### SUPPLEMENTARY INFORMATION

**TABLE 1– HEIGHT, WEIGHT and BMI**

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rauh 2006&lt;sup&gt;14&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>421</td>
<td>14-8 yr</td>
<td>186 F / 235 M high school cross country runners</td>
<td>Injuries</td>
<td>• The overall incidence rate of injury was 17.0/1,000 AE. &lt;br&gt;• Runners with a BMI in the first (RR=0.8; 95% CI: 0.6, 1.1) and fourth (RR=1.1; 95% CI: 0.8, 1.5) quartiles had a similar injury risk as runners with a BMI in the combined second and third quartiles (reference group).</td>
<td>2</td>
</tr>
<tr>
<td>Yagi 2013&lt;sup&gt;15&lt;/sup&gt;</td>
<td>Cohort</td>
<td>230</td>
<td>14-18 yr</td>
<td>186 F / 235 M high school cross country runners</td>
<td>Shin pain (medial tibial stress syndrome &amp; stress fracture)</td>
<td>• Injury rate for medial tibial stress syndrome was 0.29/1000 AE (n=102) and for stress fracture was 0.06/1000 AE (n=21). &lt;br&gt;• In females, the odds of incurring medial tibial stress syndrome increased with BMI (adjusted OR, 0.51; 95% CI: 0.31, 0.86).</td>
<td>4</td>
</tr>
<tr>
<td>Plisky 2006&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>105</td>
<td>13-18 yr</td>
<td>46 F / 59 M high school cross country runners</td>
<td>Medial tibial stress syndrome</td>
<td>• Injury rate for medial tibial stress syndrome was 2.8/1000 AE overall &lt;br&gt;• Runners with a BMI in the third quartile (20.2-21.6 kg/m²) had 7.3 times greater odds of developing medial tibial stress syndrome (OR=7.3, 95% CI: 1.2, 43.5) than runners in the second quartile (18.8-20.1 kg/m² [reference group]).</td>
<td>2</td>
</tr>
<tr>
<td>Tenforde 2013&lt;sup&gt;17&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>748</td>
<td>13-18 yr</td>
<td>442 F / 306 M high school runners</td>
<td>Stress fractures</td>
<td>• Prospective stress fractures in 5.4% of girls (n = 23) and 4.0% of boys (n = 11). &lt;br&gt;• BMI &lt; 19 kg/m², (HR=2.67; 95% CI: 1.11, 6.41) was an independent risk factors for stress fractures in girls.</td>
<td>2</td>
</tr>
</tbody>
</table>

BMI, body mass index; HR, hazard ratio; OR, odds ratio; RR, rate ratio; CI, confidence interval; AE, athletic exposure
REFERENCES: TABLE 1– HEIGHT, WEIGHT and BMI


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<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Mehl 2011\(^4\) | Descriptive Epidemiology | 6327 | 6-18 yr | 3064 F / 3263 M runners | Injuries | • Overall annual injury was 30.7 injuries per 100,000 US population and increased 21.0% during the study period, from 24.2 injuries per 100,000 US population in 1994 to 29.3 injuries per 100,000 U.S. population in 2007.  
• Children aged 12-14 yr had the highest injury rate, 45.8 injuries per 100,000 US population. | 4 |
| Roberts 2010\(^8\) | Retrospective Cohort | 310 | 7-17 yr | 85 F / 225 M marathon runners | Medical encounters | • 310 youth successfully finished Twin Cities Marathon over 26 years with only 4 requiring post-race medical encounter.  
• The risk for an acute race day medical attention in youths was less than, but not significantly different from adults (odds ratio =0.52, 95% CI: 0.19, 1.39). | 4 |
| Rauh 2014\(^9\) | Prospective Cohort | 421 | 13-18 yr | 186 F / 235 M high school cross country | Injuries | • Age was not significantly different between runners who did (15.6±1.3 yr) and did not (15.6±1.1 yr) sustain an injury (\(P=0.80\)).  
For girls, age was not significantly different between runners who did (15.7±1.2 yr) and did not (15.6±1.1 yr) sustain an injury. (\(P=0.65\))  
For boys, age was not significantly different between runners who did (15.4±1.4 yr) and did not (15.6±1.2 yr) sustain an injury. (\(P=0.38\)) | 2 |
| Bennett 2001\(^20\) | Prospective Cohort | 125 | 13-18 yr | 68 F / 57 M high school cross country | Medial tibial stress syndrome | • Age was not significantly different between runners who did (15.3±1.0 yr) and did not (15.7±1.5 yr) develop medial tibial stress syndrome. | 4 |
| Huxley 2014\(^21\) | Prospective Cohort | 103 | 13-17 yr | 66 F / 34 M / 3 Unidentified Elite track and field | Injuries | • Injured athletes self-reported training at a higher weekly intensity and a higher yearly training load at 13-14 years (\(p<0.01\)) compared to uninjured athletes  
• Injured athletes reported training was ‘harder’ each week than uninjured athletes at 13-14 years (\(p<0.01\)), and at 15-16 years (\(p<0.05\)) | 4 |
REFERENCES: TABLE 2 – AGE


# TABLE 3 – SEX

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rauh 2006</td>
<td>Prospective Cohort</td>
<td>421</td>
<td>14-18 yr</td>
<td>186 F / 235 M</td>
<td>Injuries</td>
<td>• Girls had a higher overall injury rate (19.6/1,000 AEs) than boys did (15.0/1,000 AE) (incidence rate ratio=1.3, 95% CI: 1.0, 1.6).&lt;br&gt;• Compared with boys, girls had significantly higher rates of injuries resulting in ≥15 days of disability (incidence rate ratio=3.2, 95% CI: 1.4-8.0).</td>
<td>2</td>
</tr>
<tr>
<td>Plisky 2006</td>
<td>Prospective Cohort</td>
<td>105</td>
<td>13-18 yr</td>
<td>46 F / 59 M</td>
<td>Medial tibial stress syndrome</td>
<td>• Overall injury rate for girls was 4.3/1000 AE and for boys was 1.7/1000 AE (rate ratio=2.5, 95% CI: 0.9, 8.2).</td>
<td>2</td>
</tr>
<tr>
<td>Tenforde 2013</td>
<td>Prospective Cohort</td>
<td>748</td>
<td>13-18 yr</td>
<td>442 F / 306 M</td>
<td>Stress fractures</td>
<td>• 32 injuries occurred in 5.4% of girls (n=23).&lt;br&gt;• 12 injuries occurred in 4.0% of boys (n=11).</td>
<td>2</td>
</tr>
<tr>
<td>Bennett 2001</td>
<td>Prospective Cohort</td>
<td>125</td>
<td>13-18 yr</td>
<td>68 F / 57 M</td>
<td>Medial tibial stress syndrome</td>
<td>• Injuries occurred in 19.6% of girls and 3.6% of boys.&lt;br&gt;• Sex was associated with medial tibial stress syndrome ($\chi^2=7.15$, df = 1, p=0.007 with 24% of the variability in occurrence of injury is due to sex.</td>
<td>4</td>
</tr>
<tr>
<td>Tirabassi 2016</td>
<td>Descriptive Epidemiology</td>
<td>National database</td>
<td>high school aged</td>
<td>NA</td>
<td>Injuries (medical disqualification)</td>
<td>• Medial disqualification injury rates were higher among girls than boys for cross country (rate ratio=2.6; 95% CI: 1.0, 7.5) and track and field (rate ratio=2.6; 95% CI: 1.7, 4.0).</td>
<td>4</td>
</tr>
<tr>
<td>Changstrom 2015</td>
<td>Descriptive Epidemiology</td>
<td>389</td>
<td>13-19 yr</td>
<td>210 F / 179 M</td>
<td>Stress fractures</td>
<td>• Stress fracture injury rates for girls’ cross country (10.62/100,000 AE) was higher than boys’ cross country (5.42/100,000 AE) (rate ratio=1.75; 95% CI: 1.38, 2.23).</td>
<td>4</td>
</tr>
<tr>
<td>Reinking 2010</td>
<td>Prospective Cohort</td>
<td>125</td>
<td>13-18 yr</td>
<td>62 F / 63 M</td>
<td>Exercise-related leg pain</td>
<td>• No difference between girls and boys in occurrence of exercise-related leg pain (RR=0.93, 95% CI: 0.61, 1.42)</td>
<td>2</td>
</tr>
<tr>
<td>Rauh 2000</td>
<td>Prospective Cohort</td>
<td>3233</td>
<td>14-18 yr</td>
<td>1202 F / 2031 M</td>
<td>Injuries</td>
<td>• Girls had a higher injury rate (16.7/1,000 AE) than boys (10.9/1,000AE) (rate ratio=1.5, 95% CI: 1.4, 1.7).&lt;br&gt;• Girls had a higher rate of subsequent injury to the same body part (44.1/1,000 AE) than boys (37.6/1,000AE) (rate ratio=1.4, 95% CI: 1.2, 1.6).</td>
<td>2</td>
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<tr>
<td>Study</td>
<td>Study Design</td>
<td>Sample Size</td>
<td>Grade</td>
<td>Gender</td>
<td>Sport</td>
<td>Injuries</td>
<td>Notes</td>
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<tr>
<td>Beachy 1997&lt;sup&gt;26&lt;/sup&gt;</td>
<td>Descriptive Epidemiology</td>
<td>4,024</td>
<td>7th-12th grade</td>
<td>787 F /501 M high school &amp; middle school cross country</td>
<td>Injuries</td>
<td>Cross country: Injury occurrence for boys was 48% and girls was 47.0%.</td>
<td>4</td>
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<tr>
<td>McLain 1989&lt;sup&gt;27&lt;/sup&gt;</td>
<td>Descriptive Epidemiology</td>
<td>229</td>
<td>9th-12th grade</td>
<td>40 F / 54 M high school cross country</td>
<td>Injuries</td>
<td>Cross country: Injury occurrence for boys was 13.0% and girls was 7.5%.</td>
<td>4</td>
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<tr>
<td>Lowe 1987&lt;sup&gt;28&lt;/sup&gt;</td>
<td>Descriptive Epidemiology</td>
<td>634</td>
<td>9th-12th grade</td>
<td>63 F /125 M high school cross country</td>
<td>Injuries</td>
<td>Cross country: Injury occurrence for boys was 1.6% and girls was 1.6%.</td>
<td>4</td>
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<tr>
<td>Chandy 1985&lt;sup&gt;29&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>12,920</td>
<td>9th-12th grade</td>
<td>711 F /1567 M high school cross country</td>
<td>Injuries</td>
<td>Cross country: Injury occurrence for boys was 1.5% and girls was 1.1%.</td>
<td>4</td>
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<tr>
<td>Shively 1981&lt;sup&gt;30&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>3,399</td>
<td>9th-12th grade</td>
<td>187 F /389 M high school cross country</td>
<td>Injuries</td>
<td>Cross country: Injury occurrence for boys was 2.3% and girls was 0.0%.</td>
<td>4</td>
</tr>
<tr>
<td>Study</td>
<td>Type</td>
<td>Participants</td>
<td>Grade</td>
<td>Activity</td>
<td>Injuries</td>
<td></td>
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<tr>
<td>Garrick</td>
<td>Prospective Cohort</td>
<td>167</td>
<td>9th-12th</td>
<td>High school cross country</td>
<td>Injury occurrence for boys was 29.1% and girls was 34.6%.</td>
<td></td>
<td></td>
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<tr>
<td>Pierpoint</td>
<td>Descriptive Epidemiology</td>
<td>NA</td>
<td>9th-12th</td>
<td>NA</td>
<td>Girls had higher overall injury rates (rate ratio=1.37; 95% CI: 1.27, 1.48) and practice injury rates (rate ratio=1.60; 95% CI: 1.46, 1.76) than boys.</td>
<td></td>
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<tr>
<td>Knowles</td>
<td>Prospective Cohort</td>
<td>2,269</td>
<td>9th-12th</td>
<td>High school track &amp; field</td>
<td>Injury rates for girls was 1.18/1,000 AE (95% CI: 0.75, 1.83) and boys was 1.06/1,000 AE (95% CI: 0.62, 1.81).</td>
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<td>Watson</td>
<td>Prospective Cohort</td>
<td>234</td>
<td>9th-12th</td>
<td>High school track &amp; field</td>
<td>Injury occurrence for boys was 19.1% and girls was 14.1%.</td>
<td></td>
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<tr>
<td>Requa</td>
<td>Prospective Cohort</td>
<td>516</td>
<td>9th-12th</td>
<td>High school track &amp; field</td>
<td>Injury occurrence for boys was 32.8% and girls was 35.1%.</td>
<td></td>
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<tr>
<td>Beachy</td>
<td>Prospective Cohort</td>
<td>4,592</td>
<td>7th-8th</td>
<td>High school cross country</td>
<td>Cross-country: Girls had higher rate of injuries (10.9/1000 AE) than boys (8.0/1000 AE) (rate ratio=1.36, 95% CI 1.2, 1.6). Track &amp; Field: Girls had higher rate of injuries (12.2/1000 AE) than boys (8.3/1000 AE) (rate ratio=1.46, 95% CI 1.2, 1.6).</td>
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</tbody>
</table>

CI, confidence interval; AE, athletic exposure
REFERENCES: TABLE 3 – SEX


<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Rauh 2006\(^6\) | Prospective Cohort | 421 | 14-18 yr | 186 F / 235 M high school cross country | Injuries | - Overall injury rate of 17.0/1000 AE  
- Overall rate of re-injury to same body part was highest in the shin (73.6/1000 AE), hip (53.8/1000 AE) and knee (41.8/1000 AE)  
- Previous injury (adjusted RR 1.2, 95% CI: 1.0, 1.5) and summer preseason injury (adjusted RR 1.4, 95% CI: 1.0, 1.9) were associated with future injury | 2 |
| Plisky 2006\(^6\) | Prospective Cohort | 105 | 13-18 yr | 46 F / 59 M high school cross country | MTSS | - Overall MTSS injury rate of 2.8/1000 AE  
- Runners with a previous injury were at greater odds (OR=2.2, 0.7, 6.4) of developing MTSS than runners without prior injury. | 2 |
| Tenforde 2013\(^7\) | Prospective Cohort | 748 | 13-18 yr | 442 F / 306 M high school runners | Stress fractures | - Stress fractures occurred in 5.4% of girls (n = 23) and 4.0% of boys (n = 11).  
- Prior fracture was an independent risk factor for stress fractures in girls (HR 5.83, 95% CI: 2.32, 14.67) and boys (HR 5.73, 95% CI: 1.52, 21.67). | 2 |
| Reinking 2010\(^4\) | Prospective Cohort | 125 | 13-18 yr | 62 F /63 M high school cross country | Exercise-related leg pain | - 103/125 respondents (82.4%) reported a history of exercise-related leg pain.  
- 45/93 respondents (48%) reported experiencing exercise-related leg pain during the season.  
- Runners with a history of exercise-related leg pain were at 9 times greater risk of exercise-related leg pain during the season (RR=9.14, 1.36-61.59) than runners without a history. | 2 |
| Rauh 2000\(^3\) | Prospective Cohort | 3233 | 14-18 yr | 1202 F / 2031 M high school cross country | Injuries | - Initial injury rate was 8.7/1000 AE.  
- Subsequent injury rates were 37.6/1000 AE to the same body part and 3.7/1000 AE to a new body part. | 2 |

AE, athletic exposure; RR, rate ratio; OR, odds ratio; HR, hazard ratio; CI, confidence interval
REFERENCES: TABLE 4 – PREVIOUS INJURY


<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
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<tbody>
<tr>
<td>Yagi 2013</td>
<td>Cohort</td>
<td>230</td>
<td>14-18 yr</td>
<td>96 F / 134 M high school cross country</td>
<td>Shin pain (Medial tibial stress syndrome &amp; stress fracture)</td>
<td>Increased internal rotation of the hip significantly decreased the odds of sustaining medial tibial stress syndrome in females (adjusted OR=0.91; 95% CI: 0.85, 0.99). Increased straight leg raise significantly increased the risk of stress fracture in males (adjusted OR=1.38; 95% CI: 1.04, 1.83).</td>
</tr>
<tr>
<td>Plisky 2006</td>
<td>Prospective Cohort</td>
<td>105</td>
<td>13-18 yr</td>
<td>46 F / 59 M high school cross country</td>
<td>Medial tibial stress syndrome</td>
<td>Runners with a navicular drop &gt;10mm were at the same risk (OR=0.9; 95% CI: 0.3, 2.8) than runners with a navicular drop &lt;10mm.</td>
</tr>
<tr>
<td>Rauh 2007</td>
<td>Prospective Cohort</td>
<td>393</td>
<td>14-18 yrs</td>
<td>171 F / 222 M high school cross country</td>
<td>Injuries</td>
<td>Runners with a Q-angle ≥20° had higher risk of injury than runners with a Q-angle &lt;20° (rate ratio=1.7; 95% CI: 1.2, 2.4). Runners with a right-left Q-angle difference ≥4° had a higher injury risk than runners with a right-left Q-angle difference &lt;4° (rate ratio=1.8; 95% CI: 1.4, 2.5).</td>
</tr>
<tr>
<td>Rauh 2018</td>
<td>Prospective Cohort</td>
<td>393</td>
<td>14-18 yrs</td>
<td>171 F / 222 M high school cross country</td>
<td>Injuries</td>
<td>Boys with a leg-length inequality &gt;1.5 cm had higher odds of injury than boys with a leg-length inequality &lt;0.5 cm (OR=7.47, 95% CI: 1.5, 36.9).</td>
</tr>
<tr>
<td>Luedke 2015</td>
<td>Prospective Cohort</td>
<td>68</td>
<td>13-18 yrs</td>
<td>47 F / 20 M high school cross country</td>
<td>Injuries</td>
<td>Runners in the tertiles indicating weakest hip abductors (p=0.046), knee extensor (p=0.038), and hip knee flexor muscle strength (p=0.046) had higher occurrence of anterior knee pain.</td>
</tr>
<tr>
<td>Finnoff 2011</td>
<td>Prospective Cohort</td>
<td>98</td>
<td>14-18 yrs</td>
<td>45 F /53 M high school cross country</td>
<td>Patellofemoral pain</td>
<td>Greater baseline hip abduction strength (OR=5.35, 95% CI: 1.46-19.53) and abduction-to-adduction strength ratio (OR=14.14, 95% CI: 0.90, 221.06) increased the odds of patellofemoral pain. Greater pre-injury hip ER:IR strength ratio decreased the odds of patellofemoral pain (OR=0.01, 95% CI: &lt;0.01, 0.44).</td>
</tr>
</tbody>
</table>

CI, confidence interval; OR, odds ratio
# REFERENCES: TABLE 5 – ALIGNMENT and STRENGTH


# Table 6 - Bone Stress Injury

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Tenforde 2013   | Prospective Cohort | 748             | 13-18 yr             | 442 F / 306 M high school | Stress fractures | • Prospective stress fractures in 5.4% of girls (n = 23) and 4.0% of boys (n = 11).  
  • Tibial stress fractures were most common in girls, and the metatarsus was most frequently fractured in boys.  
  • Independent risk factors for stress fractures in girls included: prior fracture (HR 5.83, 95% CI: 2.32, 14.67), body mass index < 19 kg/m², (HR 2.67, 95% CI: 1.11, 6.41) late menarche (age menarche ≥15 yr), (HR 2.49, 95% CI: 1.01, 6.17) and previous participation in gymnastics or dance (HR 3.13, 95% CI: 1.20, 9.15).  
  • Independent risk factors for stress fractures in boys included prior fracture (HR 5.73, 95% CI: 1.52, 21.67) and increased number of seasons (HR 2.35, 95% CI: 1.12, 5.00). | 2                |
| Changstrom 2015 | Descriptive Epidemiology | 389             | 13-19 yr             | 210 F / 179 M high school athletes | Stress fractures | • Overall stress fracture injury rate of 1.54/100,000 AE.  
  • The most commonly injured sites were the lower leg (40.3% of all stress fractures), foot (34.9%), and lower back/lumbar spine/pelvis (15.2%).  
  • Stress fracture injury rates were 10.62/100,000 AE for girls’ cross country and 5.42/100,000 for boys’ cross country.  
  • Girls sustained more stress fractures (63.3%) than boys (36.7%) and had higher rates of stress fracture (2.22 vs 1.27; rate ratio, 1.75; 95% CI: 1.38, 2.23). | 4                |
| Field 2011      | Prospective Cohort | 6831            | 9-15 yr              | 6831 F adolescents    | Stress fractures | • During seven years of follow-up, 267 females (3.9%) developed a stress fracture.  
  • Hours per week of running (RR=1.13, 95% CI: 1.04, 1.23), basketball (RR=1.12, 95% CI 1.03, 1.22) and cheerleading and gymnastics (RR=1.02, 95% CI 1.02, 1.23) were significant predictors of developing a stress fracture independent of age, age at menarche, family history of fracture, and hours per week of low- and moderate-impact activity. | 2                |

BMD, bone mineral density; RR, relative risk; HR, hazard ratio; CI, confidence interval; AE = athletic exposure
REFERENCES: TABLE 6 - BONE STRESS INJURY

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measures</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Rauh 2014    | Prospective Cohort | 89 | 13-18 yr | 89 F high school cross country and track | Musculoskeletal injuries | • Low BMD relative to age (BMD Z-score of ≤ -1SD) was significantly associated (adjusted OR=4.6, 95% CI: 1.5, 13.3) with increased injury occurrence.  
• Among those with BMD Z-score of ≤ -2SD, a history of oligo/amenorrhea was significantly associated (adjusted OR=4.1, 95% CI: 1.2, 13.5) with increased injury occurrence. | 2 |
| Barrack 2017 | Cross-sectional | 69 | 13-19 yr | 51 M athletes | Low BMD (BMD Z-score ≤ -1.0) | • Single risk factors of low BMD included <85% expected weight (OR=5.6, 95% CI: 1.4, 22.5) and average weekly mileage >30 in the past year (OR=6.4, 95% CI: 1.5, 27.1).  
• The strongest two-variable and three-variable risk factors included weekly mileage >30 + stress fracture history (OR=17.3, 95% CI: 1.6, 185.6) and weekly mileage >30 + <85% expected weight + stress fracture history (OR=17.3, 95% CI: 1.6, 185.6), respectively.  
• Risk factors were cumulative when predicting low BMD (including <85% expected weight, weekly mileage >30, stress fracture history and <1 serving of calcium-rich food/day): 0-1 risk factors (11.1%), 2 risk factors (42.9%), or 3-4 risk factors (80.0%). | 4 |
| Tenforde 2015 | Cross-sectional | 136 | 13-19 yr | 94 F / 42 M high school runners | BMD Z-score | • In girls, risk factors for lower lumbar BMD Z-scores included: lower android-to-gynoid fat mass ratio (β=0.49), higher fat mass (β=-0.30), being shorter (β=0.33), and the interaction between current menstrual irregularity and a history of fracture (β=-0.18).  
• In girls, risk factors for lower total body less head BMD Z-scores included: later age of menarche (β=−0.26), lower android-to-gynoid fat mass ratio (β=0.17), lower lean mass (β=0.33), and drinking less milk (β=0.19).  
• In boys, risk factors for lower lumbar BMD Z-scores included: lower BMI Z-score (β=0.57) and the belief that being thinner improves performance (β=−0.90).  
• In boys, risk factors for lower total body less head BMD Z-scores included: lower BMI Z-score (β=0.60) and the belief that being thinner improves performance (β=−0.46), and lower android-to-gynoid fat mass ratio (β=0.25) | 2 |
| Barrack 2014⁷⁰ | Prospective Cohort | 259 | 13-29 yr | 56 F (age < 18 yr) athletes | Bone stress injury | 28 participants (10.8%) developed a bone stress injury.  
* Single factors associated with the development of bone stress injury included ≥12 h/wk of purposeful exercise (OR=4.9; 95% CI: 1.4, 16.9), BMI <21.0 kg/m² (OR=2.4; 95% CI: 1.0, 5.3), and BMD Z score <-1.0 (OR=3.2; 95% CI: 1.4, 7.2).  
* The strongest 2- and 3-variable combined risk factors for bone stress injury were low BMD (Z score <-1.0) + ≥12 h/wk of exercise (OR=5.1; 95% CI: 2.2, 12.1) and ≥12 h/wk of exercise + leanness sport/activity + dietary restraint (OR, 8.7; 95% CI: 2.7, 28.3). |

BMI, body mass index; BMD, bone mineral density; OR, odds ratio; β=beta coefficient; CI, confidence interval
REFERENCES: TABLE 7 - LOW BMD and MENSTRUAL DYSFUNCTION


<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rauh 2006&lt;sup&gt;14&lt;/sup&gt;</td>
<td>Prospective Cohort</td>
<td>421</td>
<td>14-18 yr</td>
<td>186 F / 235 M high school cross country</td>
<td>Injuries</td>
<td>• No association to injury risk for: running experience, pre-season number of weeks, pre-season frequency d/wk, pre-season average weekly distance, training pace, training surface or terrain.</td>
<td>2</td>
</tr>
</tbody>
</table>
| Rauh 2014<sup>19</sup> | Prospective Cohort | 421 | 14-18 yr | 186 F / 235 M high school cross country | Injuries | • Runners who ran <8 wks during summer had higher odds of incurring injury during first month of season (OR=2.7, 95% CI 1.2, 5.8).  
• Runners who only alternated mileage 25% or less during summer had higher odds of incurring injury during the first month of season (OR=3.0, 95% CI 1.4, 6.4).  
• Runners who ran predominantly on hills >33% each run (OR=12.3, 95% CI: 2.9, 52.5) or flat irregular terrains >33% each run (OR=12.3, 95% CI: 2.2, 6.2) had higher odds of incurring an injury during first month of season for girl runners only. | 2 |
| Huxley 2014<sup>21</sup> | Prospective Cohort | 103 | 13-17 yr | 66 F / 34 M / 3 Unidentified Elite track and field | Injuries | • Injured athletes trained at a higher intensity at 13-14 years, completed more high-intensity training sessions at 13-14 years and 15-16 years, and had a higher yearly training load at 13-14 years. | 4 |
| Luedke 2016<sup>31</sup> | Prospective Cohort | 68 | 13-18 yrs | 47 F / 20 M high school cross country | Injuries | • Runners with step rate < 166 steps/min at self-selected running speed were at greater odds of incurring a shin injury (OR=5.85, 95% CI: 1.1-32.1).  
• Runners with step rate ≤ 164 steps /min at fixed running speed (3.3 m/s) were more likely to incur shin injury (OR=6.67, 95% CI: 1.2-36.7). | 2 |
| Timpka 2015<sup>32</sup> | Prospective Cohort | 110 | mean age =17 yrs | 64 F / 46 M Swedish track and field | Overuse injuries | • In assessing training load index (reported intensity x minutes of training per week), athletes in the third quartile (HR=1.76, 95% CI: 1.13-2.76, p=0.013) and fourth quartile (HR=1.81, 95% CI 1.18-2.80. p=0.007) had almost twice the risk of overuse injury compared to their peers in in the first quartile. | 4 |
| Tenforde 2011<sup>33</sup> | Retrospective Cohort | 748 | 13-18 yrs | 442 F / 306 M high school cross country & track and field | Overuse injuries | • Compared to girls with no injury, girls with previous injury reported a greater percentage of miles on pavement (55% vs 49%).  
• Compared to boys with no injury, boys with previous injury reported greater average weekly miles over past year (17.1±11.9 vs 14.1 ± 11.5 miles). | 3 |

CI, confidence interval; OR, odds ratio; HR, hazard ratio
REFERENCES: TABLE 8 – TRAINING


TABLE 9 – FOOTWEAR and FOOTSTRIKE

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Study Design</th>
<th>No. of Subjects</th>
<th>Population Age Range</th>
<th>Population Sex</th>
<th>Outcome Measure</th>
<th>Summary</th>
<th>Level of Evidence</th>
</tr>
</thead>
</table>
| Aibast 2017   | Observational | 76             | 12-18 yr             | 38 F / 38 M adolescents | Injuries     | • Lower-limb injury prevalence was 8% in habitually barefoot and 61% in habitually shod participants (p = 0.01).  
• Habitually barefoot participants spent more time engaged in moderate to vigorous physical activity compared to habitually shod subjects (60±26 min/d vs 31±13 min/d; p< 0.001) | 3                |
| Hollander 2018| Cross-sectional observational | 678         | 6-18 yr             | 335 F / 343 M children | Rearfoot strike pattern | • Habitually barefoot children showed a higher probability of using a rearfoot strike than habitually shod children (p < 0.001).  
• The probability of rearfoot strike decreased in habitually barefoot children with age (ORbarefoot-jogging =0.82, 95% CI: 0.71, 0.96; ORbarefoot-running =0.58, 95% CI: 0.50, 0.67; ORshod-running =0.68, 95% CI, 0.59, 0.79).  
• In habitually shod children, the probability of rearfoot strike increased during shod jogging (OR=1.19, 95% CI: 1.05, 1.35). | 3                |

OR, odds ratio; CI, confidence interval
REFERENCES: TABLE 9 – FOOTWEAR and FOOTSTRIKE
