DOES HIP SHAPE ASSOCIATE WITH HIP PAIN AND EARLY
279
indoor clothes using a health meter (HN-286; Omron, Kyoto, Japan) and a
during the interview. Body weight and height were measured in light
economic (i.e., annual income), and lifestyle factors (i.e., cigarette
socio-demographic factors (i.e., age, sex, living address, education), socio-
the survey questionnaires and physical examination. Information on
SxOA using data collected from a national population survey in China.
consistent. We examined the association between cigarette smoking and knee
however, its effect on symptomatic knee OA (SxOA) has not been con-
Purpose: Study of bone morphologic features of the hip can be used to
predict hip fractures, total hip replacement (THR) and radiological hip
OA (ROA). However, limited data exists on this concept. Here we
describe associations between hip shape and features of hip OA in a
large community based sample.
Methods: Baseline dual energy X-ray absorptiometry (DXA) images of
left hip of 831 subjects from the Tasmanian Older Adult Cohort (TASOAC)
were included. An 85-point hip shape model was generated from the
DXA images using the active shape modeling (ASM) toolkit
(Manchester University UK) and Shape software (University of Aber-
deen, UK). Modes 1-6, in decreasing order of variance in modes were
extracted. Within the dataset each mode was normalized and is inde-
pendent of other modes; thus every mode (from 1-6) is an independent
descriptor of hip shape. Hip pain was assessed by WOMAC. Lower limb
muscle strength was measured by dynamometer and hip fracture was
self reported. Presence of hip cartilage defects, hip bone marrow lesions
(BMLs), hip cartilage volume and hip effusion cross-sectional area (CSA)
were assessed using MRI. Joint space narrowing (JSN, 0-3) and osteo-
phytes (0-3) were assessed on x-ray using the Outerbridge’s atlas. Log
binomial regression (STATA 12, Texas, USA) was used to estimate the associations
of hip shape and data were adjusted for age, sex and BMI accordingly.
Results: The first six shape modes extracted from the dataset, describe
68% of shape variation in this study sample. In comparison to the rest of
the modes, characteristic differences were most prominent for subjects
with modes 1 and 2 shape variation. Shape mode 1 was associated with
leg strength (PR:3.66 95%CI:1:40-5.94), presence of effusion (PR:1.28
95%CI:1.02-1.62), hip cartilage volume (beta:263.3 95%CI:103.3-421.4).
Mode 2 did not associate with presence of hip pain but with worsening
hip pain in those with greater BMI (PR:3.50 95%CI:0.20-6.79). Mode 3
did not show any associations. Mode 4 was associated with lower
prevalence of both hip fractures (PR:0.40 95%CI:0.20-0.96) and pres-
ence of hip BMLs (PR:0.63 95%CI:0.42-0.93). Mode 5 was not associated
with any structural or radiological features while mode 6 associated with
higher prevalence of ROA (PR:1.14 95%CI:1.05-1.30).
Conclusions: Each mode describes independent attributes of the shape
and can be used to study specific features of hip OA. In this sample, shape
of the hip is associated with clinical, structural and radiological features.
Moreover, modes 1 and 2 in this model describe 45% of the total variance
and are associated with measures of bone, cartilage and muscle and with
worsening pain. Mode 6 was a good descriptor of radiographic OA.

THE ASSOCIATION BETWEEN CIGARETTE SMOKING AND
SYMPTOMATIC KNEE OSTEOARTHRITIS IN CHINA: RESULTS
FROM CHINA HEALTH AND RETIREMENT LONGITUDINAL STUDY

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Purpose: Several studies have reported that cigarette smoking was asso-
ciated with a decreased risk of radiographic knee osteoarthritis (OA);
however, its effect on symptomatic knee OA (SxOA) has not been con-
sistent. We examined the association between cigarette smoking and knee
SxOA using data collected from a national population survey in China.
Methods: China Health and Retirement Longitudinal Study (CHARLS) is a
population-based longitudinal survey among Chinese retired popu-
lated persons aged 45 years and their spouse (n=1708) were
interviewed in 150 randomly selected communities among China during
2011-2012. Trained health professionals went door-to-door to administer
the survey questionnaires and physical examination. Information on
socio-demographic factors (i.e., age, sex, living address, education), socio-
economic (i.e., annual income), and lifestyle factors (i.e., cigarette
smoking—alcohol consumption) and medical history were collected
during the interview. Body weight and height were measured in light
indoor clothes using a health meter (HN-286; Omron, Kyoto, Japan) and a
stadiometer (Seca 213; Seca, Hamburg, Germany), respectively. Body
mass index (BMI) was calculated by dividing the weight in kilograms by
height in meter square. Specifically, each participant was asked their
current smoking status (i.e., current smoker, former smoker, or never
smoker). Current smokers were further asked on average how many
cigarettes they smoked per day. Participants were asked whether they
had knee pain at the time of the interview and whether they had been
diagnosed arthritis by a physician. We define a subject as having SxOA if
he/she responded to both questions positively.
We divided participant’s smoking status into 3 groups: never smoker,
former smoker and current smokers. For the current smokers we fur-
ther grouped them into 3 categories according to the daily number of
cigarettes smoked (i.e., men: <10, 10-19, ≥20 cigarettes per day;
women: <5, 5-9, ≥10 cigarettes per day). We used the PROC SURVEY-
FREQ procedure (SAS 9.2; SAS Institute, Cary, NC, USA) to obtain the sex-
specific prevalence of knee SxOA according to smoking status as well as
categories of numbers of cigarettes smoked per day. We used the PROC
SURVEYLOGISTIC procedures (SAS 9.2) to examine the relation of
smoking status and number of cigarettes smoked per day to the prev-
alence of knee SxOA adjusting for age, BMI, regions (north vs. south
China), localities (rural vs. urban), education, and annual income. Both
PROC SURVEYFREQ and PROC SURVEYLOGISTIC procedures took into
account the complex survey design and non-response rate of CHARLS
survey in both estimates and the corresponding standard errors (S.E).
Results: Of 13045 participants (mean age: 59.5 years, women: 50.4%,
mean BMI: 23.9 kg/m2), prevalence of never, former and current
smokers was 25.5%8.18.4%,56.1% in men, and 91.9%2.4%,5.7% in
women. As shown in Table 1 prevalence of SxOA was 4.7% in the
never smokers, 5.9% in the former smokers, and 6.5% in the current
smokers in men, respectively. The corresponding prevalence of SxOA in
women was 10.2%,14.0% and 12.6%, respectively. After adjusting for age,
north/south China, rural/urban areas, education level and annual
income, neither current smokers (OR=1.28, 95% CI: 0.97-1.69) nor for-
mer smokers (OR=1.32, 95% CI: 0.89-1.95) had an increased prevalence
of knee SxOA when compared with the never smokers in men. Similar
results were also observed in women. There was no apparent dose-
response relationship between number of cigarettes smoked per day
and prevalence of knee SxOA among current smokers (Table 2). Further
adjustment for BMI did not change the results materially.

Conclusions: In this large population-based cross-sectional survey
conducted in China we didn’t find an association between cigarette
smoking and prevalence of knee SxOA.

<table>
<thead>
<tr>
<th>Cigarette smoking</th>
<th>Number of subjects</th>
<th>Prevalence of SxOA(%)</th>
<th>Multivariable adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>1555</td>
<td>4.7</td>
<td>1.00</td>
</tr>
<tr>
<td>Former</td>
<td>1021</td>
<td>5.9</td>
<td>1.32 (0.89-1.95)</td>
</tr>
<tr>
<td>Current</td>
<td>3637</td>
<td>6.5</td>
<td>1.28 (0.97-1.69)</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>6231</td>
<td>10.2</td>
<td>1.00</td>
</tr>
<tr>
<td>Former</td>
<td>159</td>
<td>14.0</td>
<td>1.28 (0.76-2.21)</td>
</tr>
<tr>
<td>Current</td>
<td>442</td>
<td>12.6</td>
<td>1.11 (0.76-1.65)</td>
</tr>
<tr>
<td><strong>P value</strong></td>
<td></td>
<td></td>
<td>0.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cigarette smoking</th>
<th>Number of subjects</th>
<th>Prevalence of SxOA(%)</th>
<th>Multivariable adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>1555</td>
<td>4.7</td>
<td>1.00</td>
</tr>
<tr>
<td>Former</td>
<td>1021</td>
<td>5.9</td>
<td>1.32 (0.89-1.96)</td>
</tr>
<tr>
<td>Current</td>
<td>10</td>
<td>5.5</td>
<td>1.25 (0.75-2.06)</td>
</tr>
<tr>
<td>10-19</td>
<td>551</td>
<td>5.5</td>
<td>1.17 (0.75-1.82)</td>
</tr>
<tr>
<td>≥20</td>
<td>1712</td>
<td>5.9</td>
<td>1.24 (0.87-1.76)</td>
</tr>
<tr>
<td>Missing</td>
<td>939</td>
<td>8.7</td>
<td>1.52 (1.09-2.13)</td>
</tr>
<tr>
<td><strong>P value</strong></td>
<td></td>
<td></td>
<td>0.43</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td>6231</td>
<td>10.2</td>
<td>1.00</td>
</tr>
<tr>
<td>Former</td>
<td>159</td>
<td>14.0</td>
<td>1.28 (0.74-2.20)</td>
</tr>
</tbody>
</table>
NATURAL HISTORY AND RISK FACTORS OF RADIOGRAPHIC KNEE OSTEOARTHRITIS: WUCHUAN OSTEOARTHRITIS STUDY

Purpose: To describe risk of radiographic knee osteoarthritis (ROA) worsening and to examine the risk factors for ROA worsening in a population-based longitudinal study.

Methods: Wuchuan Osteoarthritis Study was a population-based longitudinal study of natural history of knee osteoarthritis and its risk factors. Between August and October 2005, 1025 residents aged ≥50 years were recruited using door-to-door enumeration in randomly selected rural communities in Wuchuan, China, and were followed until November 2013. At baseline and follow-up visits, subjects completed a home interview (including socio-demographic factors, history of knee injury, joint symptoms, physical activity and work history) and had a clinical examination including height, weight, and height-bearing postureantero inferior semiview of radiographs at tibiofemoral (TF) joints. Knee radiographs were read by one investigator according to Kellgren and Lawrence (K/L) criteria. Reader was blinded to the time sequence of knee radiographs. For each batch of Wuchuan OA Study films (n=100), 10 films from the Osteoarthritis Initiatives (OAI) were added to test inter-reader reliability. In addition, 10 previously read knee radiographs from the Wuchuan OA Study were fed back to the reader to test intra-reliability. Kappa statistics for inter-reader and intra-reader reliability were 0.86 and 0.92 respectively. We defined a knee as having K/L grade worsening if its K/L grade increased by at least 1 grade except for the change from 0 to 1 during follow-up. We used logistic regression to examine the association of each risk factor at baseline (i.e. age, sex, Body Mass Index (BMI), education levels, history of knee injury, and duration of each physical activities) to the risk of K/L grade worsening. Generalized estimating equation was used to account for the correlation between two knees.

Results: Of 1,025 participants (2050 knees) in the original study, 389 (38%) did not participate follow-up visit owing to lost to follow-up (n=290) or death (n=99), 7 knees with K/L grade 4 at baseline were excluded from analysis. Of 635 subjects (1265 knees) who had the follow-up visit and with K/L grade ≤3 at baseline (women: 50.7%, mean age at baseline: 55.1 years), 208 (18.5%) knees with K/L grade ≤1 at baseline (n=1124) developed incident ROA (i.e. K/L grade increased to ≥2) and 71 (50.4%) knees with K/L grade 2 or 3 at baseline (n=141) developed progressive ROA (i.e. K/L grade increased ≥1 grade) over 8 years of follow-up. 279 (22.1%) knees’ K/L grade worsened during follow-up period. As shown in Table 1, female gender (odds ratio (OR) = 1.8, 95% confidence interval (CI): 1.3-2.6), older age (OR for 5-year difference = 1.3, 95% CI: 1.2-1.5), and higher BMI (OR for 1-unit increase = 1.1, 95% CI: 1.0-1.2) were strongly associated with risk of K/L grade worsening. However, no apparent association was found between education, history of knee injury and K/L grade worsening. Longer duration of standing, walking, walking on bumpy road, and job involved in digging were associated with higher risk of K/L grade worsening (OR ranges from 1.8 to 2.1). Bending, kneeling, squatting, and lifting heavy objects were not significantly associated with K/L grade worsening.

Conclusions: In this population-based longitudinal study conducted among residents in rural areas, China, incidence of knee radiographic worsening was high. Several previously reported risk factors for knee ROA were also associated with knee radiographic worsening among Chinese population.

Table 1. Association between each risk factor and risk of knee K/L grade worsening.

<table>
<thead>
<tr>
<th>Potential risk factors</th>
<th>Level</th>
<th>N (% of knees with K/L grade worsening</th>
<th>Adjusted OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>5 years</td>
<td>1.3 (1.2, 1.5)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>BMI (1 kg/m²)</td>
<td></td>
<td>1.1 (1.0, 1.2)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>primary school</td>
<td>1.3 (1.2, 1.5)</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>middle school or above</td>
<td>1.1 (1.0, 1.2)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Women</td>
<td>1.3 (1.1, 1.5)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>History of knee injury</td>
<td>No</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>1.4 (1.3, 1.6)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Duration of physical activity at work, year</td>
<td>2 hours per day</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>1.5 (1.3, 1.7)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.7, 2.2)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Working on bumpy road</td>
<td>2 hours per day</td>
<td>1.2 (1.0, 1.4)</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>1.4 (1.2, 1.7)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.6, 2.3)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Digging</td>
<td>2 hours per day</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-39</td>
<td>1.2 (1.0, 1.4)</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.7, 2.2)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Bending</td>
<td>2 hours per day</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>1.2 (1.0, 1.4)</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.7, 2.3)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Kneeling</td>
<td>30 minutes per day</td>
<td>1.1 (1.0, 1.3)</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.7, 2.3)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Squatting</td>
<td>30 minutes per day</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
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</tr>
<tr>
<td></td>
<td>40+</td>
<td>1.9 (1.7, 2.3)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Lifting</td>
<td>10kg object per day</td>
<td>1.0 (0.9, 1.1)</td>
<td>0.315</td>
<td></td>
</tr>
</tbody>
</table>

[1] Adjusting for each other