Table G10.A1. Tabulation of Information From Studies Comparing Injury Rates Among Persons of Similar Levels of Fitness and Physical Activity Habits Who Are Assigned Different Doses of Physical Activity

<table>
<thead>
<tr>
<th>Citation</th>
<th>Subjects</th>
<th>Length of Study</th>
<th>Activity</th>
<th>Frequency</th>
<th>Duration</th>
<th>Intensity</th>
<th>MET-min/wk</th>
<th>Injury Definition</th>
<th>Percent Injured</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann, 1969 (1)</td>
<td>132 mostly sedentary males, 25-60 years, “free of major disease”</td>
<td>26 weeks</td>
<td>Progressive levels of calisthenics, walking, jogging</td>
<td>3-4 day/wk</td>
<td>60 min</td>
<td>Gradual increase in intensity</td>
<td>Increasing from 2,200 to 3,200</td>
<td>Musculoskeletal “impairment”</td>
<td>49%</td>
<td>Authors: “Middle-aged men require 8 to 10 weeks of gradual preparative training before they are able to train...without developing impairments.”</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>11%</td>
<td>Drop out due to “impairment”</td>
</tr>
<tr>
<td>Kilbom, 1969 (2); Saltin, 1969 (3)</td>
<td>63 sedentary otherwise healthy males, 36-60 years</td>
<td>10 weeks</td>
<td>Calisthenics, walk, jog, run</td>
<td>3 day/wk</td>
<td>30-45 min</td>
<td>Strive for maximal effort</td>
<td>900-1,000</td>
<td>“Troublesome complications”</td>
<td>48%</td>
<td>High injury rates due to running at high intensity, especially early in program</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Drop out due to adverse events</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Pollock, 1977 (4)</td>
<td>187 male inmates, 20-35 years</td>
<td>20 weeks</td>
<td>Jogging1</td>
<td>1 day/wk</td>
<td>30 min</td>
<td>85%-90% Max HR</td>
<td>375</td>
<td>Training related, missed jogging for 7+ days</td>
<td>0%</td>
<td>Frequency and duration of running are related to incidence of injuries</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 day/wk</td>
<td>30 min</td>
<td></td>
<td>1,125</td>
<td></td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5 day/wk</td>
<td>30 min</td>
<td></td>
<td>1,875</td>
<td></td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 day/wk</td>
<td>15 min</td>
<td></td>
<td>560</td>
<td></td>
<td>22%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 day/wk</td>
<td>30 min</td>
<td></td>
<td>1,125</td>
<td></td>
<td>24%</td>
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</tbody>
</table>
Table G10.A1. Tabulation of Information From Studies Comparing Injury Rates Among Persons of Similar Levels of Fitness and Physical Activity Habits Who Are Assigned Different Doses of Physical Activity (continued)

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<tr>
<th>Citation</th>
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<th>Frequency</th>
<th>Duration</th>
<th>Intensity</th>
<th>MET-min/wk</th>
<th>Injury Definition</th>
<th>Percent Injured</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pollock, 1977 (4)</td>
<td>187 male inmates, 20-35 years</td>
<td>20 weeks</td>
<td>Jogging(^1)</td>
<td>3 day/wk</td>
<td>45 min</td>
<td>85%-90% Max HR</td>
<td>1,670</td>
<td>Training related, missed jogging for 7+ days</td>
<td>54%</td>
<td>Frequency and duration of running are related to incidence of injuries</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Pollock, 1991 (5)</td>
<td>57 sedentary otherwise healthy males and females, 70-79 years</td>
<td>Week 1-13</td>
<td>Walking and jogging</td>
<td>3 day/wk</td>
<td>60 min</td>
<td>40%-70% Max HRR</td>
<td>450-630</td>
<td>Training related, missed jogging for 7+ days</td>
<td>5%</td>
<td>Intensity of walking/jogging is related to incidence of injuries</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>75%-85% Max HRR</td>
<td>1,170</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Weeks 14-26</td>
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<td></td>
<td></td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Carroll, 1992 (6)</td>
<td>68 sedentary otherwise healthy males and females, 60-79 years</td>
<td>Week 1-13</td>
<td>Walking(^2)</td>
<td>3 day/wk</td>
<td>20-40 min</td>
<td>40%-60% Max HRR</td>
<td>300-600</td>
<td>Stopped or significantly altered training 7+ days due to musculoskeletal problem</td>
<td>9%</td>
<td>Intensity of walking not related to incidence of injuries</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Week 14-26 (60% subjects)</td>
<td></td>
<td></td>
<td>45 min</td>
<td>65%-70% Max HRR</td>
<td>650</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Week 14-26 (40% subjects)</td>
<td></td>
<td></td>
<td>35 min</td>
<td>80-85% Max HRR</td>
<td>750</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weeks 1-26</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Citation</td>
<td>Subjects</td>
<td>Length of Study</td>
<td>Activity</td>
<td>Frequency</td>
<td>Duration</td>
<td>Intensity</td>
<td>MET-min/wk</td>
<td>Injury Definition</td>
<td>Percent Injured</td>
<td>Comment</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
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<td>------------------</td>
<td>----------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Suter, 1994 (7)</td>
<td>75 sedentary otherwise healthy males, mean age 41 years</td>
<td>26 weeks</td>
<td>Walking³</td>
<td>6 day/wk</td>
<td>30 min</td>
<td>50% VO2max</td>
<td>900</td>
<td>Stopped training 7+ days⁴ et al.</td>
<td>21%</td>
<td>Incidence of more severe injuries similar, incidence of mild injuries higher among joggers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jogging³</td>
<td>4 day/wk</td>
<td></td>
<td>75% VO2max</td>
<td>1,200</td>
<td></td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Walking³</td>
<td>6 day/wk</td>
<td></td>
<td>50% VO2max</td>
<td>900</td>
<td>Any injury⁴</td>
<td>54%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Jogging³</td>
<td>4 day/wk</td>
<td></td>
<td>75% VO2max</td>
<td>1,200</td>
<td></td>
<td>75%</td>
<td></td>
</tr>
<tr>
<td>Ready, 1996 (8)</td>
<td>78 sedentary otherwise healthy post-menopausal females, mean age 61 years</td>
<td>24 weeks</td>
<td>Walking³</td>
<td>3 day/wk</td>
<td>60 min</td>
<td>60% VO2max</td>
<td>760</td>
<td>Dropped out of study</td>
<td>8%</td>
<td>Drop outs due to injury related to volume of walking</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Walking³</td>
<td>5 day/wk</td>
<td></td>
<td></td>
<td>1,200</td>
<td></td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>–</td>
<td>–</td>
<td></td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Dunn, 1999 (9)</td>
<td>235 sedentary otherwise healthy males and females, 35-60 years</td>
<td>104 weeks</td>
<td>Gradual increase in aerobic activity of one's choice in structured setting or on own</td>
<td>3-5 day/wk</td>
<td>150 min/wk</td>
<td>Moderate intensity</td>
<td>500</td>
<td>Drop out of study due to injury</td>
<td>–</td>
<td>Low drop out rate, no inactive comparison</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Structured</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table G10.A1. Tabulation of Information From Studies Comparing Injury Rates Among Persons of Similar Levels of Fitness and Physical Activity Habits Who Are Assigned Different Doses of Physical Activity (continued)

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<th>Duration</th>
<th>Intensity</th>
<th>MET-min/wk</th>
<th>Injury Definition</th>
<th>Percent Injured</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunn, 1999 (9) (continued)</td>
<td>235 sedentary otherwise healthy males and females, 35-60 years</td>
<td>104 weeks</td>
<td>Gradual increase in aerobic activity of one's choice in structured setting or on own</td>
<td>3-5 day/wk</td>
<td>150 min/wk</td>
<td>Moderate intensity</td>
<td>500</td>
<td>Lifestyle (on own)</td>
<td>1%</td>
<td>Low drop out rate, no inactive comparison</td>
</tr>
<tr>
<td>King, 2000 (10)</td>
<td>103 sedentary otherwise healthy males, and females, mean age 70 years</td>
<td>52 weeks</td>
<td>Gradual increase in aerobic and strength training, aerobic goal is brisk walking</td>
<td>4 day/wk</td>
<td>40-60 min</td>
<td>60%-75% HRR</td>
<td>750</td>
<td>Drop out of study due to injury</td>
<td>0%</td>
<td>Low drop out rate, few complaints of soreness, separate rates for aerobic and stretching groups not provided</td>
</tr>
<tr>
<td>Ory, 2005 (12)</td>
<td>11 home-based, community, clinic, and worksite intervention trials; 5,518 total participants, ranging from 80 to 1,608 per trial</td>
<td>Varied</td>
<td>10 interventions recommended moderate activity, 1 moderate to vigorous</td>
<td>–</td>
<td>–</td>
<td>Moderate to vigorous</td>
<td>–</td>
<td>Serious adverse event</td>
<td>None</td>
<td>Ratio of adverse events to number of participants ranged from 0% to 22%, suggesting dissimilar reporting practices</td>
</tr>
<tr>
<td>King, 2002 (11)</td>
<td>100 sedentary otherwise healthy females, 49-82 years</td>
<td>52 weeks</td>
<td>Gradual increase over 6 weeks to goal of brisk walking</td>
<td>4 day/wk</td>
<td>30-40 min</td>
<td>40%-60% HRR</td>
<td>550</td>
<td>Drop out of study due to injury</td>
<td>0%</td>
<td>Low drop out rate, few complaints of soreness, no inactive comparison</td>
</tr>
<tr>
<td>King, 2000 (10)</td>
<td>103 sedentary otherwise healthy males, and females, mean age 70 years</td>
<td>52 weeks</td>
<td>Stretching</td>
<td>4 day/wk</td>
<td>–</td>
<td>Mild</td>
<td>500</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>

Note: HRR = Heart Rate Reserve; MET = Metabolic Equivalent of Task; wk = Week; min = Minute; Lifestyle (on own) = Lifestyle activities on own volition or in a structured setting; 1% = Approximately 1% of participants; 0% = Approximately 0% of participants; <10% = Approximately less than 10%; None = None of the participants had a serious adverse event.
<table>
<thead>
<tr>
<th>Citation</th>
<th>Subjects</th>
<th>Length of Study</th>
<th>Activity</th>
<th>Frequency</th>
<th>Duration</th>
<th>Intensity</th>
<th>MET-min/wk</th>
<th>Injury Definition</th>
<th>Percent Injured</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIFE Study Invest., 2006 (13)</td>
<td>424 sedentary otherwise healthy males and females, 70-89 years</td>
<td>52 weeks</td>
<td>Slow progression to 150 min/wk of walking at moderate pace&lt;sup&gt;6&lt;/sup&gt;</td>
<td>3-5 day/wk</td>
<td>150 min/wk</td>
<td>Moderate pace</td>
<td>500</td>
<td>Sore muscles</td>
<td>84%</td>
<td>Musculoskeletal problems were equally common in intervention and control groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Foot pain</td>
<td>53%</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Joint sprain</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>0</td>
<td></td>
<td>0</td>
<td>-</td>
<td></td>
<td>-</td>
<td>Sore muscles</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Foot pain</td>
<td>49%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Joint sprain</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Church, 2007 (14)</td>
<td>464 sedentary postmenopausal overweight or obese females; mean age, 57 years</td>
<td>26 weeks</td>
<td>Treadmill walking, recumbant exercycles, gradual increase to goal over 8 weeks</td>
<td>3-4 day/wk</td>
<td>75 min/wk</td>
<td>50% VO&lt;sub&gt;2max&lt;/sub&gt;</td>
<td>250</td>
<td>Drop out of study due to injury</td>
<td>0%</td>
<td>Drop out rate low (1% overall), unrelated to volume of activity</td>
</tr>
<tr>
<td>Citation</td>
<td>Subjects</td>
<td>Length of Study</td>
<td>Activity</td>
<td>Frequency</td>
<td>Duration</td>
<td>Intensity</td>
<td>MET-min/wk</td>
<td>Injury Definition</td>
<td>Percent Injured</td>
<td>Comment</td>
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<td>Church, 2007 (14)</td>
<td>464 sedentary postmenopausal overweight or obese females; mean age, 57 years</td>
<td>26 weeks</td>
<td>Treadmill walking, recumbent exercycles, gradual increase to goal over 8 weeks</td>
<td>3-4 day/wk</td>
<td>200 min/wk</td>
<td>50% VO$_2$max</td>
<td>750</td>
<td>Drop out of study due to injury</td>
<td>0%</td>
<td>Drop out rate low (1% overall), unrelated to volume of activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>–</td>
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<td></td>
</tr>
<tr>
<td>Yueng, 2001 (15)</td>
<td>Cochrane review of interventions to prevent lower limb soft tissue running injuries</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>Incidence of injuries can be reduced by reducing frequency, duration, intensity, or total amount of training</td>
</tr>
</tbody>
</table>

HR, heart rate; HRR, heart rate reserve; MET, metabolic equivalent; mph, mile per hour

1MET-min estimates are calculated assuming an 8 minutes/mile pace, or 12.5 METs/min.
2Assumes about 100 MET-min/wk during warm-up and cool-down; walking at 40-50% HRRmax is 3.5 METs, 60-70% HRRmax is 4.0 METs, and 80-85% HRRmax is 6.0 METs.
3Assumes a jogging pace of 10 min/mile (10 METs) and walking pace of 4 min/mile (5 METs).
4Same subjects, different outcomes
5Average measured walking pace was 3.7 mph, estimated at 4 METs.
6Assumes walking pace of 20 min/mile (3.3 METs).

**Reference List**


14. Church TS, Earnest CP, Skinner JS, Blair SN. Effects of different doses of physical activity on cardiorespiratory fitness among sedentary, overweight or obese postmenopausal women with elevated blood pressure: a randomized controlled trial. JAMA 2007 May 16;297(19):2081-91.