclusions and Relevance In this study, maternal exposure to higher levels of fluoride during pregnancy was associated with lower IQ scores in children aged 3 to 4 years. These findings indicate the possible need to reduce fluoride intake during pregnancy.

Increase risk of still born with increase gestational weight

Large-for-gestational age and stillbirth: is there a role for antenatal testing?

Carter EB[1], Stockburger J[1], Tuuli MG[1], Macones GA[1], Odibo AO[2], Trudell AS[3].

OBJECTIVE:
To investigate the association between large-for-gestational-age (LGA) pregnancy and stillbirth to determine if the LGA fetus may benefit from antenatal testing with non-stress test or biophysical profile.

METHODS:
This was a retrospective cohort study of singleton pregnancies that were ongoing at 24 weeks' gestation and that had undergone routine second-trimester anatomy ultrasound examination, during the period 1990 to 2009. Pregnancies complicated by fetal anomaly or aneuploidy, those with missing birth weight information and those that were small-for-gestational age were excluded. Appropriate-for-gestational age (AGA) and LGA were defined as birth weight between the 10th and 90th percentiles and $> 90^{th}$ percentile, respectively, according to the Alexander growth standard. The incidence of stillbirth was calculated as the number of stillbirths per 10 000 ongoing pregnancies. Adjusted odds ratios (aOR) with 95% CI for stillbirth in LGA compared with AGA pregnancies were estimated using logistic regression analysis, controlling for pre-existing and gestational diabetes. The incidence and aOR for stillbirth were estimated at 4-week intervals from ≥ 24 to ≥ 40 weeks' gestation.

RESULTS:
Of 52 749 pregnancies ongoing at 24 weeks, 46 205 (87.6%) were AGA and 6544 (12.4%) were LGA at delivery. The incidence of stillbirth in LGA pregnancies was significantly higher than that in AGA pregnancies from 36 weeks' gestation (26/10 000 vs 7/10 000; aOR, 3.10; 95% CI, 1.68-5.70). When women with diabetes were excluded in stratified analysis, pregnancies complicated by LGA continued to be at increased risk for stillbirth ≥ 36 weeks (18/10 000 vs 7/10 000; OR, 2.63; 95% CI, 1.27-5.43).

CONCLUSION:
Pregnancies complicated by LGA are at significantly increased risk for stillbirth at or beyond 36 weeks, independent of maternal diabetes status, and may benefit from antenatal testing.

Alcohol and pre-term births

Association between maternal alcohol consumption during pregnancy and risk of preterm delivery: The Japan Environment and Children's Study
BJOG: An International Journal of Obstetrics and Gynaecology
Ikehara S, et al. | August 08, 2019

Researchers conducted a prospective cohort study of a total of 94,349 singleton pregnancies in order to assess how maternal alcohol consumption during pregnancy influence the risk of preterm delivery. Questionnaires detailing alcohol consumption during the first trimester and during the second and third trimesters were administered to the participants.

The analysis revealed a four-fold higher risk of preterm delivery among pregnant women in correlation with heavy alcohol consumption ($\geq$ 300 g ethanol/week) during the second and third trimesters.

PID and ectopic pregnancy

Association of pelvic inflammatory disease (PID) with ectopic pregnancy and preterm labor in Taiwan: A nationwide population-based retrospective cohort study.

Huang CC[1], Huang CC[2,3], Lin SY[4], Chang CY[2,5], Lin WC[2,5], Chung CH[6], Lin FH[6], Tsao CH[7,8], Lo CM[1], Chien WC[7,9,6].

BACKGROUND:
Pelvic inflammatory disease (PID) is an infectious disease that causes tubal occlusion and other pelvic and abdominal adhesions. The incidence of pelvic inflammatory disease (PID) has increased due to the sexually active status of the young population. This leads to a more serious problem and a larger effect than previously observed. However, there have been few studies on this topic in Asian populations.

AIM:
We aimed to evaluate the risk of preterm labor and/or ectopic pregnancy in Taiwanese women following PID.

DESIGN:
Using the Taiwan National Health Insurance Database, we designed a retrospective cohort study that included 12- to 55-year-old pregnant women between 2000 and 2010. We selected a 1:3 age-matched control group of non-PID women. The endpoint was any episode of preterm labor or ectopic pregnancy; otherwise, the patients were tracked until 31 December 2010.

METHODS:
The risk factors for preterm labor or ectopic pregnancy were explored. For cases included from the index date until the end of 2010, we analyzed the risk of incident preterm labor or ectopic pregnancy. With the use of a multivariate Cox proportional hazard regression analysis, we calculated the hazard ratio (HR) with a 95% CI and compared it with that of the control group.

RESULTS:
This study examined 30,450 patients with PID and 91,350 controls. During the follow-up period, patients in the PID group were more likely to develop preterm labor or ectopic pregnancy than patients in the control group. The cumulative incidence rates for developing preterm labor were 1.84% (561/30,450 individuals) in patients with PID and 1.63% (1492/91,350 individuals) in patients without PID. On the other hand, the cumulative incidence rate for developing ectopic pregnancy in patients with PID was 0.05% (14/30,450 individuals) but was only 0.04% (33/91,350 individuals) in patients without PID. Compared with those without PID, the patients with PID had a 1.864 times (P<0.001) higher risk of developing preterm labor and a 2.121 times (P = 0.003) higher risk of developing ectopic pregnancy.

CONCLUSION:
Our study provided evidence of an increased risk of preterm labor or ectopic pregnancy in PID patients.

Pelvic pain in pregnancy and function

Original article

The Timed Up & Go test in pregnant women with pelvic girdle pain compared to asymptomatic pregnant and non-pregnant women

lLeneChristensen[a]Nina K.Vøllestad[a]Marit B.Veierød[b]BrittStuge[c]JanCabri[d]Hilde StendalRobinson[a]

Highlights
• First study to compare Timed Up and G (TUG) in pregnant and non-pregnant women.
• No difference in TUG between asymptomatic pregnant and non-pregnant women.
• Pregnant women with pelvic girdle pain (PGP) used significantly longer time on TUG.
• Pain was the most important factor influencing TUG in pregnant women with PGP.

Abstract

Background
The Timed Up and Go (TUG) test, a standardized functional mobility test, has been proposed as a physical performance-based measure in pregnant women with pelvic girdle pain (PGP).

Objectives
This cross-sectional study aimed to investigate physical function by the use of TUG in pregnant women with PGP compared to asymptomatic pregnant and non-pregnant women, and to identify factors associated with increased TUG.

Methods
In total, 25 pregnant women with PGP, 24 asymptomatic pregnant and 25 asymptomatic non-pregnant women participated. One-way analysis of variance was used to explore difference in TUG between the groups and multiple linear regression analyses to explore associations between TUG and potential explanatory variables.

Results
The time on TUG varied among pregnant women with PGP, and was significantly higher (mean (95% CI) 6.9 (6.5, 7.3) seconds) than for asymptomatic pregnant (5.8 (5.5, 6.0), $p < 0.001$) and non-pregnant (5.5 (5.4, 5.6), $p < 0.001$) women. In the total study sample, group, increased BMI and sick leave were significantly associated with increased TUG (p-values≤0.02). In pregnant women with PGP, pain intensity was the only significant clinical factor associated with increased TUG ($p = 0.002$).

Conclusion
Pregnant women with PGP used longer time and showed larger variation in TUG than asymptomatic pregnant and non-pregnant women, this underpins that TUG targets activities relevant to PGP. Our results provide new knowledge about factors influencing TUG time. Importantly, multivariable analyses suggest that pain intensity should be considered when interpreting TUG time in pregnant women with PGP.

8. VISCERA

Gluten intake before 5 increase risk of CD

Association of Gluten Intake During the First 5 Years of Life With Incidence of Celiac Disease Autoimmunity and Celiac Disease Among Children at Increased Risk.

Andrén Aronsson C[1], Lee HS[2], Hård Af Segerstad EM[1], Uusitalo U[2], Yang J[2], Koletzko S[3,4], Liu E[5], Kurppa K[6], Bingley PJ[7], Toppari J[8,9], Ziegler AG[10], She JX[11], Hagopian WA[12], Rewers M[13], Akolkar B[14], Krischer JP[2], Virtanen SM[15,16,17], Norris JM[18], Agardh D[1]; TEDDY Study Group.

IMPORTANCE:
High gluten intake during childhood may confer risk of celiac disease.

OBJECTIVES:
To investigate if the amount of gluten intake is associated with celiac disease autoimmunity and celiac disease in genetically at-risk children.

DESIGN, SETTING, AND PARTICIPANTS:
The participants in The Environmental Determinants of Diabetes in the Young (TEDDY), a prospective observational birth cohort study designed to identify environmental triggers of type 1 diabetes and celiac disease, were followed up at 6 clinical centers in Finland, Germany, Sweden, and the United States. Between 2004 and 2010, 8676 newborns carrying HLA antigen genotypes associated with type 1 diabetes and celiac disease were enrolled. Screening for celiac disease with tissue transglutaminase autoantibodies was performed annually in 6757 children from the age of 2 years. Data on gluten intake were available in 6605 children (98%) by September 30, 2017.

EXPOSURES:
Gluten intake was estimated from 3-day food records collected at ages 6, 9, and 12 months and biannually thereafter until the age of 5 years.

MAIN OUTCOMES AND MEASURES:
The primary outcome was celiac disease autoimmunity, defined as positive tissue transglutaminase autoantibodies found in 2 consecutive serum samples. The secondary outcome was celiac disease confirmed by intestinal biopsy or persistently high tissue transglutaminase autoantibody levels.

RESULTS:
Of the 6605 children (49% females; median follow-up: 9.0 years [interquartile range, 8.0-10.0 years]), 1216 (18%) developed celiac disease autoimmunity and 447 (7%) developed celiac disease. The incidence for both outcomes peaked at the age of 2 to 3 years. Daily gluten intake was associated with higher risk of celiac disease autoimmunity for every 1-g/d increase in gluten consumption (hazard ratio [HR], 1.30 [95% CI, 1.22-1.38]; absolute risk by the age of 3 years if the reference amount of gluten was consumed, 28.1%; absolute risk if gluten intake was 1-g/d higher than the reference amount, 34.2%; absolute risk difference, 6.1% [95% CI, 4.5%-7.7%]). Daily gluten intake was associated with higher risk of celiac disease for every 1-g/d increase in gluten consumption (HR, 1.50 [95% CI, 1.35-1.66]; absolute risk by age of 3 years if the reference amount of gluten was consumed, 20.7%; absolute risk if gluten intake was 1-g/d higher than the reference amount, 27.9%; absolute risk difference, 7.2% [95% CI, 6.1%-8.3%]).

CONCLUSIONS AND RELEVANCE:
Higher gluten intake during the first 5 years of life was associated with increased risk of celiac disease autoimmunity and celiac disease among genetically predisposed children.

IBD and suicide and depression – there is a link

Association of Childhood-Onset Inflammatory Bowel Disease With Risk of Psychiatric Disorders and Suicide Attempt.

Butwicka A[1,2,3], Olén O[4,5,6,7], Larsson H[1,8], Halfvarson J[9], Almqvist C[1,10], Lichtenstein P[1], Serlachius E[3,11], Frisén L[3,11], Ludvigsson JF[1,12,13,14].

IMPORTANCE: Inflammatory bowel disease (IBD) has been associated with psychiatric morbidity in adults, although previous studies have not accounted for familial confounding. In children, IBD has an even more severe course, but the association between childhood-onset IBD and psychiatric morbidity remains unclear.

OBJECTIVE: To examine the risk of psychiatric morbidity in individuals with childhood-onset IBD, controlling for potential confounding shared between siblings.

DESIGN, SETTING, AND PARTICIPANTS: A population-based cohort study was conducted using data from the Swedish national health care and population registers of all children younger than 18 years born from 1973 to 2013. The study included 6464 individuals with a diagnosis of childhood-onset IBD (3228 with ulcerative colitis, 2536 with Crohn disease, and 700 with IBD unclassified) who were compared with 323 200 matched reference individuals from the general population and 6999 siblings of patients with IBD. Cox proportional hazards regression was used to estimate hazard ratios (HRs) with 95% CIs. Statistical analysis was performed from January 1, 1973, to December 1, 2013.

MAIN OUTCOMES AND MEASURES: The primary outcome was any psychiatric disorder and suicide attempt. Secondary outcomes were the following specific psychiatric disorders: psychotic, mood, anxiety, eating, personality, and behavioral disorders; substance misuse; attention-deficit/hyperactivity disorder; autism spectrum disorders; and intellectual disability.

RESULTS: The study included 6464 individuals with a diagnosis of childhood-onset IBD (2831 girls and 3633 boys; mean [SD] age at diagnosis of IBD, 13 [4] years). During a median follow-up time of 9 years, 1117 individuals with IBD (17.3%) received a diagnosis of any psychiatric disorder (incidence rate, 17.1 per 1000 person-years), compared with 38 044 of 323 200 individuals (11.8%) in the general population (incidence rate, 11.2 per 1000 person-years), corresponding to an HR of 1.6 (95% CI, 1.5-1.7), equaling 1 extra case of any psychiatric disorder per 170 person-years. Inflammatory bowel disease was significantly associated with suicide attempt (HR, 1.4; 95% CI, 1.2-1.7) as well as mood disorders (HR, 1.6; 95% CI, 1.4-1.7), anxiety disorders (HR, 1.9; 95% CI, 1.7-2.0) eating disorders (HR, 1.6; 95% CI, 1.3-2.0), personality disorders (HR, 1.4; 95% CI, 1.1-1.8), attention-deficit/hyperactivity disorder (HR, 1.2; 95% CI, 1.1-1.4), and autism spectrum disorders (HR, 1.4; 95% CI, 1.1-1.7) Results were similar for boys and girls. Hazard ratios for any psychiatric disorder were highest in the first year of follow-up but remained statistically significant after more than 5 years. Psychiatric disorders were particularly common for patients with very early-onset IBD (<6 years) and for patients with a parental psychiatric history. Results were largely confirmed by sibling comparison, with similar estimates noted for any psychiatric disorder (HR, 1.6; 95% CI, 1.5-1.8) and suicide attempt (HR, 1.7; 95% CI, 1.2-2.3).

CONCLUSIONS AND RELEVANCE:
Overall, childhood-onset IBD was associated with psychiatric morbidity, confirmed by between-sibling results. Particularly concerning is the increased risk of suicide attempt, suggesting that long-term psychological support be considered for patients with childhood-onset IBD.

IBD and pulmonary fibrosis

Increased Risk of Idiopathic Pulmonary Fibrosis in Inflammatory Bowel Disease: A Nationwide Study

Jihye Kim Joo Sung Kim

Background and Aim

The relationship between inflammatory bowel disease (IBD) and idiopathic pulmonary fibrosis (IPF) remains unclear. We evaluated the risk for developing IPF in patients with IBD using a nationwide, population-based study.

Methods

Using claims data from the National Health Insurance service in Korea, patients with IBD, including Crohn's disease (CD) and ulcerative colitis (UC), were identified through both ICD-10 and rare and intractable diseases (RID) program codes from January 2010 to December 2013. We compared 38,921 IBD patients with age- and sex-matched individuals without IBD in a ratio of 1:3. Patients with newly diagnosed IPF were identified by both ICD-10 and RID registration codes.

Results

During a mean 4.9-year follow-up, the incidence of IPF in patients with IBD was 33.21 per 100,000 person-years. The overall risk of IPF was significantly higher in IBD patients than in non-IBD controls (hazard ratio [HR], 1.62; 95% confidence interval [CI], 1.20-2.20; $P = 0.003$). In patients with CD, the incidence (per 100,000 person-years) of IPF was 26.04; in controls, the incidence was 9.15 (HR, 2.89; 95% CI, 1.46-5.72; $P = 0.002$). The incidence of IPF in patients with UC tended to be higher than in controls (36.66 vs. 26.54 per 100,000 person-years; 95% CI, 0.99-1.99; HR, 1.41; $P = 0.066$). The risk of developing IPF in patients with IBD was higher in males than in females ($P = 0.093$ in CD; $P = 0.147$ in UC by interaction analysis).

Conclusions

Patients with IBD, especially CD, have an increased risk of developing IPF.

10 A. CERVICAL SPINE

Proprioceptive testing

Reliability, measurement error and construct validity of four proprioceptive tests in patients with chronic idiopathic neck pain.

Gonçalves C[1], Silva AG[2].

BACKGROUND:
There are different neck proprioceptive tests that are believed to be targeting different sources of proprioceptive information.

OBJECTIVE:
To assess the reliability, measurement error, discriminative validity and convergent validity of four proprioceptive tests (head repositioning to neutral - HRNT, torsion test - TT, head repositioning to 30° rotation - HR30T and figure of eight relocation test - F8T) in individuals with chronic idiopathic neck pain and asymptomatic individuals. A secondary aim was to assess the divergent validity of these tests by correlating them against measures of disability, pain catastrophizing and fear of movement.

DESIGN:
- Reliability and validity study.

METHODS:
- 66 participants (33 with chronic neck pain and 33 asymptomatic) were assessed using four proprioceptive tests, pain catastrophizing scale, neck disability index, tampa scale of kinesiophobia and visual analogue scale.

RESULTS:
Proprioceptive tests showed moderate to good reliability (ICC: 0.55 to 0.85), but high measurement error. All tests but the HR30T were significantly different between participants with and without neck pain ($p < 0.05$). Only the HRNT showed an area under the curve above 0.5 (AUC95% CI = 0.51; 0.78, $p \leq 0.042$). Between test correlations ranged between 0.35 and 0.61 and correlations between proprioceptive tests and catastrophizing, fear of movement and disability were, in general, lower than 0.3.

CONCLUSION:
The four proprioceptive tests showed reliability and measurement errors good enough for group comparisons but of limited utility for individual comparisons. They seem to measure related but dissimilar constructs and the HRNT seemed better at discriminating individuals with and without NP and easier to perform in clinical practice.

13 B. TMJ/ORAL

Correlation found between periodontitis and knee OA

Association of periodontitis with radiographic knee osteoarthritis.

Kim JW[1,2], Chung MK[3], Lee J[1], Kwok SK[1], Kim WU[1], Park SH[1], Ju JH[1].

BACKGROUND:
To examine whether periodontitis is associated with the presence and severity of radiographic knee osteoarthritis (OA).

METHODS:
Using data from the Korea National Health and Nutrition Examination Survey between 2010 and 2013, participants over the age of 50 were included in this study. Dental examinations and knee radiographs are performed in participants aged ≥50 years in this cohort. Periodontitis was defined using the community periodontal index, which was determined by measuring periodontal pocket depth. The definition of radiographic knee OA was based on the Kellgren-Lawrence (K-L) grading system, which determined a K-L grade ≥2 to be radiographic knee OA. The associations between periodontitis and presence and severity of radiographic knee OA were examined using logistic regression analyses.

RESULTS:
Among 7,969 total participants, 965 men and 2,078 women had radiographic knee OA. Periodontitis was observed in 1,185 (39.4%) people among those who had radiographic knee OA. Periodontitis (adjusted odds radio [aOR] 1.21, 95% confidence interval 1.05-1.40) was associated with radiographic knee OA after adjusting for variables including age, sex, body mass index, socioeconomic status, diabetes, and dental status. Participants were more likely to have radiographic knee OA as the severity of periodontitis increased (non-severe periodontitis, aOR 1.14 [0.98-1.32]; severe periodontitis, aOR 1.47 [1.17-1.85]). Moreover, the presence of periodontitis significantly increased with an increasing K-L grade (grade 1, aOR 1.30 [1.09-1.54]; grade 2, aOR 1.32 [1.08-1.60]; grade 3, aOR 1.39 [1.14-1.70]; grade 4, aOR 1.45 [1.11-1.90]).

CONCLUSION:
Periodontitis is associated with the presence and severity of radiographic knee OA. This article is protected by copyright. All rights reserved.

13 C. AIRWAYS/SWALLOWING/SPEECH

Relationship of sleep deprivation and suicide in adolescents

Associations between sleep duration and suicidality in adolescents: A systematic review and dose-response meta-analysis.

Chiu HY[1], Lee HC[2], Chen PY[3], Lai YF[4], Tu YK[5].

Sleep duration has received considerable attention as a potential risk factor of suicidality in youths; however, evidence on the dose-response association between sleep duration and suicidality has not been synthesized.

This meta-analysis examined linear and nonlinear dose-response relationships between sleep duration and the risk of suicidality in adolescents and explored potential moderators of the associations. Electronic databases, namely EMBASE, PubMed, PsycINFO, ProQuest Dissertations & Theses A&I Wanfang Data (Chinese database), and the China Knowledge Resource Integrated Database, were searched from their inception to April 18, 2017. Studies examining the association between sleep duration and suicidality in adolescents were included. A random-effects dose-response model was used to estimate the linear and nonlinear dose-response relationships. We identified 13 reports that included a total of 598,281 participants for a systematic review, and 12 reports were further used for a dose-response meta-analysis. Strong curvilinear dose-response associations were obtained for both suicidal ideation and attempts, with the lowest suicidal ideation and attempt risks at sleep durations of 8 h and 8-9 h per day (all $P_{nonlinearity} < 0.001$). A linear dose-response relationship between sleep duration and suicide plans (pooled OR = 0.89, 95% confidence interval [CI] = 0.88-0.90) was obtained, indicating that the risk of suicide plans statistically decreased by 11% for every 1-h increase in sleep duration. Depression did not moderate the association between sleep duration and suicidality in youths.

Our findings suggest curvilinear dose-response associations between sleep duration and the risks of suicidal ideation and attempts and a linear dose-response relationship between sleep duration and suicide plan risk. Additional longitudinal studies are warranted to establish causality.

Light, sleep and weight gain

Association of Exposure to Artificial Light at Night While Sleeping With Risk of Obesity in Women.

Park YM[1], White AJ[1], Jackson CL[1], Weinberg CR[2], Sandler DP[1].

IMPORTANCE:
Short sleep has been associated with obesity, but to date the association between exposure to artificial light at night (ALAN) while sleeping and obesity is unknown.

OBJECTIVE:To determine whether ALAN exposure while sleeping is associated with the prevalence and risk of obesity.
DESIGN, SETTING, AND PARTICIPANTS: This baseline and prospective analysis included women aged 35 to 74 years enrolled in the Sister Study in all 50 US states and Puerto Rico from July 2003 through March 2009. Follow-up was completed on August 14, 2015. A total of 43 722 women with no history of cancer or cardiovascular disease who were not shift workers, daytime sleepers, or pregnant at baseline were included in the analysis. Data were analyzed from September 1, 2017, through December 31, 2018.
EXPOSURES:Artificial light at night while sleeping reported at enrollment, categorized as no light, small nightlight in the room, light outside the room, and light or television in the room.
MAIN OUTCOMES AND MEASURES:
Prevalent obesity at baseline was based on measured general obesity (body mass index [BMI] ≥30.0) and central obesity (waist circumference [WC] ≥88 cm, waist-to-hip ratio [WHR] ≥0.85, or waist-to-height ratio [WHtR]≥0.5). To evaluate incident overweight and obesity, self-reported BMI at enrollment was compared with self-reported BMI at follow-up (mean [SD] follow-up, 5.7 [1.0] years). Generalized log-linear models with robust error variance were used to estimate multivariable-adjusted prevalence ratios (PRs) and relative risks (RRs) with 95% CIs for prevalent and incident obesity.

RESULTS:
Among the population of 43 722 women (mean [SD] age, 55.4 [8.9] years), having any ALAN exposure while sleeping was positively associated with a higher prevalence of obesity at baseline, as measured using BMI (PR, 1.03; 95% CI, 1.02-1.03), WC (PR, 1.12; 95% CI, 1.09-1.16), WHR (PR, 1.04; 95% CI, 1.00-1.08), and WHtR (PR, 1.07; 95% CI, 1.04-1.09), after adjusting for confounding factors, with P < .001 for trend for each measure. Having any ALAN exposure while sleeping was also associated with incident obesity (RR, 1.19; 95% CI, 1.06-1.34). Compared with no ALAN, sleeping with a television or a light on in the room was associated with gaining 5 kg or more (RR, 1.17; 95% CI, 1.08-1.27; P < .001 for trend), a BMI increase of 10% or more (RR, 1.13; 95% CI, 1.02-1.26; P = .04 for trend), incident overweight (RR, 1.22; 95% CI,1.06-1.40; P = .03 for trend), and incident obesity (RR, 1.33; 95% CI, 1.13-1.57; P < .001 for trend). Results were supported by sensitivity analyses and additional multivariable analyses including potential mediators such as sleep duration and quality, diet, and physical activity.

CONCLUSIONS AND RELEVANCE:
These results suggest that exposure to ALAN while sleeping may be a risk factor for weight gain and development of overweight or obesity. Further prospective and interventional studies could help elucidate this association and clarify whether lowering exposure to ALAN while sleeping can promote obesity prevention.

14. HEADACHES

Vit D deficiency and HA's

The potential role of serum vitamin D level in migraine headache: a case–control study

Authors Hussein M, Fathy W, Abd Elkareem RM
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Purpose: Much concern was directed toward exploring the relationship between vitamin D and migraine. There is strong evidence that vitamin D supplementation can decrease frequency, severity, and duration of migraine headache attacks. The aim of this work was to investigate the difference in serum levels of 25 (OH)-vitamin D between patients with migraine and healthy controls, to determine the differences in headache characteristics according to vitamin D status, and to correlate serum 25 (OH)-vitamin D level with duration, frequency, and severity of migraine headache attacks.

Patients and methods: This is a case–control study conducted on 40 patients diagnosed with migraine and 40 healthy controls. History was taken from patients with migraine regarding headache characteristics. Migraine severity scale (MIGSEV) and Headache Impact Test-6 (HIT-6) were used for migraine assessment. Serum 25(OH)-vitamin D was measured for all patients and controls using enzyme-linked immunosorbent assay (ELISA).

Results: Patients with migraine had significantly lower 25(OH)-vitamin D serum level in comparison to controls (P-value=0.019). The incidence of aura, phonophobia/photophobia, autonomic manifestations, allodynia, and resistance to medications were significantly higher in migraineurs with vitamin D deficiency than those with normal vitamin D. There was a statistically significant negative correlation between 25(OH)-vitamin D serum level and attack duration in hours (P-value<0.001), frequency of the attacks/month (P-value<0.001), MIGSEV scale (P-value=0.001), and HIT-6 scale (P-value=0.001).

Conclusion: Patients with migraine had significant vitamin D deficiency compared to healthy controls. Such deficiency significantly affects headache characteristics, duration, frequency, and severity of headache attacks.

20 A. ROTATOR CUFF

Predicting RC tears

The Effectiveness of Using the Critical Shoulder Angle and Acromion Index for Predicting Rotator Cuff Tears: Accurate Diagnosis Based on Standard and Nonstandard Anteroposterior Radiographs

panelYiyongTangM.D.JingyiHouM.D.QingyueLiM.D.FangqiLiM.D.CongdaZhangM.D.Weiping LiM.D.RuiYangM.D.

Purpose

To explore whether the critical shoulder angle (CSA) and acromion index (AI) on nonstandard anteroposterior (AP) radiographs could be used as parameters for rotator cuff tear (RCT) diagnosis and to determine the optimized parameters.

Methods

This study included 174 patients with RCTs or intact rotator cuffs in whom AP radiographs were obtained at our hospital. The radiographs were assessed by 2 independent radiologists and were grouped according to the Suter-Henninger criteria. The CSA and AI were measured on all films. We performed receiver operating characteristic curve analysis by calculating the area under the curve (AUC) to compare the sensitivity and accuracy of both parameters.

Results

Of the 174 enrolled patients, only 47 (27%) met the requirements for standard AP films (types A1 and C1). On standard AP films, both the CSA and AI were significantly different between the RCT and control groups ($P < .001$ for CSA and $P < .001$ for AI), with AUCs of 0.86 and 0.80 for the CSA and AI, respectively. On nonstandard AP films (other radiograph types), the mean CSA value was not significantly different between the RCT and control groups ($P = .536$) whereas the AI showed a significant difference ($P = .024$). The AUCs were 0.57 for the CSA and 0.64 for the AI.

Conclusions

On standard AP films, both the CSA and AI could predict rotator cuff disorders, and the CSA had a higher diagnostic accuracy than the AI. In contrast, on nonstandard AP films, the diagnostic efficacy of the AI was better than that of the CSA. On the basis of this study, we suggest an evaluation of the AP films of patients before diagnosis to confirm whether the AP films meet the criteria for standard AP films.

Level of Evidence

Level I, diagnostic study.

32 A. KNEE/ACL

Teenage risk of revision

Risk for Revision After Anterior Cruciate Ligament Reconstruction Is Higher Among Adolescents

Results From the Danish Registry of Knee Ligament Reconstruction
Peter Faunø, MD,[*†] Lene Rahr-Wagner, MD,[†] and Martin Lind, MD, PhD[†]

Background: The number of children and adolescents with anterior cruciate ligament (ACL) reconstructions is increasing, and disturbing reports on high rerupture rates in this group have been noted.

Purpose: To describe the outcome of ACL reconstruction in children and adolescents based on data from the Danish Knee Ligament Reconstruction Registry (DKRR).

Study Design: Cohort study; Level of evidence, 3.

Methods: Data were retrieved from the DKRR, a national population-based registry. The analysis was based on a population of 14,806 ACL-reconstructed patients. The outcome was evaluated using risk of ACL revision, subjective outcome score (Knee injury and Osteoarthritis Outcome Score [KOOS]), Tegner function score, and objective knee laxity. Three age groups were defined (A, <13 years; B, 13-15 years; and C, 15-20 years) and compared with D, patients ≥20 years (adults). There were 95 patients in group A, 327 in B, 2888 in C, and 11,496 in D.

Results: There was a significantly increased risk of revision surgery in the age groups B (6.7%) and C (4.9%) compared with the adults in group D (2.0%). Objective knee laxity did not differ between the 4 groups. Groups A, B, and C had a higher score on the combined KOOS symptoms, pain, sport, and quality of life subscales (KOOS4; 79.6, 76.6, and 73.1, respectively) compared with the adults (69.7). Group B had higher KOOS quality of life (76.6) and sports (71.1) scores than did group C (73.1 and 66.4, respectively). The Tegner activity score did not differ between the 4 groups. No impact of the use of extracortical graft fixation was detected in the youngest age group.

Conclusion: Study results indicated an increased risk of graft failure in patients between 13 and 20 years of age. This is in contrast to the better subjective and equal objective knee score found in the same age groups.

Clinical Relevance: The new knowledge about the high revision rate among ACL-reconstructed teenagers is important for evidence-based preoperative information of ACL patients and their parents.

High Risk of Further ACL Injury in a 10-Year Follow-up Study of ACL-Reconstructed Soccer Players in the Swedish National Knee Ligament Registry

panelAlexanderSandonM.D.[a]BjörnEngströmM.D.[b]MagnusForssbladM.D.[c]

Purpose

To follow up on soccer players 10 years after a primary anterior cruciate ligament (ACL) reconstruction to find out how many players returned to play soccer, what influenced their decision, and if there are any differences in additional ACL injuries (graft failure and/or contralateral ACL injury) between those who returned to play and those who did not.

Methods

The study cohort consists of 1661 soccer players from the Swedish National Knee Ligament Registry. A questionnaire was sent to each player regarding their return to play and additional knee injuries that may have occurred 10 years after their primary ACL. The results are based on the 684 responders. Data such as age, sex, surgical procedural data, associated injuries, patient-reported outcome measures, and additional knee surgeries were collected from the registry.

Results

In this study, 51% returned to play soccer. For those who did not return to play, the primary reason was knee related (65.4% of the cases). The most common knee-related reasons for not returning were pain and/or instability (50%; n = 109), followed by fear of reinjury (32%; n = 69). Players who return to soccer have a significantly higher risk of additional ACL injury. Of the players who returned to play soccer, 28.7% (odds ratio [OR] 2.3, $P < .001$) had additional ACL injury, 9.7% (OR 2.9, $P < .001$) had a graft failure and 20.6% (OR 2.1, $P < .001$) had a contralateral ACL injury.

Conclusions

Players that return to soccer have a significantly higher risk of sustaining further ACL injury. Only half of the soccer players return to play after ACL reconstruction, and in two-thirds of those who did not return, the reason was knee related. The high risk of sustaining additional knee injury is of serious concern to the player's future knee health and should be considered when deciding on a return to play.

Meniscus with ACL

Second-Look Arthroscopic Evaluations of Meniscal Repairs Associated With Anterior Cruciate Ligament Reconstruction

Author links open overlay panelRyoKantoM.D.[ab]MotoiYamaguchiM.D., Ph.D.[a]KenSasakiM.D., Ph.D.[a]AkioMatsumotoM.D., Ph.D.[a]HiroshiNakayamaM.D., Ph.D.[b]ShinichiYoshiyaM.D., Ph.D.[b]

Purpose

To examine the healing status of meniscal repair performed concomitantly with anterior cruciate ligament (ACL) reconstruction with our current indication and surgical procedure based on second-look arthroscopic results. Additionally, the significance of the demographic and clinical factors that can potentially influence the healing rate was statistically assessed.

Methods

Between January 2009 and January 2015, second-look was performed for patients who opted to have tibial screw removal and agreed to have concomitant arthroscopy. The healing status of the repaired meniscus was classified into 3 conditions: healed, incompletely healed, and not healed. In addition, clinical outcomes were evaluated at a minimal 1-year follow-up. The effects of patient factors on the meniscal healing rate were statistically assessed.

Results

A total of 217 knees underwent arthroscopic meniscal repair concomitant with ACL reconstruction, while second-look was performed for 105 knees. The average period from index surgery to second-look was 15.0 months. Clinical evaluation was conducted at a mean of 17 months (12-50 months). Based on the second-look arthroscopic findings, 64 menisci, 22 menisci, and 29 menisci were categorized as healed, incompletely healed, and not healed, respectively. When the not healed condition was defined as failed repair, a Tegner activity score of 8 or more, recurrent instability, tears in the red-white to white-white zones, and time from injury to surgery of 4 months or longer were identified as clinical factors significantly correlated with failure ($P < .01$).

Conclusions

Meniscal repair in ACL reconstructed knees with expanded indications achieved a healing rate (including incomplete healing) of 75%. Clinical factors such as high sports activity level, recurrent ACL instability, poor vascularity of the repaired site, and long duration from injury to surgery were shown to impair the healing status.

46 B. LOWER LIMB NEUROMOILIZATION

SLR mobility

Differential movement of the sciatic nerve and hamstrings during the straight leg raise with ankle dorsiflexion: Implications for diagnosis of neural aspect to hamstring disorders.

Bueno-Gracia E[1], Pérez-Bellmunt A[2], Estébanez-de-Miguel E[3], López-de-Celis C[2], Shacklock M[4], Caudevilla-Polo S[3], González-Rueda V[2].

INTRODUCTION:
In hamstrings injuries, sciatic nerve and muscle disorders can coexist. Therefore, differential diagnosis to include or exclude nerve involvement is an important aspect of evaluation. The objective of this paper is to investigate the mechanical behavior of the sciatic nerve and biceps femoris muscle in the proximal thigh with the ankle dorsiflexion maneuver at different degrees of hip flexion during the straight leg raise in cadavers.

MATERIAL AND METHODS:
A cross-sectional study was carried out. Linear displacement transducers were inserted into the sciatic nerve and the biceps femoris muscle of 11 lower extremities from 6 fresh cadavers to measure potential strain of both structures during ankle dorsiflexion at 0°, 30°, 60° and 90° of hip flexion during the straight leg raise. Excursion was also measured with a digital calliper.

RESULTS:
Ankle dorsiflexion resulted in significant strain and distal excursion of the sciatic nerve at all ranges of hip flexion during the straight leg raise (p < 0.05). In contrast, the ankle movement did not affect the strain in biceps femoris at any position of the hip (p > 0.05).

CONCLUSION:
Ankle dorsiflexion at different degrees of hip flexion during the straight leg raise produces changes in the strain and excursion of the sciatic nerve in the upper thigh. In contrast, the biceps femoris muscle at the same location was not affected by ankle movement. These findings show differential behaviour between the nerve and muscle with ankle dorsiflexion at this location that could be used as differential diagnosis in posterior hip pain.

51. CFS/BET

LBP and body mechanics

Risk and Prognostic Factors of Low Back Pain: Repeated Population-based Cohort Study in Sweden.

Halonen JI[1,2], Shiri R[2], Magnusson Hanson LL[1], Lallukka T[2,3].

STUDY DESIGN:
Prospective longitudinal cohort study.

OBJECTIVE:
To determine the associations for workload and health-related factors with incident and recurrent low back pain (LBP), and to determine the mediating role of health-related factors in associations between physical workload factors and incident LBP.

SUMMARY OF BACKGROUND DATA:
It is not known whether the risk factors for the development of LBP also prognostic factors for recurrence of LBP are and whether the associations between physical workload and incident LBP are mediated by health-related factors. We used data from the Swedish Longitudinal Occupational Survey of Health study. Those responding to any two subsequent surveys in 2010 to 2016 were included for the main analyses (N=17,962). Information on occupational lifting, working in twisted positions, weight/height, smoking, physical activity, depressive symptoms, and sleep problems were self-reported. Incident LBP was defined as pain limiting daily activities in the preceding three months in participants free from LBP at baseline. Recurrent LBP was defined as having LBP both at baseline and follow-up. For the mediation analyses, those responding to three subsequent surveys were included (N=3516).

METHODS:
Main associations were determined using generalized estimating equation models for repeated measures data. Mediation was examined with counterfactual mediation analysis.

RESULTS:
All risk factors at baseline but smoking and physical activity were associated with incident LBP after adjustment for confounders. The strongest associations were observed for working in twisted positions (risk ratio =1.52, 95% CI 1.37, 1.70) and occupational lifting (risk ratio =1.52, 95% CI 1.32, 1.74). These associations were not mediated by health-related factors. The studied factors did not have meaningful effects on recurrent LBP.

CONCLUSION:
The findings suggest that workload and health-related factors have stronger effects on the development than on the recurrence or progression of LBP, and that health-related factors do not mediate associations between workload factors and incident LBP.

LEVEL OF EVIDENCE:3.

55. SCOLIOSIS

Vibration impact

Differential response to vibration of three forms of scoliosis during axial cyclic loading: a finite element study.

Jia S[1,2], Li Y[3], Xie J[2], Tian T[4], Zhang S[2], Han L[5].

BACKGROUND:
Scoliosis is a serious disease that can affect all segments of society. Few studies have investigated the response to vibration of differing sinusoidal axial cyclic loading frequencies for different forms of scoliosis in the lumbar spine.

METHODS:
In this study, four finite element models, comprising a healthy spine, Lenke-A, Lenke-B and Lenke-C scoliosis of the lumbar S1-L1 region were developed. Modal analysis extracted resonant frequencies of the FE models with an upper body mass of 40 kg and 400 N preload. A transient dynamic analysis was performed to obtain the response to vibration of models under a sinusoidal axial loading of ± 40N at frequencies of 3, 5, 7, 9, 11 and 13 Hz using an upper body mass of 40 kg and 400 N preload.

RESULTS:
The first-order resonant frequencies of healthy, Lenke-A, Lenke-B and Lenke-C spines were 9.2, 3.9, 4.6 and 5.7 Hz, respectively. A Lenke-A lumbar spine was more likely to deform at a lower vibration frequency and Lenke-C deformed more easily at a higher vibration frequency. Furthermore, the vibration amplitude in the Y-direction (left-right) was greatest and least in the Z-direction (top-bottom). The frequency of cyclic loading closest to the resonant frequency resulted in a maximum value of peak-to-peak vibrational displacement. Furthermore, the vibrational amplitudes in patients with scoliosis were larger than they were in healthy subjects. In addition, axial displacement of the vertebrae in the healthy spine changed steadily whereas fluctuations in the scoliotic vertebrae in scoliosis patients were greater than that of other vertebrae.

CONCLUSIONS:
Different forms of scoliosis may have different vibrational characteristics, the scoliotic vertebrae being the weak link in scoliosis under loading condition of whole-body vibration. Scoliosis was more sensitive to this form of vibration. Where the frequency of axial cyclic vibrational loading of the lumbar spine was closer to its resonant frequency, the vibrational amplitude was larger. These results suggest that vibration will exacerbate the degree of scoliosis and so such patients should reduce their exposure to vibration. Clinical treatment should pay attention to the scoliotic vertebrae and reduce their vibration. These findings may assist in the clinical prevention and treatment of scoliosis.