

## **Appendix**

### **Does leisure time physical activity protect against low back pain? Systematic review and meta-analysis of 36 prospective cohort studies**

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**Supplementary Table S1:** PubMed search strategy made in July, 2016

| Search | Query  | No of items found |
|--------|--|-------------------|
| #1     | Exercise[Mesh] OR exercise[Text Word] OR sports[Mesh] OR sports[Text Word] OR leisure activities[Mesh] OR leisure activities[Text Word] OR walking[Mesh] OR walking[Text Word] OR running[Mesh] OR running[Text Word] OR jogging[Mesh] OR jogging[Text Word] OR football[Mesh] OR football[Text Word] OR baseball[Mesh] OR baseball[Text Word] OR basketball[Mesh] OR basketball[Text Word] OR bicycling[Mesh] OR bicycling[Text Word] OR swimming[Mesh] OR swimming[Text Word] OR volleyball[Mesh] OR volleyball[Text Word] OR soccer[Mesh] OR soccer[Text Word] OR wrestling[Mesh] OR wrestling[Text Word] OR weight lifting[Mesh] OR weight lifting[Text Word] OR track and field[Mesh] OR track and field[Text Word] OR skiing[Mesh] OR skiing[Text Word] OR skating[Mesh] OR skating[Text Word] OR mountaineering[Mesh] OR mountaineering[Text Word] OR hockey[Mesh] OR hockey[Text Word] OR gymnastics[Mesh] OR gymnastics[Text Word] OR tennis[Mesh] OR tennis[Text Word] OR golf[Mesh] OR golf[Text Word] OR boxing[Mesh] OR boxing[Text Word] OR physical fitness[Mesh] OR physical fitness[Text Word] OR athletic performance[Mesh] OR athletic performance[Text Word] | 510,589           |
| #2     | Spinal diseases[Mesh] OR spinal diseases[Text Word] OR spinal pain[Text Word] OR back pain[Mesh] OR back pain[Text Word] OR back disorders[Text Word] OR sciatica[Mesh] OR sciatica[Text Word] OR lumbar radicular pain[Text Word] OR sciatic pain[Text Word]  | 146,039           |
| Final  | #1 AND #2  | 8,135             |

**Table S2:** Quality assessment

| Type of bias     | Criteria definition   | Classification (potential for bias)  |
|------------------|---|--|
| Selection bias   | Sampling method of the study population, representativeness (response rate, difference between responders and non-responders, investigate and control of variables in case of difference between responders and non-responders) | <p><b>Low:</b> Target population defined as representative of the general population or subgroup of the general population (specific age group, women, men, specific geographic area, and specific occupational group) and response rate is 80% or more.</p> <p><b>Moderate:</b> Target population defined as somewhat representative of the general population, a restricted subgroup of the general population, response rate 60%-79%.</p> <p><b>High:</b> Target population defined as “self-referred”/volunteers, response rate less than 60%.</p> |
| Performance bias | Valid and reliable assessment of exposure<br>Assessors blinded for outcome status   | <p><b>Low:</b> Physical activity assessed using physical activity index or Metabolic Equivalent Task (MET), or frequency of participation in sports and other leisure-time physical exercise assessed.</p> <p><b>Moderate:</b> Participation in some types of sports assessed. Other activities not considered.</p> <p><b>High:</b> A “yes” or “no” question used. Frequency and duration of physical activity not assessed.</p>   |
| Confounding      | Matching two groups<br>Stratification<br>Statistical analysis   | <p><b>Low:</b> Controlled for most potential confounding factors including age and sex.</p> <p><b>Moderate:</b> Controlled for few potential confounding factors, including both age and sex.</p> <p><b>High:</b> Not controlled for both age and sex, or controlled for less than two confounding factors.</p>  |
| Attrition bias   | Withdrawals and drop-out rates<br>Size of missing data  | <p><b>Low:</b> Follow up participation rate of 80% or higher or missing data on less than 20%.</p> <p><b>Moderate:</b> Follow up participation rate of 60%-79%, or missing data on 20%-40%.</p> <p><b>High:</b> Follow up participation rate of less than 60%, or missing data on more than 40%.</p>   |

**Table S3:** Studies included in the meta-analysis

| First author and year of publication   | Country | Follow-up time | Study population   | Low back pain at baseline                                    | Age range at baseline | Sex                    | Sample size (in analysis)                      | Physical activity   | Low back pain at follow-up                            | Quality assessment: Risk of bias * |             |             |           | Results  | Adjustment for other covariates  |
|--|---------|----------------|--|--|-----------------------|------------------------|--|---|---|------------------------------------|-------------|-------------|-----------|--|--|
|  |         |                |  |  |                       |                        |  |   |   | Selection                          | Performance | Confounding | Attrition |  |  |
| <i>Low back pain in the past month</i> |         |                |  |  |                       |                        |  |   |   |                                    |             |             |           |  |  |
| Hübscher 2015 <sup>1</sup>             | Denmark | 2 years        | A representative sample of twins. Longitudinal Study of Aging Danish Twins (LSADT) | Without back pain during the month before baseline interview | 70 or older           | Both, 55% were females | 2333 for light and 2073 for strenuous activity | Current engagement in light leisure time physical activity (e.g., light gardening, easy gymnastics, short (less than 0.5 hours) walks, or bike rides (yes/no)) and in strenuous leisure time physical activity (e.g., heavy gardening, long (more than half an hour) walks or bike rides, sports, or dancing) | Low back pain in the past month                       | Moderate                           | Moderate    | Moderate    | Low       | Adjusted OR 0.81 (CI 0.63-1.04) for light physical activity and 1.04 (CI 0.82-1.31) for strenuous physical activity.<br><br>Estimated adjusted RR 0.83 (CI 0.67-1.03) for light activity and 1.03 (CI 0.84-1.25) for strenuous activity.<br><br>Estimated RR 0.93 (CI 0.73-1.19) for light or strenuous activity vs. no activity.<br><br>In the co-twin control analysis, OR 0.70 (CI 0.33-1.48) for light activity and 0.89 (CI 0.53-1.51) for strenuous activity | Sex and depression   |
| Lunde 2015 <sup>2</sup>                | Norway  | 6.5 years      | Students of 13 technical schools   | With or without low back pain                                | Mean age 17.5 ± 1.2   | Both, 64% were women   | 420 (153 men and 267 women)                    | Frequency of leisure time physical activity leading to increased heart rate or shortness of breath (9 repeated measures). It  | Low back pain in the past month (9 repeated measures) | Moderate                           | Moderate    | Low         | High      | OR 0.939 (CI 0.583-1.513) for men, 0.713 (CI 0.522-0.974) for women and 0.776 (CI 0.600-1.004) for both sexes.<br><br>Estimated RR 0.96 (CI 0.67-1.31) for men, 0.81 (CI 0.66-0.99) for women and 0.85 (CI 0.71-1.00) for both sexes   | Age, sex, education/profession, ethnicity, socioeconomic status, smoking, body mass index, physical work demands, and follow-up time |

| Author                       | Country | Duration | Population     | Exposure          | Age                        | Sex                    | N    | Exposure Definition  | Outcome   | High     | Moderate | Low      | Low  | OR/RR (CI)  | Adjustment   |
|------------------------------|---------|----------|----------------|-------------------|----------------------------|------------------------|------|--|---|----------|----------|----------|------|---|--|
| George 2012 <sup>3</sup>     | USA     | 2 years  | Soldiers       | Without back pain | 18-35, mean age 22.3 ± 4.5 | Both, 30% were females | 1230 | Exercising routinely prior to military service vs. not routinely   | First episode of low back pain in the past month during the follow-up | High     | Moderate | Low      | Low  | OR 1.074 (CI 0.834-1.382).<br>Estimated RR 1.04 (CI 0.90-1.19)  | Age, sex, race, education, income, active duty status, smoking, body mass index, time in army, previous injury, depression, anxiety, fear of pain questionnaire, and exercise and education groups |
| Wedderkopp 2009 <sup>4</sup> | Denmark | 3 years  | Schoolchildren | Without back pain | 8-10                       | Both, 53% were females | 265  | Physical activity was assessed using accelerometer, and classified into average physical activity (counts per minute) and minutes per day spent on high physical activity (each grouped into low, moderate, or high) | Low back pain in the past month                                       | Moderate | Low      | Moderate | High | OR 2.5 (CI 1.0-6.2) for counts per minute and 4.6 (CI 1.9-11.2) for high physical activity, comparing the lowest tertile with the highest tertile.<br><br>Estimated OR 0.40 (CI 0.16-0.996) for average physical activity and 0.22 (CI 0.09-0.53) for high physical activity, comparing the highest tertile with the lowest tertile.<br><br>Estimated RR 0.44 (CI 0.18-0.997) for average physical activity (counts per minute) and 0.25 (CI 0.10-0.57) for high physical activity, comparing the | Sex, and puberty   |

|  |           |          |                    |                               |                                    |                        |                                |  |   |      |          |          |          |   |   |
|--|-----------|----------|--------------------|-------------------------------|------------------------------------|------------------------|--------------------------------|--|---|------|----------|----------|----------|---|---|
| Jones 2003 <sup>5</sup>                          | UK        | 1 year   | Schoolchildren     | Without low back pain         | 11-14                              | Both                   | 903                            | Number of sports activities more than 20 minutes per week  | Low back pain lasted for one day or longer in the past month                                | Low  | Moderate | Moderate | Low      | RR 1.121 (CI 0.779-1.614) for 6-11 times (moderate activity), 1.551 (CI 1.122-2.146) for 12 or more (high activity) and 1.344 (CI 1.055-1.712) for 6 or more (moderate or high)   | Age and sex   |
| Harreby 1997 <sup>6</sup>                        | Denmark   | 25 years | Schoolchildren     | With or without low back pain | 14 at baseline and 38 at follow-up | Both, 54% were females | 474                            | Number of hours of leisure time physical activity per week (e.g., sports or gardening)   | Low back pain in the past month, past week, and current low back pain                       | Low  | Low      | High     | Moderate | For leisure time physical activity for at least 3 hours/week vs. no activity, estimated RR was 0.52 (CI 0.26-1.04) for current low back pain, 0.66 (CI 0.41-1.05) for low back pain in the past week, and 0.55 (CI 0.40-0.77) for low back pain in the past month.<br><br>Estimated RR 0.97 (CI 0.78-1.19) for mildly to moderately active vs. inactive, 0.55 (CI 0.40-0.77) for highly active vs. inactive and 0.85 (CI 0.69-1.04) for active vs. inactive for low back pain in the past month | Unadjusted  |
| <b><i>Low back pain in the past 6 months</i></b> |           |          |                    |                               |                                    |                        |                                |  |   |      |          |          |          |   |   |
| Hussain 2016 <sup>7</sup>                        | Australia | 12 years | General population | With or without low back pain | 25 or older at baseline            | Both                   | 4974 (2197 men and 2777 women) | Hours spent in walking, or other moderate or vigorous activities. Inactive vs. active defined as physical activity <2.5 h/week vs. ≥2.5 h/week | Pain intensity in the past 6 months. Low pain intensity (<50) and high pain intensity (≥50) | High | Moderate | Low      | High     | For men OR 1.01 (CI 0.79-1.28) for low pain intensity and 1.21 (CI 0.89-1.65) for high pain intensity for inactive vs. active.<br><br>For women OR 0.91 (CI 0.73-1.12) for low pain intensity and 0.90 (CI 0.68-1.18) for high pain intensity for inactive vs. active.  | Age, education, smoking, body mass index, dietary guideline index score, television viewing time, and mental component score of SF-36 |

|                           |         |          |             |   |                      |       |         |   |   |          |          |      |          |   |  |
|---------------------------|---------|----------|-------------|---|----------------------|-------|---------|---|---|----------|----------|------|----------|---|--|
|                           |         |          |             |   |                      |       |         |   |   |          |          |      |          | OR for low back pain 1.08 (CI 0.89-1.31) for men, 0.91 (CI 0.76-1.07) for women and 0.98 (CI 0.86-1.12) for both sexes combined for inactive vs. active.                                |  |
|                           |         |          |             |   |                      |       |         |   |   |          |          |      |          | OR for low back pain 0.93 (CI 0.76-1.13) for men, 1.10 (CI 0.92-1.31) for women and 1.02 (CI 0.89-1.17) for both sexes combined for active vs. inactive.                                |  |
|                           |         |          |             |   |                      |       |         |   |   |          |          |      |          | RR for low back pain 0.99 (CI 0.94-1.03) for men, 1.02 (CI 0.98-1.05) for women and 1.01 (CI 0.98-1.04) for both sexes combined for active vs. inactive                                 |  |
| Taanila 2012 <sup>8</sup> | Finland | 6 months | Conscripts  | Without low back pain during the past month | 18-28, median age 19 | Men   | 982     | Frequency of sweating exercise (brisk sport activity during leisure time) | Consultation for low back pain in the past 6 months | Low      | Moderate | Low  | Low      | HR 0.7 (CI 0.4-1.2) for 1-2 times per week and 1.0 (CI 0.6-1.6) for at least 3 times per week vs. no physical activity.<br><br>Estimated HR 0.85 (CI 0.59-1.23) for active vs. inactive | Age, educational level, school degree level, father's occupation, company, smoking, and baseline medical conditions (sports injury, earlier musculoskeletal symptoms, regular medication use, chronic impairment or disability due to musculoskeletal disorders, orthopedic surgery) |
| Feldman                   | Canada  | 1 year   | Schoolchild | Without                                     | Mean                 | Both, | 377 for | Hours spent   | Low back pain                                       | Moderate | Moderate | High | Moderate | At 6 months, 13.5% of   | Unadjusted   |

|                   |  |  |   |  |            |                 |  |   |   |  |  |  |  |  |
|-------------------|--|--|---|--|------------|-----------------|--|---|---|--|--|--|--|--|
| 2001 <sup>9</sup> |  |  | ren. Students from two public and one private schools | low back pain during the past 6 months | 13.8 ± 1.2 | 47% were female | first 6 months and 357 for the second 6 months | in different sports activities over the past 6 months. 91% were active at least in one extracurricular activity | at least once a week during the past six months |  |  |  |  | participants with LBP (n =48) and 5.4% of those without LBP (n =329) were highly active.<br><br>At 12 months 9.3% of participants with LBP (n = 32) and 6.1% of those without LBP (n = 357) were highly active.<br><br>Estimated RR 2.28 (CI 0.95-5.47) for the first 6 months and 1.52 (0.48-4.81) for the second 6 months.<br><br>Estimated RR 1.97 (CI 0.62-6.18) for high level of activity vs. moderate or low level of activity for 1-year follow-up |
|-------------------|--|--|---|--|------------|-----------------|--|---|---|--|--|--|--|--|

**Low back pain in the past 12 months**

|                               |           |                                     |   |  |                               |                        |        |  |   |          |          |          |          |  |   |
|-------------------------------|-----------|-------------------------------------|---|--|-------------------------------|------------------------|--------|--|---|----------|----------|----------|----------|--|---|
| Brady 2016 <sup>10</sup>      | Australia | 15 years                            | A random sample national health insurance population (Medicare) | With or without back pain  | Mean age 49.5 ± 1.5           | Women                  | 11,478 | Participation in vigorous physical activity such as vigorous aerobics, competitive sport, or vigorous cycling or running | Having sometimes or often back pain in the past 12 months   | Moderate | Moderate | Low      | Moderate | Adjusted OR 0.91 (CI 0.87-0.95).<br><br>Estimated RR 0.955 (CI 0.93-0.98)  | Age, height, weight, depression, employment status, smoking, and menopause status |
| Kapellusch 2014 <sup>11</sup> | USA       | Median 1.2 and mean 1.4 ± 1.0 years | Occupational population from 30 diverse production facilities   | Without low back pain for at least 3 months, sciatica and low back surgeries | 18.5-65.2, mean age 37.1 ± 12 | Both, 33% were females | 258    | Frequency of leisure time physical activity; none, 1-3 times, and 4 times or more per week                               | Self-reported use of over-the-counter or prescription medication for low back pain during the follow-up | High     | Low      | Moderate | Low      | HR 1.56 (CI 0.95-2.57) for moderate, 1.42 (CI 0.86-2.35) for high and 1.49 (CI 0.97-2.28) for moderate or high activity vs. inactivity.<br><br>HR 1.41 (CI 0.87-2.28) for moderate, 1.37 (CI 0.83-2.26) for high and 1.39 (CI 0.92-2.10) for moderate or | Age, sex and BMI.<br><br>Peak lifting index, history of low back pain,            |



|                            |         |                |  |   |                      |                        |                              |  |  |          |          |          |          | high activity vs. inactivity  | housework and anxiety (Tense-Edge-Nervous scale)   |
|----------------------------|---------|----------------|--|---|----------------------|------------------------|------------------------------|--|--|----------|----------|----------|----------|---|--|
| Shiri 2013 <sup>12</sup>   | Finland | 6 years        | General population                         | Without low back pain longer than 7 days during the preceding 12 months | 24-39                | Both                   | 1224 (581 men and 643 women) | MET consisting of frequency, intensity and duration of leisure time physical activity. Average leisure-time physical activity during baseline and follow-up period | Low back pain (with or without radiation) longer than 7 days in the past 12 months | Moderate | Low      | Moderate | Moderate | RR 1.05 (CI 0.77-1.43) for moderate, 1.05 (CI 0.77-1.44) for high and 1.05 (0.80-1.38) for moderate/high compared with low activity in men.<br><br>RR 1.01 (CI 0.74-1.38) for moderate, 1.19 (CI 0.90-1.58) for high and 1.11 (0.86-1.43) for moderate/high compared with low activity in women.<br><br>RR 1.00 (CI 0.80-1.24) for moderate, 1.11 (CI 0.90-1.36) for high and 1.05 (0.87-1.27) for moderate/high compared with low activity in men and women combined | Age, sex, educational status, occupational status, and smoking   |
| Thiese 2011 <sup>13</sup>  | USA     | Mean 1.4 years | Occupational population                    | Without chronic low back pain   | Mean age 38.2 ± 11.3 | Both, 26.5% were women | 68                           | Physical activity measured by accelerometer. Tertile distribution was used to define low, moderate, and high activity  | New onset of low back pain during the follow-up period                             | Moderate | Low      | Moderate | Low      | HR 1.29 (0.48-3.47) for moderately active vs. inactive.<br><br>HR 2.65 (CI 0.80-8.79) for highly active vs. inactive.<br><br>HR 1.61 (CI 0.65-3.96) for active vs. inactive   | Age, BMI, sex, smoking, back compressive force, feeling depressed, and seeing a health care provider for low back pain |
| Bovenzi 2010 <sup>14</sup> | Italy   | 1 year         | Professional drivers of several industries | Without low back pain during the past 12 months                         | Mean age 40.8 ± 9.2  | Men                    | 202                          | Frequency of leisure time physical activity per week   | Low back pain for one day or longer in the past 12 months                          | Moderate | Moderate | Low      | High     | OR 1.01 (CI 0.57-1.78) for at least one time per week vs. never/almost never.<br><br>Estimated RR 1.01 (CI 0.68-1.37)   | Age, body mass index, smoking, physical work load factors, and psychosocial or psychosomatic factors                   |

|                            |         |        |                            |                   |           |                      |      |   |  |          |          |     |          |   |   |
|----------------------------|---------|--------|----------------------------|-------------------|-----------|----------------------|------|---|--|----------|----------|-----|----------|---|---|
| Miranda 2008 <sup>15</sup> | Finland | 1 year | Workers of forest industry | Without back pain | 16.4-65.0 | Both, 26% were women | 2237 | Exercise (e.g., bicycling or swimming) for at least 20 minutes per session: None, once a week, and 2 times or more per week | Low back pain longer than 7 days in the past 12 months | Moderate | Moderate | Low | Moderate | <p>Estimated unadjusted RR 0.66 (CI 0.41-1.05) for once a week vs. inactive, 0.78 (CI 0.54-1.13) for 2 times or more vs. inactive and 0.75 (CI 0.52-1.08) for active vs. inactive in subjects younger than 40 years.</p> <p>Estimated unadjusted RR 1.35 (CI 0.86-2.11) for once a week vs. inactive, 1.16 (CI 0.79-1.72) for 2 times or more vs. inactive and 1.21 (CI 0.82-1.77) for active vs. inactive in subjects 40-49 years.</p> <p>Estimated unadjusted RR 1.08 (CI 0.68-1.71) for once a week vs. inactive, 0.82 (CI 0.54-1.22) for 2 times or more vs. inactive and 0.88 (CI 0.59-1.29) for active vs. inactive in subjects 50 years or older.</p> <p>Estimated unadjusted RR 0.995 (CI 0.76-1.30) for once a week vs. inactive, 0.90 (CI 0.72-1.13) for 2 times or more vs. inactive and 0.92 (CI 0.74-1.14) for active vs. inactive in all subjects.</p> <p>Estimated adjusted RR 0.8 (CI 0.52-1.24) for moderate, 1.0 (CI 0.68-1.47) for high and 0.91 (CI 0.68-1.21) for active vs. inactive in subjects younger than 40 years.</p> <p>Estimated adjusted RR 1.22 (CI 0.81-1.85) for moderate, 1.11 (CI 0.70-1.76) for high</p> | Age, sex, smoking, body mass index, heavy lifting, awkward postures, and whole body vibration |
|----------------------------|---------|--------|----------------------------|-------------------|-----------|----------------------|------|---|--|----------|----------|-----|----------|---|---|

|                             |         |           |   |  |  |                      |      |  |                                     |          |      |          |          |   |  |
|-----------------------------|---------|-----------|---|--|--|----------------------|------|--|-------------------------------------|----------|------|----------|----------|---|--|
|                             |         |           |   |  |  |                      |      |  |                                     |          |      |          |          | and 1.17 (CI 0.86-1.59) for active vs. inactive in subjects 40-49 years.  |  |
|                             |         |           |   |  |  |                      |      |  |                                     |          |      |          |          | Estimated adjusted RR 0.79 (CI 0.50-1.23) for moderate, 0.71 (CI 0.46-1.09) for high and 0.75 (CI 0.54-1.02) for active vs. inactive in subjects 50 years or older. |  |
|                             |         |           |   |  |  |                      |      |  |                                     |          |      |          |          | Estimated adjusted RR 0.93 (CI 0.72-1.19) for moderate, 0.92 (CI 0.72-1.18) for high and 0.93 (CI 0.78-1.11) for active vs. inactive in all subjects                |  |
| Strøyer 2008 <sup>16</sup>  | Denmark | 2.5 years | Healthcare workers at institutions for physically and mentally disabled persons | Without clinically significant low back pain | 11% younger than 36 years, 28% 36-45, 41% 46-55, and 20% older than 55 years | Both, 83% were women | 327  | Leisure time physical activity more than 4 hours per week vs. 4 hours per week or less, using modified Saltin & Grimby questionnaire                           | Low back in the past 12 months      | High     | High | Moderate | Moderate | OR 1.08 (CI 0.35-3.32) for high vs. low or moderate.<br><br>Estimated RR 1.07 (CI 0.38-2.60)  | Age and sex  |
| Andersen 2007 <sup>17</sup> | Denmark | 2 years   | Occupational population   | Without musculoskeletal pain                 | 18-67  | Both                 | 1492 | Low or moderate activity (4 hours or less per week), and high activity (light activity 4 hours or more per week, or strenuous physical activity for 2 hours or | Low back pain in the last 12 months | Moderate | High | Moderate | Low      | HR 1.0 (0.7-1.3) for high vs. low or moderate activity  | Age, sex, occupational group, and intervention group |

|                                  |         |         |   |  |                |                                     |  |   |   |          |          |      |     |   |            |
|----------------------------------|---------|---------|---|--|----------------|-------------------------------------|--|---|---|----------|----------|------|-----|---|------------|
| Hartvigsen<br>2007 <sup>18</sup> | Denmark | 2 years | A<br>representati<br>ve sample<br>of twins.<br>Longitudina<br>l Study of<br>Aging<br>Danish<br>Twins<br>(LSADT) | Without<br>back pain<br>during the<br>month<br>before<br>baseline<br>interview | 70 or<br>older | Both,<br>52%<br>were<br>femal<br>es | 1387<br>(671<br>men and<br>716<br>women) | more per<br>week)<br><br>Current<br>engagement<br>in light<br>leisure time<br>physical<br>activity (e.g.,<br>light<br>gardening,<br>easy<br>gymnastics,<br>short (less<br>than 0.5<br>hours)<br>walks, or<br>bike rides<br>(yes/no)) and<br>in strenuous<br>leisure time<br>physical<br>activity (e.g.,<br>heavy<br>gardening,<br>long (more<br>than half an<br>hour) walks<br>or bike rides,<br>sports, or<br>dancing) | Low back pain<br>for at least one<br>day in the past<br>12 months | Moderate | Moderate | High | Low | OR 0.69 (CI 0.34-1.39) for<br>men, 1.26 (CI 0.65-2.47) for<br>women and 0.95 (CI 0.59-<br>1.54) for both sexes<br>combined for light activity.<br><br>OR 0.60 (CI 0.36-1.00) for<br>men, 0.59 (CI 0.37-0.95) for<br>women and 0.59 (CI 0.42-<br>0.83) for both sexes<br>combined for strenuous<br>activity.<br><br>Estimated OR 0.630 (CI<br>0.416-0.952) for men, 0.760<br>(CI 0.517-1.116) for women<br>and 0.692 (CI 0.524-0.914)<br>for both sexes for active vs.<br>inactive.<br><br>Estimated RR for men, 0.72<br>(CI 0.37-1.32) for light,<br>0.63 (CI 0.39-1.00) for<br>strenuous and 0.66 (CI<br>0.45-0.96) for active vs.<br>inactive.<br><br>Estimated RR for women,<br>1.21 (CI 0.69-2.00) for<br>light, 0.63 (CI 0.41-0.96)<br>for strenuous and 0.79 (CI<br>0.56-1.10) for active vs.<br>inactive.<br><br>Estimated RR for both<br>sexes, 0.96 (CI 0.63-1.43)<br>for light, 0.63 (CI 0.46-<br>0.85) for strenuous and 0.72<br>(CI 0.56-0.93) for active vs.<br>inactive.<br><br>In the co-twin control<br>analysis, OR 0.21 (CI 0.12-<br>0.37) for strenuous activity | Unadjusted |
|----------------------------------|---------|---------|---|--|----------------|-------------------------------------|--|---|---|----------|----------|------|-----|---|------------|

|                                |           |          |                                     |   |                      |                          |                             |   |   |      |          |          |          |   |                                 |
|--------------------------------|-----------|----------|-------------------------------------|---|----------------------|--------------------------|-----------------------------|---|---|------|----------|----------|----------|---|---------------------------------|
| Jacob 2006 <sup>19</sup>       | Israel    | 1 year   | Population-based                    | Without low back pain in the past month | 22-70, mean age 45.5 | Both, 54.5% were females | 211                         | Sport activity index. tertile distribution  | Low back pain for at least one day in the past 12 months    | High | Low      | High     | Low      | OR 1.33 (CI 0.41-2.51) for moderate vs. low and 0.57 (CI 0.13-2.05) for high vs. low.<br><br>Estimated OR 1.03 (CI 0.48-2.20) for active vs. inactive.<br><br>Estimated RR 1.25 (CI 0.46-1.97) for moderate, 0.62 (CI 0.15-1.72) for high and 1.02 (CI 0.53-1.80) for moderate or high  | Unadjusted                      |
| Leino-Arjas 2006 <sup>20</sup> | Finland   | 28 years | Metal industry employees            | With or without low back pain           | 18-64                | Both, 35% were females   | 544 (353 men and 191 women) | Number of hours multiply by intensity of different activities (sports, exercise, housework and commuting to work) | Often or frequent local low back pain in the past 12 months | Low  | Moderate | Moderate | Moderate | OR 0.67 (CI 0.37-1.22) for moderate and 0.78 (CI 0.45-1.35) for high activity in men and 0.87 (CI 0.40-1.86) for moderate and 0.61 (CI 0.28-1.33) for high activity in women.<br><br>Estimated RR 0.786 (CI 0.515-1.111) for moderate and 0.865 (CI 0.597-1.168) for high activity in men and 0.930 (CI 0.571-1.301) for moderate and 0.758 (CI 0.438-1.142) for high activity in women.<br><br>Estimated RR 0.83 (CI 0.64-1.07) in men and 0.85 (CI 0.62-1.17) in women for moderate/high activity.<br><br>Estimated RR 0.85 (CI 0.64-1.13) for moderate, 0.83 (CI 0.63-1.09) for high and 0.84 (CI 0.69-1.02) for moderate/high activity in men and in men combined | Age, sex and occupational class |
| Yip 2004 <sup>21</sup>         | Hong Kong | 1 year   | A convenience sample of nurses from | Without low back pain                   | Mean age 31.1        | Both, 85% were women     | 144                         | 1) Low activity (no sports or other   | Low back pain in the past 12 months                         | High | Moderate | High     | Moderate | RR 1.38 (CI 0.88-2.17) for moderate, 1.28 (CI 0.65-2.50) for high, and 1.36 (CI 0.88-2.11) for moderate or  | Unadjusted                      |

6 district  
hospitals

n

physical activities that caused sweating or breathlessness); 2) moderate activity (3 or more times/week at least for 20 minutes causing some sweating or breathlessness (e.g., walking, gardening or practicing Tai Chi); and 3) high activity (3 or more times/week at least for 20 minutes, of jogging/running, hiking, biking or swimming, causing moderate to high sweating or breathlessness, or 5 or more times/week at least for 30 minutes, of any physical activity causing some

high compared with low activity during leisure-time

|                            |             |             |                               |  |       |                      |      |  |   |          |          |          |      |   |   |
|----------------------------|-------------|-------------|-------------------------------|--|-------|----------------------|------|--|---|----------|----------|----------|------|---|---|
| Picavet 2003 <sup>22</sup> | Netherlands | 1 to 4 yrs. | Population based              | With or without low back pain  | 20–59 | Both                 | 3759 | sweating or breathlessness)<br>Lack of moderate leisure-time activity defined as less than 0.5 hour per day or per week spent on activities of at least 4 METs (e.g., gardening, cycling, or sports) | Low back pain in the past 12 months   | High     | Moderate | Moderate | High | OR 1.11 (CI 0.94-1.32) for <0.5 hour per week and 1.04 (CI 0.90-1.21) for <0.5 hour activity per day.<br><br>Estimated OR 0.90 (CI 0.76-1.07) for 0.5 hour or more vs. <0.5 hour per week and 0.96 (CI 0.83-1.12) for 0.5 hour or more vs. <0.5 hour per day.<br><br>Estimated RR 0.94 (CI 0.84-1.04) for 0.5 hour or more vs. <0.5 hour per week and 0.98 (CI 0.89-1.07) for 0.5 hour or more vs. <0.5 hour per day. | Adjusted for age, sex, and low back pain at baseline. The results did not differ in working/non-working, or educational level subgroups |
| Power 2001 <sup>23</sup>   | UK          | 10 years    | The 1958 British birth cohort | Excluded from analysis: those with back pain at 23 years, those with back pain at 23 years who recovered, persistent back pain at 23 and 33 years, and those with incident back pain between 23 and 32 years | 23    | Both, 51% were women | 4906 | Inactivity at age 23 years defined as watching more than 5 episodes of television and no sports activity per week  | Low back pain lasted for more than one day in the past 12 months (at 32 to 33 years of age) | Moderate | High     | High     | High | OR 1.04 (CI 0.87-1.25) for inactive vs. active.<br><br>Estimated OR 0.962 (CI 0.802-1.153) for active vs. inactive<br><br>Estimated RR 0.966 (CI 0.818-1.136) for active vs. inactive   | Unadjusted  |

|                            |         |          |   |   |                                    |                        |                              |   |   |          |          |          |          |   |  |
|----------------------------|---------|----------|---|---|------------------------------------|------------------------|------------------------------|---|---|----------|----------|----------|----------|---|--|
| Croft 1999 <sup>24</sup>   | UK      | 1 year   | Two registered general practice populations | Without low back pain in the previous month | 18-75                              | Both, 56% were women   | 1649 (722 men and 927 women) | Participation in a regular sport activity (yes/no), walking > 30 minutes vs. < 30 minutes each day                              | Consultation due to back pain in the past 12 months identified via computer recording system, or self-reported low back pain in the past 12 months without consultation | High     | Moderate | Moderate | High     | RR 1.0 (CI 0.8-1.3) in men and 1.34 (CI 1.1-1.7) in women for sport activity.<br><br>RR 1.0 (CI 0.8-1.3) in men and 1.1 (CI 0.9-1.4) in women for walking.<br><br>RR 1.176 (CI 1.00-1.383) for sport activity and 1.054 (CI 0.895-1.241) for walking in both sexes.<br><br>RR 1.0 (CI 0.8-1.3) in men, 1.22 (CI 0.94-1.57) in women and 1.11 (CI 0.92-1.35) in both sexes for sport activity or walking   | Age and sex.<br><br>Estimate for regular sport in women was controlled for age, General Health Questionnaire score, self-rated health, weight, and do-it-yourself activities |
| Eriksen 1999 <sup>25</sup> | Norway  | 4 years  | Population-based                            | Without back pain                           | 20-62                              | Both, 47% were women   | 523                          | Number of leisure time physical activity sessions (for at least 20 minutes to the level of sweating or breathlessness) per week | Low back pain in the past 12 months   | Moderate | Low      | Low      | Moderate | Estimated unadjusted RR 0.86 (CI 0.66-1.11) for 1-2 sessions vs. none, 0.74 (CI 0.52-1.04) for 3 or more sessions vs. none, and 0.82 (CI 0.65-1.03) for one or more vs. none.<br><br>Adjusted OR 1.55 (CI 1.03-2.33) for inactive vs. active (1 session or more/week).<br><br>Estimated OR for active vs. inactive 0.645 (CI 0.43-0.97).<br><br>Estimated RR for active vs. inactive 0.75 (CI 0.56-0.98). | Age, sex, marital status, smoking, heavy physical work, emotional symptoms, musculoskeletal pain other than low back pain, and monotonous movements in the job               |
| Harreby 1997 <sup>6</sup>  | Denmark | 25 years | Schoolchildren                              | With or without low back pain               | 14 at baseline and 38 at follow-up | Both, 54% were females | 474                          | Number of hours of leisure time physical activity per week (e.g., sports or gardening)  | Low back pain in the past 12 months   | Low      | Low      | High     | Moderate | Estimated RR 0.75 (CI 0.59-0.94) for leisure time physical activity for at least 3 hours/week vs. no activity   | Unadjusted   |



|                            |             |        |                |                           |       |     |     |   |                                     |          |      |          |     |  |   |
|----------------------------|-------------|--------|----------------|---------------------------|-------|-----|-----|---|-------------------------------------|----------|------|----------|-----|--|---|
| Burdorf 1996 <sup>26</sup> | Netherlands | 1 year | Novice golfers | With or without back pain | 22-60 | Men | 196 | Participation in other sports (tennis, squash, jogging, field hockey, soccer, judo) | Low back pain in the past 12 months | Moderate | High | Moderate | Low | RR 1.88 (CI 0.89-3.92) for active athletes compared with men who played golf only.<br><br>Participation in other sports, frequency of playing golf, and number of golf lessons were not associated with first-time back pain in men without a history of back pain at baseline (quantitative results not reported) | Age and previous back pain more than once |
|----------------------------|-------------|--------|----------------|---------------------------|-------|-----|-----|---|-------------------------------------|----------|------|----------|-----|--|---|

**Frequent low back pain**

|                              |         |          |                       |                               |       |                        |                                  |  |   |          |          |      |          |  |  |
|------------------------------|---------|----------|-----------------------|-------------------------------|-------|------------------------|----------------------------------|--|---|----------|----------|------|----------|--|--|
| Jacobs 2006 <sup>27</sup>    | Israel  | 7 years  | An elderly population | With or without back pain     | 70    | Both, 51% were women   | 277                              | Active vs. inactive. Active defined as going for a walk $\geq 4$ times a week or performing sports $\geq 2$ times a week | Back pain on a frequent basis at age 77                             | Moderate | Moderate | High | Moderate | 15% of subjects without back pain and 25% of those with back pain were inactive. Prevalence of back pain was 55% in 220 active subjects and 70% in 57 inactive subjects.<br><br>Estimated RR 0.784 (CI 0.637-0.964) for active vs. inactive                                      | Unadjusted   |
| Mikkelsen 2006 <sup>28</sup> | Finland | 25 years | Schoolchildren        | With or without low back pain | 12-17 | Both, 54% were females | 1106 (508 males and 598 females) | Frequency of childhood physical activity outside school hours for at least 30 minutes per session                        | Having ever low back pain longer than one day for at least 10 times | Moderate | Moderate | Low  | Moderate | OR 0.62 (CI 0.39-0.98) for males and 0.80 (CI 0.48-1.32) for females for active (at least 2 times per week) vs. inactive (less than 2 times).<br><br>Estimated RR 0.70 (CI 0.47-0.99) for males, 0.83 (CI 0.53-1.25) for females and 0.75 (CI 0.57-1.00) for both sexes combined | Age, body mass index at follow-up, endurance strength, flexibility, and physical activity at follow-up |

**Chronic low back pain**

|          |          |        |           |         |       |       |     |              |             |      |          |     |     |                            |                |
|----------|----------|--------|-----------|---------|-------|-------|-----|--------------|-------------|------|----------|-----|-----|----------------------------|----------------|
| Sihawong | Thailand | 1 year | Full-time | Without | 15-55 | Both, | 615 | Frequency of | Chronic low | High | Moderate | Low | Low | Adjusted OR 0.82 (CI 0.27- | Age, sex, body |
|----------|----------|--------|-----------|---------|-------|-------|-----|--------------|-------------|------|----------|-----|-----|----------------------------|----------------|

|                           |        |                  |   |   |             |                      |                                      |   |   |          |          |          |     |  |   |
|---------------------------|--------|------------------|---|---|-------------|----------------------|--------------------------------------|---|---|----------|----------|----------|-----|--|---|
| 2015 <sup>29</sup>        |        |                  | office workers  | spinal pain during previous 3 months                |             | 75% were females     |                                      | regular exercise or sport activities in the past 12 months (never, occasionally, regularly)   | back pain (low back pain with pain intensity of >30 mm on 100-mm VAS that lasted 3 consecutive months or longer in any 6-month of the 1-year follow-up) |          |          |          |     | 2.56) for occasionally and 0.42 (CI 0.06-2.93) for regularly compared with never.<br><br>Estimated adjusted RR 0.83 (CI 0.28-2.31) for occasionally, 0.44 (CI 0.06-2.59) for regularly and 0.71 (CI 0.28-1.79) for occasionally or regularly compared with never | mass index, psychological job demands, history of low back pain, frequent rest breaks, pain intensity at baseline, and disability at baseline |
| Herin 2014 <sup>30</sup>  | France | 5 years          | Occupational population   | Without musculoskeletal pain                        | 37-52       | Both, 36% were women | 6793 (4246 men and 2447 women)       | Participation in sports activities (yes/no)   | Chronic low back pain (low back pain lasted at least 6 months (duration of current episode or intermittent symptoms over the last 6 months)             | Low      | Moderate | Moderate | Low | HR 0.88 (CI 0.77-1.01) for men, and 0.99 (CI 0.82-1.19) for women.<br><br>Estimated HR 0.92 (CI 0.82-1.03) for both sexes  | Age, sex, body mass index and social class  |
| Makris 2014 <sup>31</sup> | USA    | 9 years (median) | Community-living elderly people                                 | Without back pain                                   | 70 or older | Both, 65% were women | 731                                  | Low activity (score <64 for men and <52 for women) vs. moderate or high physical activity using Physical Activity Scale for the Elderly | One episode of back pain restricting activity lasting 2 months (persistent), or 2 episodes of any duration (recurrent) in the past 18 months            | Moderate | Low      | High     | Low | HR of persistent or recurrent back pain 1.44 (CI not reported, P value 0.001) for low activity.<br><br>Estimated HR 0.695 (CI 0.55-0.88) for active vs. inactive   | Unadjusted  |
| Nilsen 2011 <sup>32</sup> | Norway | 11 years         | Population based. The Nord-Trøndelag Health Study (HUNT). HUNT1 | Without musculoskeletal pain or physical impairment | 20 or older | Both, 52% were women | 32,417 (15,465 men and 16,952 women) | Number of hours of leisure time physical activity (e.g., walking, skiing or swimming)   | Chronic low back pain (low back pain lasted 3 consecutive months or longer during the past 12   | Low      | Low      | Moderate | Low | RR 0.91 (CI 0.80-1.03) for <1 hour, 0.88 (CI 0.77-1.00) for 1-1.9 hours, and 0.75 (CI 0.64-0.88) for 2 hours or more in men.<br><br>RR 0.90 (CI 0.81-1.01) for <1 hour, 0.84 (CI 0.74-   | Age, sex, body mass index, smoking, and occupation  |

|                                      |                 |          | and<br>HUNT2  |  |                                 |                                     |  | based on<br>frequency<br>and duration<br>of physical<br>activity  | months)   |          |          |      |          | 0.95) for 1-1.9 hours, and<br>0.92 (CI 0.79-1.07) for 2<br>hours or more in women.<br><br>Estimated RR 0.86 (CI<br>0.79-0.94) for 1-1.9 hours,<br>and 0.84 (CI 0.75-0.93) for<br>2 hours or more in men and<br>women combined.<br><br>Estimated RR for one hour<br>or more vs. inactive 0.83<br>(CI 0.75-0.91) for men and<br>0.87 (CI 0.79-0.96) for<br>women and 0.85 (CI 0.79-<br>0.91) for men and women<br>combined  |   |
|--------------------------------------|-----------------|----------|---|--|---------------------------------|-------------------------------------|--|---|---|----------|----------|------|----------|---|---|
| van<br>Oostrom<br>2011 <sup>33</sup> | Netherlan<br>ds | 10 years | Population<br>based   | Without<br>low back<br>pain<br>longer<br>than 12<br>weeks<br>during the<br>past 12<br>months | 26-65,<br>mean age<br>45.9 ± 10 | Both,<br>53%<br>were<br>wome<br>n   | 3830                                     | Physically<br>active<br>defined as<br>3.5 hours per<br>week spent<br>on at least<br>moderately<br>intensive<br>physical<br>activity   | Chronic low<br>back pain (low<br>back pain<br>lasted at least<br>30 days during<br>the past 12<br>months) | Moderate | Moderate | Low  | Moderate | OR 0.86 (CI 0.68-1.08).<br><br>Estimated RR 0.87 (CI<br>0.70-1.07)  | Age, sex,<br>educational<br>level, smoking,<br>body mass<br>index, work<br>status |
| Hartvigsen<br>2007 <sup>18</sup>     | Denmark         | 2 years  | A<br>representati<br>ve sample<br>of twins.<br>Longitudina<br>l Study of<br>Aging<br>Danish<br>Twins<br>(LSADT) | Without<br>back pain<br>during the<br>month<br>before<br>baseline<br>interview               | 70 or<br>older                  | Both,<br>52%<br>were<br>femal<br>es | 1387<br>(671<br>men and<br>716<br>women) | Current<br>engagement<br>in light<br>leisure time<br>physical<br>activity (e.g.,<br>light<br>gardening,<br>easy<br>gymnastics,<br>short (less<br>than 0.5<br>hours)<br>walks, or<br>bike rides<br>(yes/no)) and<br>in strenuous<br>leisure time | Chronic low<br>back pain (low<br>back pain<br>longer than 30<br>days during<br>the past 12<br>months)     | Moderate | Moderate | High | Low      | OR 0.66 (CI 0.27-1.65) for<br>men, 1.04 (CI 0.44-2.48) for<br>women and 0.85 (CI 0.46-<br>1.60) for both sexes<br>combined for light activity.<br><br>OR 0.45 (CI 0.22-0.93) for<br>men, 0.57 (CI 0.30-1.10) for<br>women and 0.51 (CI 0.32-<br>0.83) for both sexes<br>combined for strenuous<br>activity.<br><br>Estimated OR 0.522 (CI<br>0.297-0.918) for men, 0.708<br>(CI 0.421-1.190) for women<br>and 0.616 (CI 0.422-0.899)<br>for both sexes for active vs. | Unadjusted  |

|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      |  |   |
|----------------------------|-------------|-------------|------------------|-------------------------------|-------|------|------|---|------------------------------------|------|----------|----------|------|--|---|
|                            |             |             |                  |                               |       |      |      | physical activity (e.g., heavy gardening, long (more than half an hour) walks or bike rides, sports, or dancing)  |                                    |      |          |          |      | inactive.  |   |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | Estimated RR for men, 0.67 (CI 0.28-1.59) for light, 0.47 (CI 0.23-0.94) for strenuous and 0.54 (CI 0.31-0.92) for active vs. inactive.          |   |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | Estimated RR for women, 1.04 (CI 0.46-2.22) for light, 0.59 (CI 0.32-1.09) for strenuous and 0.73 (CI 0.44-1.17) for active vs. inactive.        |   |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | Estimated RR for both sexes, 0.86 (CI 0.48-1.54) for light, 0.53 (CI 0.34-0.84) for strenuous and 0.63 (CI 0.44-0.91) for active vs. inactive.   |   |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | In the co-twin control analysis, OR 0.08 (CI 0.03-0.18) for strenuous activity   |   |
| Picavet 2003 <sup>22</sup> | Netherlands | 1 to 4 yrs. | Population based | With or without low back pain | 20–59 | Both | 3759 | Lack of moderate leisure-time activity defined as less than 0.5 hour per day or per week spent on activities of at least 4 METs (e.g., gardening, cycling, or sports) | Chronic low back pain (> 3 months) | High | Moderate | Moderate | High | OR 0.91 (CI 0.72-1.15) for <0.5 hour per week and 0.99 (CI 0.80-1.21) for <0.5 hour activity per day.  | Adjusted for age, sex, and low back pain at baseline. The results did not differ in working/non-working, or educational level subgroups |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | Estimated OR 1.10 (CI 0.87-1.39) for 0.5 hour or more vs. <0.5 hour per week and 1.01 (CI 0.82-1.24) for 0.5 hour or more vs. <0.5 hour per day. |   |
|                            |             |             |                  |                               |       |      |      |   |                                    |      |          |          |      | Estimated RR 1.09 (CI 0.88-1.32) for 0.5 hour or more vs. <0.5 hour per week and 1.01 (CI 0.84-1.20) for 0.5 hour or more vs. <0.5 hour per day  |   |

**Hospitalization due to low back pain**

| Author                      | Country | Age                                  | Population  | Outcome                   | Follow-up                                    | Sex  | N                                      | Exposure   | Outcome   | Low      | Moderate | Low      | Moderate | HR (CI)   | Notes  |
|-----------------------------|---------|--------------------------------------|-------------|---------------------------|--|------|--|--|---|----------|----------|----------|----------|---|--|
| Rivinoja 2011 <sup>34</sup> | Finland | 28 years                             | Adolescents | With or without back pain | 14 at baseline<br>42 at the end of follow-up | Both | 9016 (4535 males and 4481 females)     | Frequency of participation in sports, participation in different types of sports, and membership in a sport club outside of school hours | Hospitalization for conservative care for low back pain or sciatica | Low      | Moderate | Low      | Moderate | HR 0.9 (CI 0.6-1.3) for males, 1.4 (CI 0.8-2.3) for females and 1.05 (CI 0.77-1.44) for males and females combined for participation in sports for at least every other day vs. 2 times or less.<br><br>HR 0.9 (CI 0.6-1.3) for males, 0.9 (CI 0.5-1.6) for females and 0.90 (CI 0.65-1.24) for males and females combined for membership in a sport club.<br><br>HR 0.8 (CI 0.6-1.2) for males, 0.7 (CI 0.4-1.1) for females and 0.77 (CI 0.57-1.02) for males and females combined for sports with risk of injury vs. other types of sports | Sex, smoking, overweight, participation in sports, participation in sports with risk of injury, and membership in a sport club |
| Mattila 2008 <sup>35</sup>  | Finland | Mean 11.1 years. Range 0 to 23 years | Adolescents | With or without back pain | 14-18  | Both | 57,408 (26688 males and 30719 females) | Frequency of participation in sports clubs and other physical activity   | Hospitalization due to low back pain                                | Moderate | Moderate | Moderate | Low      | For participation in sports clubs, HR was 1.19 (1.02-1.41) for 1-3 times/week, 1.06 (CI 0.80-1.41) for 4 times or more/week, and 1.16 (CI 1.01-1.34) for 1 time or more/week compared with never in males and females combined.<br><br>For participation in sports clubs, HR was 1.10 (0.90-1.30) for 1-3 times/week, 1.00 (CI 0.70-1.30) for 4 times or more/week, and 1.07 (CI 0.91-1.26) for 1 time or more/week compared with never in males.<br><br>For participation in sports clubs, HR was 1.60 (1.10-2.20) for 1-3 times/week,       | Age and sex  |

1.50 (CI 0.70-3.20) for 4 times or more/week, and 1.58 (CI 1.15-2.17) for 1 time or more/week compared with never in females.

For participation in other physical exercise, HR was 0.70 (0.50-1.20) for 1-3 times/week, 0.80 (CI 0.50-1.40) for 4 times or more/week, and 0.74 (CI 0.53-1.04) for 1 time or more/week compared with never in males and females combined.

For participation in sports clubs or other physical exercise, HR was 1.12 (CI 0.86-1.45) for 1-3 times/week, 0.99 (CI 0.65-1.51) for 4 times or more/week, and 1.09 (CI 0.87-1.36) for 1 time or more/week compared with never in males and females combined.

*Sick leave due to low back pain*

|                              |    |              |   |                           |       |                        |                                |   |  |          |          |          |     |  |   |
|------------------------------|----|--------------|---|---------------------------|-------|------------------------|--------------------------------|---|--|----------|----------|----------|-----|--|---|
| Hemingway 1999 <sup>36</sup> | UK | Mean 4 years | Non-industrial civil servants working in the London offices of 20 departments | With or without back pain | 35-55 | Both, 33% were females | 4886 (3506 men and 1380 women) | Vigorous leisure time activity (e.g., running or digging): one hour or more vigorous activity. Moderate activity (e.g., scrubbing or polishing car): less than one hour | Sickness absence due to back pain during the follow-up | Moderate | Moderate | Moderate | Low | For 7 days or less sickness absence, RR 0.96 (CI 0.8-1.2) for moderate and 0.85 (CI 0.6-1.2) for low vs. high activity in men.<br><br>For longer than 7 days, RR 0.75 (CI 0.5-1.2) for moderate and 1.17 (CI 0.6-2.2) for low vs. high activity in men.<br><br>For 7 days or less sickness absence, RR 1.61 (CI 1.0-2.6) for moderate and 1.76 | Age, BMI, employment grade and baseline back pain |
|------------------------------|----|--------------|---|---------------------------|-------|------------------------|--------------------------------|---|--|----------|----------|----------|-----|--|---|

vigorous activity and one hour or more moderately energetic activity

(CI 1.1-2.9) for low vs. high activity in women.

For longer than 7 days, RR 0.68 (CI 0.3-1.4) for moderate and 1.01 (CI 0.5-2.2) for low vs. high activity in women.

For 7 days or less sickness absence, estimated RR 1.13 (CI 0.92-1.38) for moderate and 1.18 (CI 0.83-1.66) for high activity compared with low activity in men.

For longer than 7 days, estimated RR 0.64 (CI 0.41-0.99) for moderate and 0.85 (CI 0.45-1.64) for high activity compared with low activity in men.

For 7 days or less sickness absence, estimated RR 0.91 (CI 0.57-1.48) for moderate and 0.57 (CI 0.35-0.92) for high activity compared with low activity in women.

For longer than 7 days, estimated RR 0.67 (CI 0.31-1.45) for moderate and 0.99 (CI 0.47-2.08) for high activity compared with low activity in women.

For one day or longer sickness absence, estimated RR 1.02 (CI 0.75-1.40) for moderate and 1.10 (CI 0.66-1.83) for high, and 1.04 (CI 0.80-1.36) for moderate or high activity compared with low activity in men.

For one day or longer sickness absence, estimated

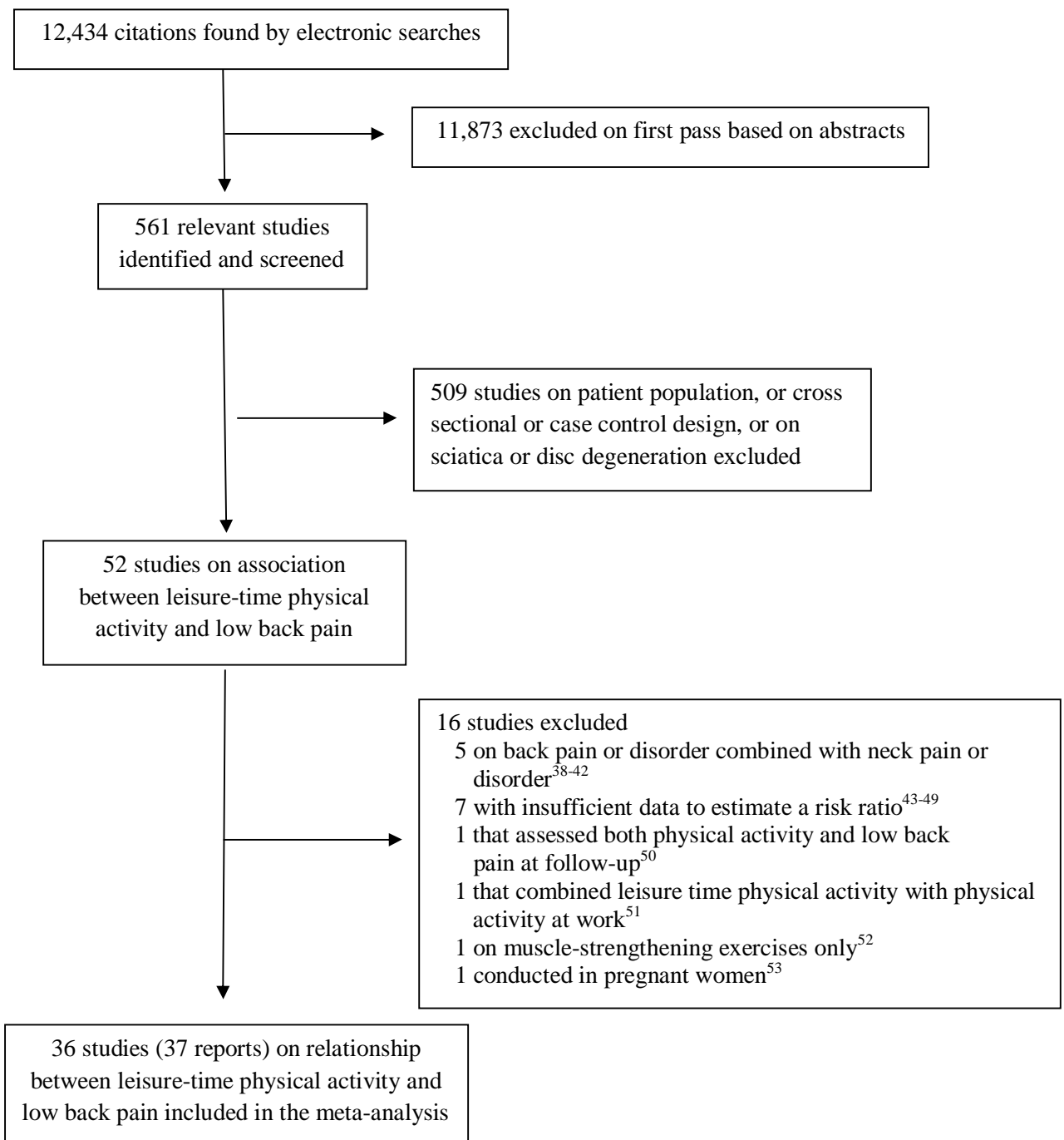
|                           |         |          |                                       |                       |                 |                        |     |                                 |  |     |          |      |          |   |            |
|---------------------------|---------|----------|---------------------------------------|-----------------------|-----------------|------------------------|-----|---------------------------------|--|-----|----------|------|----------|---|------------|
|                           |         |          |                                       |                       |                 |                        |     |                                 |  |     |          |      |          | RR 0.84 (CI 0.43-1.64) for moderate and 0.67 (CI 0.34-1.32) for high, and 0.75 (CI 0.47-1.21) for moderate or high activity compared with low activity in women.  |            |
|                           |         |          |                                       |                       |                 |                        |     |                                 |  |     |          |      |          | For one day or longer sickness absence, estimated RR 0.99 (CI 0.74-1.31) for moderate and 0.92 (CI 0.61-1.38) for high, and 0.96 (CI 0.76-1.21) for moderate or high activity compared with low activity in both sexes  |            |
| Müller 1999 <sup>37</sup> | Denmark | 15 years | Three age cohorts of one municipality | Without low back pain | 30, 40, 50 yrs. | Both, 53% were females | 220 | Time spent on sports activities | Self-reported sickness absence due to low back pain during the previous 7 years, or in the past 12 months before follow-up | Low | Moderate | High | Moderate | OR 0.68 (CI 0.17-2.61) for physical activity < 3h vs. 3 hours or more for sick leave in the past 12 months in 201 subjects.<br><br>OR 0.52 (CI 0.22-1.20) for physical activity < 3h vs. 3 hours or more for sick leave in the past 7 years in 220 subjects.<br><br>Estimated OR 1.47 (CI 0.37-5.76) for physical activity 3 hours or more vs. less than 3 hours for sick leave in the past 12 months.<br><br>Estimated OR 1.92 (CI 0.82-4.49) for physical activity 3 hours or more vs. less than 3 hours for sick leave in the past 7 years.<br><br>Estimated RR 1.42 (CI 0.39-4.32) for physical activity 3 hours or more vs. less than 3 hours for sick leave in the past 12 months.<br><br>Estimated RR 1.68 (CI 0.84-2.89) for physical | Unadjusted |



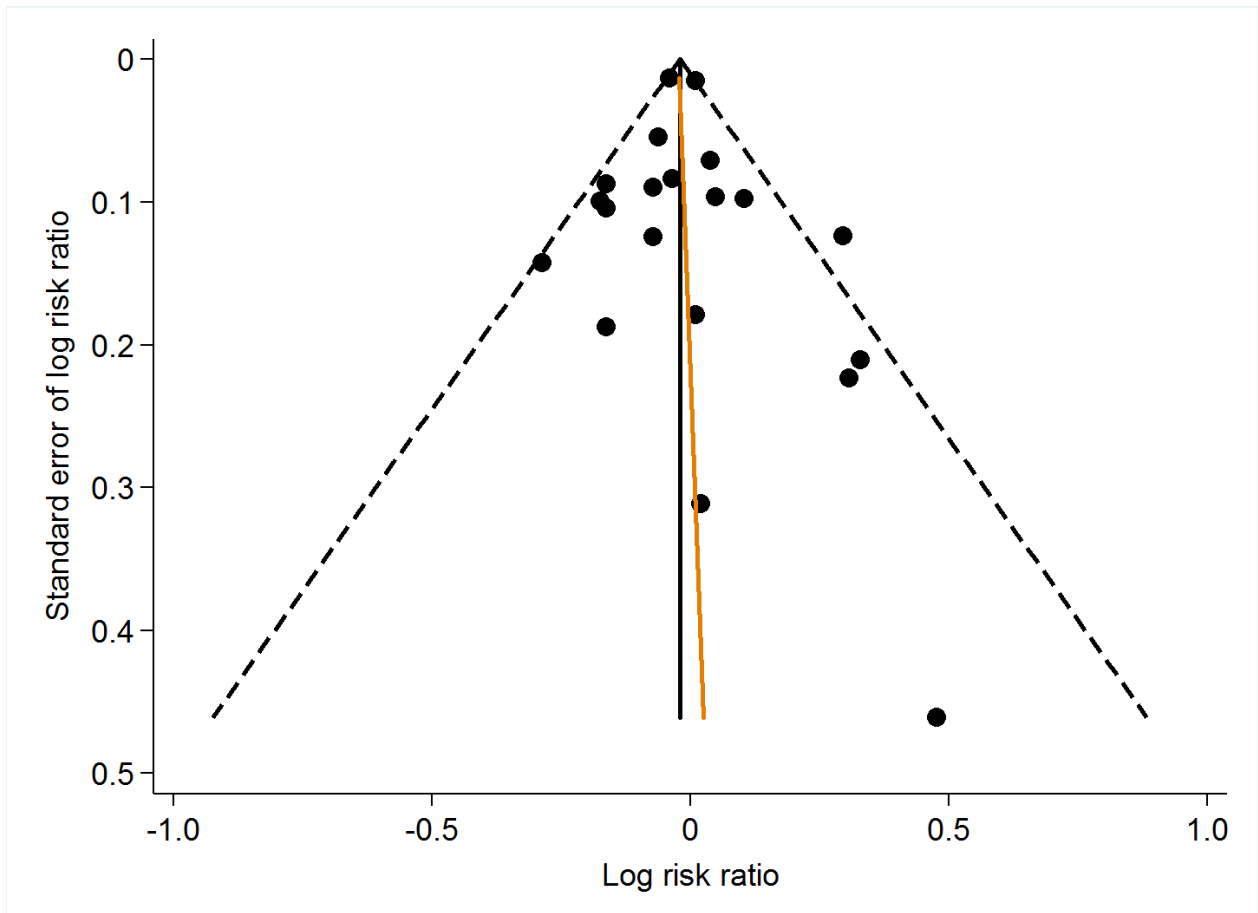
activity 3 hours or more vs.  
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leave in the past 7 years

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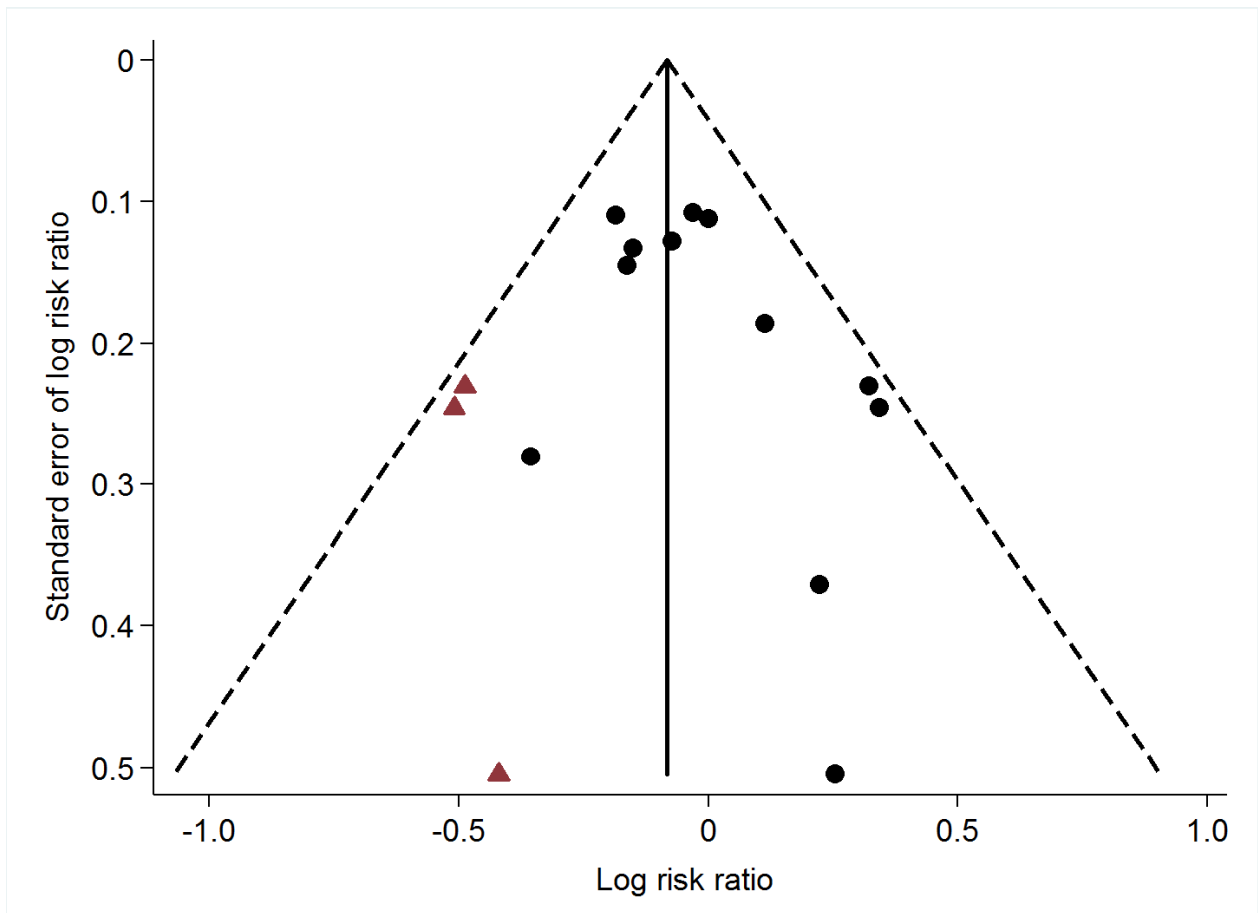
\* Low means low risk of bias and high means high of bias



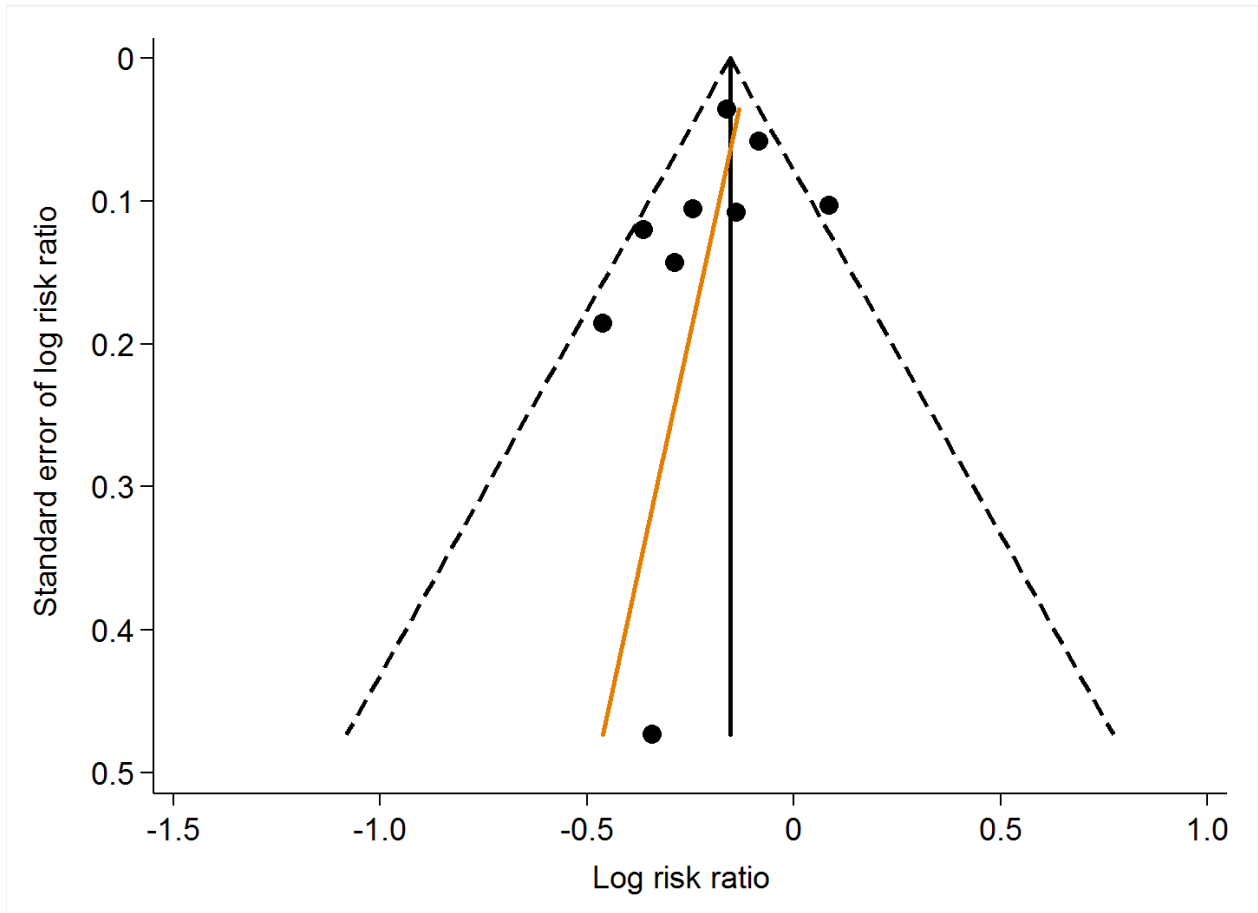
**Figure S1:** Flow chart of the search strategy and selection of studies



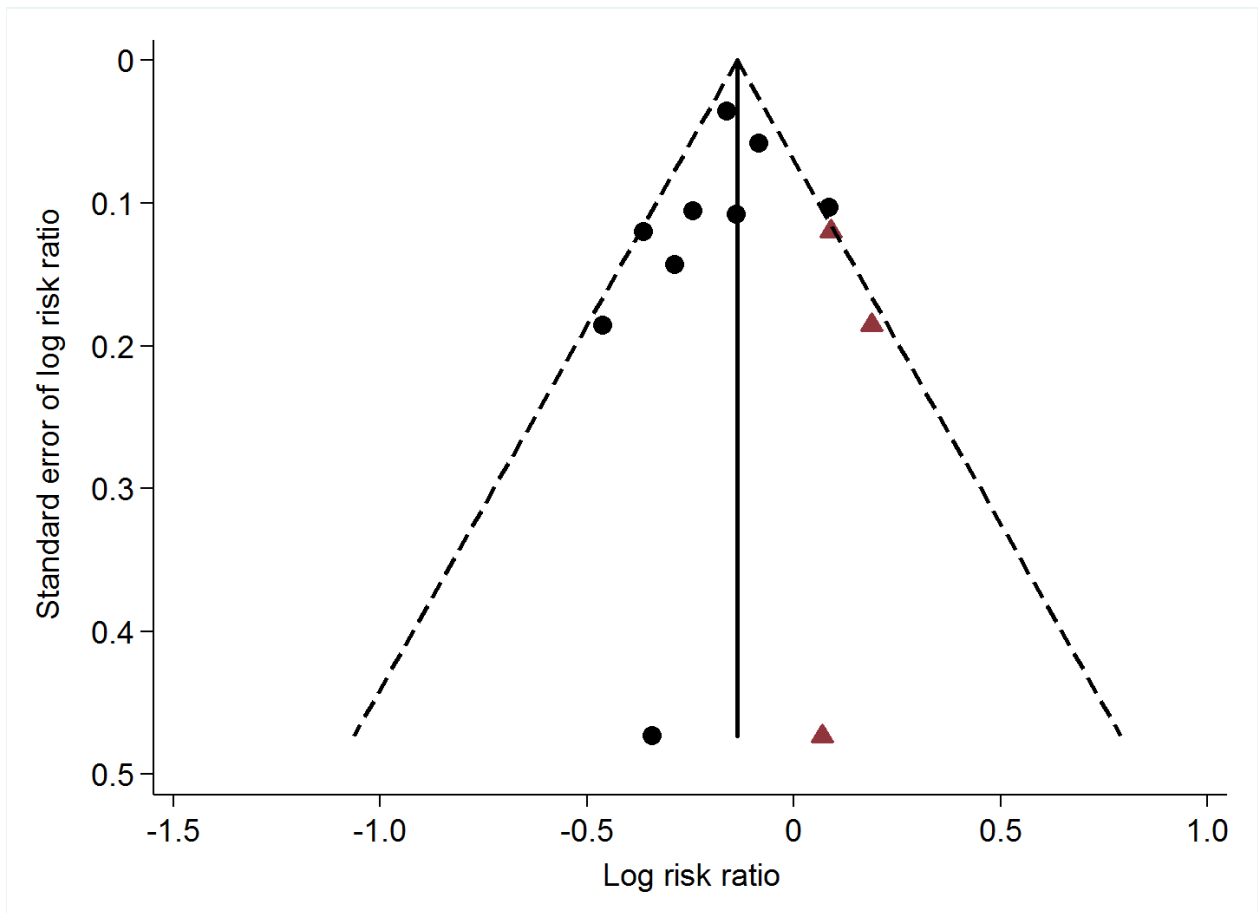
**Figure S2:** A funnel plot of 20 studies on low back pain in the past 1-12 months for active vs. inactive. Dark orange line indicates the fitted regression line ( $P$  for Egger test = 0.78)



**Figure S3:** A filled funnel plot showing 12 observed studies (solid black circles) on low back pain in the past 1-12 months for moderate vs. low physical activity and three studies imputed (solid maroon triangles) by the trim and fill method



**Figure S4:** A funnel plot of nine studies on frequent or chronic low back pain for active vs. inactive. Dark orange line indicates the fitted regression line ( $P$  for Egger test = 0.38)



**Figure S5:** A filled funnel plot showing nine observed studies (solid black circles) on frequent or chronic low back pain for active vs. inactive and three studies imputed (solid maroon triangles) by the trim and fill method

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