# B1: Evidence on physical activity for adults (18 to under 65 years of age)

## *Guiding Questions*

B1. What is the association between **physical activity** and health-related outcomes?
  a. Is there a dose response association (volume, duration, frequency, intensity)?
  b. Does the association vary by type or domain of physical activity?

## *Inclusion Criteria*

**Population**: Adults 18 years of age and older
**Exposure:** Greater volume, duration, frequency or intensity of physical activity
**Comparison:** No physical activity or lesser volume, duration, frequency, or intensity of physical activity

| Outcomes | Importance |
|---|---|
| All-cause and cause-specific mortality | Critical |
| Incidence of CVD | Critical |
| Incidence of cancer | Critical |
| Incidence of Type 2 Diabetes | Critical |
| Adiposity/Prevention of weight gain/Body composition | Critical |
| Mental health outcomes (e.g. depressive symptoms, anxiety symptoms) | Critical |
| Cognitive outcomes (e.g. dementia, cognition) | Critical |
| Sleep duration and quality | Important |
| Incidence of hypertension | Important |
| Health-related quality of life | Important |

Abbreviations: CVD = cardiovascular disease; NA = not applicable; PA = physical activity

## *Included Evidence*

Seventy-five reviews (published from 2017 to 2019) were initially identified that examined the association between physical activity and health-related outcomes among adults *(1-75)*. However, 35 reviews were excluded from further evaluation given the study design, populations, exposures, or outcomes that were out-of-scope or other concerns regarding the quality or relevance of the review. **Table 2.1** presents the reviews that were excluded and their reason for exclusion.

**Table 2.2** presents the ratings for each remaining review according to all the AMSTAR 2 main domains. In general, the included reviews had many limitations in their design, execution, and reporting. Only two systematic reviews were rated as having high credibility based on the AMSTAR 2 instrument. Fifteen were rated as having moderate credibility, 11 were rated as having low credibility, and the remaining 9 were rated as having critically low credibility. Given concerns regarding the comprehensiveness and the validity of the results presented in reviews rated as having critically low credibility, they were not incorporated into the final Evidence Profiles. All 3 pooled cohort studies were rated as good quality according to the Newcastle-Ottawa Scale (**Table 2.3**).

**Table 2.4** lists the 28 reviews and 3 pooled cohort studies that were included in the evidence profiles by outcome. Most of the included reviews searched for evidence through 2016 or 2017; very few reviews searched for evidence into 2018 or 2019. As a result, very few individual studies represented within the reviews were published in 2018 or 2019. Most reviews had narrow foci in terms of study designs, exposures (limited to specific types of physical activity), and outcomes. Extracted data for each included review is presented in **Appendix 2.**



## Table 2.1. Excluded Systematic Reviews, with Reasons for Exclusion

| Author, Year | Reason for Exclusion | Rationale |
|---|---|---|
| Al Tunaiji 2019 *(1)* | Design | Includes no studies published after 2017 |
| Amirfaiz 2019 *(3)* | Outcome | Outcome (metabolic syndrome) out of scope |
| Banno 2018 *(5)* | Population | Review limited to persons with insomnia; not generalizable |
| Coenen 2018 *(16)* | Exposure | Occupational physical activity |
| Colpani 2018 *(17)* | Exposure | Any lifestyle factor, not physical activity independently |
| Del Pozo-Cruz 2018 *(18)* | Exposure | Replacing sedentary time |
| Fernandes 2018 *(22)* | Exposure | Acute exercise only |
| Flahr 2018 *(23)* | Population | Review limited to studies of shift workers; not generalizable |
| Fuezeki 2017 *(24)* | Design | Analysis of NHANES data only |
| Guo 2017 *(27)* | Exposure | Any cardiovascular health metric |
| Halloway 2017 *(28)* | Outcome | MRI brain imaging |
| Herold 2019 *(30)* | Outcome | Required measures of functional or structural brain changes |
| Hussenoeder 2018 *(32)* | Design | Overview-of-reviews |
| Igarashi 2018a *(33)* | Outcome | Continuous blood pressure |
| Igarashi 2018b *(34)* | Outcome | Continuous blood pressure |
| Jiang 2017 *(35)* | Population | Review limited to persons with insomnia; not generalizable |
| Lewis 2018 *(37)* | Outcome | Outcome (zeitebers/circadian system time cues) out of scope |
| Lipnicki 2019 *(38)* | Design | Not a systematic review |
| Liu 2018 *(40)* | Design | Pooled data from Asia consortium; study is included in the review by Blond *(11)* |
| Lopez-Valenciano 2019 *(41)* | Outcome | Continuous blood pressure |
| Loprinzi 2018a *(44)* | Exercise | Acute exercise |
| Loprinzi 2018c *(42)* | Population | Most studies conducted with rodents |
| Lowe 2019 *(45)* | Population | Review limited to persons with insomnia; not generalizable |
| Murphy 2019 *(48)* | Outcome | Continuous blood pressure |
| Nordengen 2019 *(49)* | Outcome | Continuous blood pressure |
| Oja 2018 *(52)* | Outcome | Continuous blood pressure |
| Origua Rios 2017 *(53)* | Outcome | Results not presented by study nor in format amendable to GRADE evaluation |
| Prince 2019 *(56)* | Relevance | Aim is to examine the prevalence of different types of PA according to various occupational types |
| Shepherd-Banigan 2017 *(62)* | Relevance | Only 3 new trials identified that examined the effects of yoga on the incidence of hot flashes among peri- and post-menopausal women |
| Smart 2019 *(64)* | Outcome | Continuous blood pressure |
| Stringhini 2017 *(67)* | Design | Not a systematic review |
| Viana 2019 *(71)* | Quality | Statement of concern published by journal to alert readers of uncertainty about the weight and significance reported by authors |
| Wang 2019 *(72)* | Population | Review limited to persons with active sleep disturbances or insomnia; not generalizable |
| Wewege 2018 *(74)* | Redundancy | Review by Andreato 2018 is more recent, more comprehensive, and better quality and includes all included studies by Wewege; similar results were found with both reviews. |
| Zhang 2018 *(75)* | Outcome | Continuous blood pressure |

## Table 2.2. Credibility Ratings (based on AMSTAR 2 *(76)*)

| Author, Year | PICO[1] | Apriori Methods[2] | Study Design Selection[3] | Lit Search Strategy[4] | Study Selection[5] | Data Extraction[6] | Excluded Studies[7] | Included Studies[8] | RoB Assessment[9] | Funding Sources[10] | Statistical Methods[11] | Impact of RoB[12] | RoB Results[13] | Heterogeneity[14] | Publication Bias[15] | COI[16] | Overall Rating[17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amagasa 2018 *(2)* | Y | Y | N | PY | N | Y | PY | Y | N | N | N/A | N/A | N | Y | N/A | Y | **Low** |
| Andreato 2019 *(4)* | Y | PY | N | PY | Y | Y | PY | Y | Y | N | Y | N | Y | Y | N | Y | **Moderate** |
| Barredo 2017 *(6)* | N | N | N | N | N | Y | N | N | PY | N | N/A | N/A | N | N | N/A | N | **Critically Low** |
| Baumeister 2019 *(7)* | Y | N | N | PY | Y | Y | PY | Y | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Behrens 2019 *(8)* | Y | PY | N | PY | Y | Y | PY | PY | PY | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Benke 2018 *(9)* | Y | PY | N | PY | N | Y | PY | PY | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Binkley 2019 *(10)* | N | N | N | N | N | N | N | Y | Y | N | N/A | N/A | N | N | N/A | N | **Critically Low** |
| Blond 2019 *(11)* | Y | PY | N | PY | Y | N | PY | Y | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Boyer 2019 *(12)* | Y | N | N | N | N | N | N | Y | Y | N | Y | Y | Y | N | Y | N | **Low** |
| Brasure 2018 *(13)* | Y | Y | Y | PY | Y | Y | Y | Y | Y | N | N/A | N/A | Y | Y | N/A | Y | **High** |
| Chastin 2019 *(14)* | Y | Y | Y | PY | Y | Y | N | Y | PY | N | Y | Y | N | N | Y | Y | **Moderate** |
| Cocchiara 2019 *(15)* | N | N | N | PY | Y | Y | N | N | Y | N | N/A | N/A | N | N | N/A | Y | **Critically Low** |
| Dinu 2019 *(19)* | Y | N | N | PY | Y | Y | PY | PY | Y | N | N | Y | Y | Y | N | Y | **Low** |
| Ekelund 2019 *(20)* | Y | PY | N | PY | N | Y | PY | Y | Y | N | Y | N | N | N | Y | Y | **Moderate** |
| Engeroff 2018 *(21)* | Y | N | N | PY | Y | Y | PY | Y | PY | N | N/A | N/A | Y | N | N/A | Y | **Moderate** |
| Gordon 2017 *(26)* | Y | PY | N | PY | N | N | PY | PY | PY | N | Y | Y | Y | Y | Y | Y | **Low** |
| Gordon 2018 *(25)* | Y | PY | N | PY | N | Y | N | PY | PY | N | Y | Y | Y | Y | Y | N | **Low** |
| Hart 2019 *(29)* | Y | N | N | N | Y | Y | N | PY | PY | N | Y | Y | Y | Y | Y | Y | **Critically Low** |
| Hidayat 2019 *(31)* | Y | PY | N | PY | Y | Y | PY | N | N | N | Y | N | N | Y | Y | Y | **Critically Low** |
| Kovacevic 2018 *(36)* | Y | PY | N | Y | Y | N | PY | Y | PY | N | N/A | N/A | Y | Y | N/A | Y | **Moderate** |
| Liu 2019 *(39)* | Y | PY | N | PY | Y | Y | PY | PY | Y | N | Y | Y | Y | Y | Y | N | **Moderate** |
| Loprinzi 2018 *(43)* | Y | N | N | PY | N | N | N | PY | N | N | N/A | N/A | N | Y | N/A | Y | **Critically Low** |
| Maillard 2018 *(46)* | N | N | N | PY | N | N | PY | N | N | N | N | N | N | Y | N | Y | **Critically Low** |

| Author, Year | PICO[1] | Apriori Methods[2] | Study Design Selection[3] | Lit Search Strategy[4] | Study Selection[5] | Data Extraction[6] | Excluded Studies[7] | Included Studies[8] | RoB Assessment[9] | Funding Sources[10] | Statistical Methods[11] | Impact of RoB[12] | RoB Results[13] | Heterogeneity[14] | Publication Bias[15] | COI[16] | Overall Rating[17] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Martinez-Dominguez 2018 *(47)* | Y | PY | N | PY | N | N | PY | PY | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Northey 2018 *(50)* | Y | PY | N | PY | Y | Y | PY | PY | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Paudel 2019 *(54)* | Y | Y | N | PY | Y | Y | PY | PY | PY | N | N | Y | Y | Y | Y | Y | **Low** |
| Perez-Lopez 2017 *(55)* | Y | PY | N | PY | Y | Y | PY | PY | Y | N | Y | N | N | Y | Y | Y | **Moderate** |
| Rathore 2017 *(57)* | Y | N | Y | PY | N | N | N | Y | Y | N | Y | Y | Y | Y | N | Y | **Low** |
| Robbins 2019 *(58)* | Y | PY | N | PY | Y | Y | PY | PY | PY | N | N/A | N/A | N | Y | N/A | Y | **Low** |
| Saeidifard 2019 *(59)* | Y | N | N | PY | Y | Y | PY | Y | Y | N | N | N | N | N | N | Y | **Critically Low** |
| Schuch 2018 *(61)* | Y | PY | Y | Y | Y | N | Y | Y | Y | N | Y | Y | Y | Y | Y | Y | **High** |
| Schuch 2019 *(60)* | Y | PY | Y | PY | Y | Y | Y | Y | PY | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Stanmore 2017 *(66)* | Y | N | N | PY | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | **Low** |
| Stutz 2019 *(68)* | Y | PY | N | PY | Y | Y | N | Y | Y | N | Y | Y | Y | Y | Y | Y | **Moderate** |
| Su 2019 *(69)* | Y | PY | N | PY | Y | N | PY | PY | N | N | Y | N | N | Y | Y | Y | **Critically Low** |
| Sultana 2019 *(70)* | Y | N | N | PY | Y | Y | N | Y | PY | N | Y | N | Y | Y | Y | Y | **Low** |
| Wang 2017 *(73)* | Y | N | Y | PY | N | Y | N | Y | Y | N | Y | N | Y | Y | N | N | **Low** |

Abbreviations: COI = conflict of interest; N = no; N/A = not applicable; PICO = population, intervention, comparator, outcome; PY = PY; RoB = risk of bias; Y = yes



[1] Did the research questions and inclusion criteria for the review include the components of PICO?
[2] Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?
[3] Did the review authors explain their selection of the study designs for inclusion in the review?
[4] Did the review authors use a comprehensive literature search strategy?
[5] Did the review authors perform study selection in duplicate?
[6] Did the review authors perform data extraction in duplicate?
[7] Did the review authors provide a list of excluded studies and justify the exclusions?
[8] Did the review authors describe the included studies in adequate detail?
[9] Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?
[10] Did the review authors report on the sources of funding for the studies included in the review?
[11] If meta-analysis was performed did the review authors use appropriate methods for statistical combination of results?
[12] If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?

[13] Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?
[14] Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?
[15] If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?
[16] Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?
[17] Shea et al. 2017. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both.

Table 2.3. Quality Ratings of Included Pooled Cohort Studies (based on Newcastle-Ottawa scale *(77)*)

| **Author, Year** | Represen-tativeness of the exposed cohort | Selection of the non-exposed cohort | Ascertain-ment of exposure | Outcome of interest was not present at start of study | **Bias in selection of the exposed cohort** | Comparability of cohorts on the basis of the design or analysis | **Bias due to con-founding** | Assessment of outcome | Was follow-up long enough for outcome to occur | Adequacy of follow-up of cohorts | **Bias due to outcome ascertain-ment** | Quality Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O'Donovan 2017 *(51)* | Truly representative of the target populations of the corresponding countries | Drawn from the same community as the exposed cohort | Structured interview | Yes | **Low** | Controlled foo age, sex, smoking, total cholesterol, SBP, BMI, longstanding illness, and SES | **Low** | Record linkage | Yes | No statement | **Low** | Good |
| Siahpush 2019 *(63)* | Truly representative of the civilian noninstitutional population of the US | Drawn from the same community as the exposed cohort | Structured interview | Yes | **Low** | Controlled for BMI, alcohol consumption, presence of chronic condition, sex, age, poverty status, education, home ownership, marital status, race/ethnicity, nativity, and survey year | **Low** | Record linkage | Yes | Subjects lost to follow up unlikely to introduce bias | **Low** | Good |
| Stamatakis 2017 *(65)* | Truly representative of the target populations of the corresponding countries | Drawn from the same community as the exposed cohort | Structured interview | Yes | **Low** | Analysis controlled for BMI, age, educational attainment, presence of long-standing illness, weekly frequency of alcohol consumption, smoking habits, psychological distress/depression, number of servings of fruit and vegetables | **Low** | Record linkage | Yes | No statement | **Low** | Good |

## Table 2.4. Included Systematic Reviews, by Author

| | Outcomes | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Author, Year** | **All-cause mortality** | **CVD mortality** | **Incidence of CVD** | **Incidence of cancer** | **Incidence of Type 2 Diabetes** | **Adiposity-related outcomes** | **Mental health-related outcomes** | **Cognitive function** | **Sleep** | **Incidence of HYP** | **Health-related QOL** | **Last Search Date** | **Credibility/ Quality** |
| Amagasa 2018 *(2)* | X | | | | | X | X | X | | | | Jan-2017 | Low |
| Andreato 2019 *(4)* | | | | | | X | | | | | | May-2018 | Moderate |
| Barredo 2017 *(6)* | | | | | | | | | | | X | Nov-2015 | Critically Low |
| Baumeister 2019 *(7)* | | | | X | | | | | | | | Aug-2018 | Moderate |
| Behrens 2019 *(8)* | | | | X | | | | | | | | Mar-2018 | Moderate |
| Benke 2018 *(9)* | | | | X | | | | | | | | July-2017 | Moderate |
| Binkley 2019 *(10)* | | | | | | X | | | | | X | Jan-2015 | Critically Low |
| Blond 2019 *(11)* | X | X | | | | | | | | | | Mar-2019 | Moderate |
| Boyer 2019 *(12)* | | | | | X | | | | | | | Jun-2016 | Low |
| Brasure 2018 *(13)* | | | | | | | | X | | | | Jul-2017 | High |
| Chastin 2019 *(14)* | X | | | | | X | | | | | | Feb-2018 | Moderate |
| Cocchiara 2019 *(15)* | | | | | | | X | | X | | | Feb-2017 | Critically Low |
| Dinu 2019 *(19)* | X | X | X | | X | | | | | | | Feb-2018 | Low |
| Ekelund 2019 *(20)* | X | | | | | | | | | | | Jul-2018 | Moderate |
| Engeroff 2018 *(21)* | | | | | | | | X | | | | Nov-2017 | Moderate |
| Gordon 2017 *(26)* | | | | | | | X | | | | | Feb-2017 | Low |
| Gordon 2018 *(25)* | | | | | | | X | | | | | Aug-2017 | Low |
| Hart 2019 *(29)* | | | | | | | | | | | X | Dec-2017 | Critically Low |
| Hidayat 2019 *(31)* | | | | | | | | | | | | Jul-2018 | Critically Low |
| Kovacevic 2018 *(36)* | | | | | | | | | X | | | Jun-2016 | Moderate |
| Liu 2019 *(39)* | | | | | | | | | | | | Aug-2018 | Moderate |
| Loprinzi 2018 *(43)* | | | | | | | | X | | | | Sep-2017 | Critically Low |
| Maillard 2018 *(46)* | | | | | | X | | | | | | Jul-2017 | Critically Low |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Martinez-Dominguez 2018 *(47)* | | | | | | | X | | | | | Jul-2017 | Moderate |

| | Outcomes | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Author, Year** | **All-cause mortality** | **CVD mortality** | **Incidence of CVD** | **Incidence of cancer** | **Incidence of Type 2 Diabetes** | **Adiposity-related outcomes** | **Mental health-related outcomes** | **Cognitive function** | **Sleep** | **Incidence of HYP** | **Health-related QOL** | **Last Search Date** | **Credibility/ Quality** |
| Northey 2018 *(50)* | | | | | | | | X | | | | Nov-2016 | Moderate |
| O'Donovan 2017[a] *(51)* | X | X | | | | | | | | | | NA | Good quality |
| Paudel 2019 *(54)* | | | | | X | X | | | | X | | Mar-2018 | Low |
| Perez-Lopez 2017 *(55)* | | | | | | | X | | X | | X | Jun-2017 | Low |
| Rathore 2017 *(57)* | | | | | | | | X | | | | Dec-2016 | Low |
| Robbins 2019 *(58)* | | | | | | | | | X | | | Sep-2018 | Low |
| Saeidifard 2019 *(59)* | X | X | X | | | | | | | | | Sep-2017 | Critically Low |
| Schuch 2018 *(61)* | | | | | | | X | | | | | Oct-2017 | High |
| Schuch 2019 *(60)* | | | | | | | X | | | | | Oct-2018 | Moderate |
| Siahpush 2019[a] *(63)* | X | X | | | | | | | | | | NA | Good quality |
| Stamatakis 2017[a] *(65)* | X | X | | | | | | | | | | NA | Good quality |
| Stanmore 2017 *(66)* | | | | | | | | X | | | | Jan-2017 | Low |
| Stutz 2019 *(68)* | | | | | | | | | X | | | Jun-2017 | Moderate |
| Su 2019 *(69)* | | | | | | X | | | | | | Jul-2018 | Critically Low |
| Sultana 2019 *(70)* | | | | | | X | | | | | | Jun-2019 | Low |
| Wang 2017 *(73)* | | | | | | | | | | | X | Jan-2015 | Low |

[a] Not a systematic review. Pooled cohort analysis.

# B. Adults

## B.1. Physical Activity

**Questions:** What is the association between **physical activity** and health-related outcomes? Is there a dose response association (volume, duration, frequency, intensity)? Does the association vary by type or domain of PA?
**Population:** Adults 18 years of age and older
**Exposure:** Greater volume, duration, frequency, or intensity of physical activity
**Comparison**: No physical activity or lesser volume, duration, frequency, or intensity of physical activity

### *Table B.1.a. All-cause mortality: Association between physical activity and all-cause mortality among adults (in alphabetical order by author)*

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Amagasa 2018 *(2)*<br><br>Low | 4 cohort studies<br><br>N=17,133 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | All four cohort studies used data from NHANES 2003 to 2004 and 2005 to 2006; age range 50 to 80 years and compared replacing SB with LPA (3/4 studies) or quintiles of LPA (1/4 study).<br><br>3/4 studies reported **replacing 30-60 min of SB with LPA** was associated with lower **all-cause mortality** risk after adjustment for MVPA (HR range, 0.80 to 0.88 [95% CI range, 0.73 to 0.92]). 1/4 only found an effect among women with low MVPA when comparing modest to high levels of LPA vs. very low LPA. | MODERATE[a] |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Blond 2019 *(11)*<br><br>Moderate | 48 prospective cohort studies<br><br>N=NR | No serious risk of bias | Serious inconsistency | No serious indirectness | No serious imprecision | Dose--response relationship | Five studies used accelerometers to measure PA while all other studies used self-reported PA. Eight measures included occupational PA. Most studies focused on MVPA or leisure-time PA.<br><br>A curvilinear relationship was found between **total PA** and **all-cause mortality** (*p* non-linearity <0.001). Compared with 750 MET min/week, those participating in 2000 MET min/week (4 hrs/week) had a statistically significantly lower risk of all-cause mortality (HR = 0.82 [95% CI, 0.81 to 0.84]) with an ARD = -16 deaths per 10,000 person years [95% CI, -17 to -14 deaths). Other comparisons presented below. | MODERATE[b] |

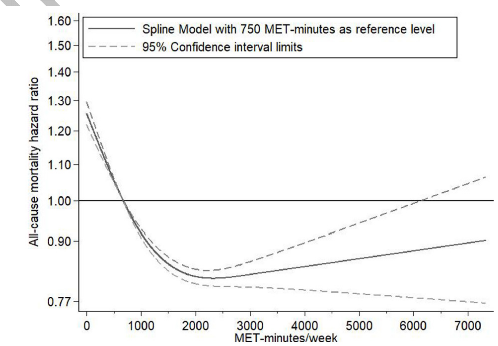


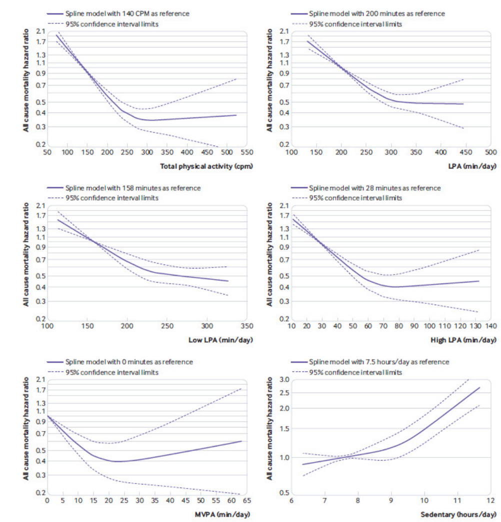

**Figure 2** Dose–response relationship between physical activity and all cause mortality. Dose–response relation between metabolic equivalent of task (MET) min/week (with 750 MET min/week as the reference) and mortality risk estimated with restricted cubic spline regression and generalised least square trend estimation for summarised dose–response data.

**Table 1** Mortality HRs with 750 metabolic equivalent of task (MET) min/week as reference and estimated absolute rate differences per 10 000 person years

| MET min/week | | 0 | 500 | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 |
|---|---|---|---|---|---|---|---|---|---|
| Running (5 mph)* | | 0 hour/week | 1 hour/week | 2 hours/week | 4 hours/week | 6 hours/week | 8 hours/week | 10 hours/week | 12 hours/week |
| All cause mortality | Studies | 30 | 35 | 33 | 34 | 17 | 5 | 2 | 3 |
| | Participants† | 812 489 | 984 339 | 358 878 | 465 615 | 225 616 | 78 220 | 4436 | 97 856 |
| | PY† | 10 324 343 | 9 532 179 | 4 007 856 | 5 235 839 | 1 910 230 | 689 649 | 65 073 | 48,6671 |
| | Total cases† | 47 141 | 104 927 | 36 201 | 43 861 | 12 342 | 3684 | 246 | 2962 |
| | HR (95% CI) | 1.26 (1.22 to 1.29) | 1.06 (1.05 to 1.06) | 0.92 (0.91 to 0.93) | 0.82 (0.81 to 0.84) | 0.83 (0.80 to 0.85) | 0.84 (0.79 to 0.90) | 0.86 (0.78 to 0.94) | 0.88 (0.78 to 0.99) |
| | ARD (95% CI)‡ | 23 (19 to 25) | 5 (4 to 5) | −7 (−8 to −6) | −16 (−17 to −14) | −15 (−18 to −13) | −14 (−18 to −8) | −12 (−19 to −5) | −11 (−19 to −1) |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Chastin 2019 *(14)*<br><br>Moderate | 12 prospective cohort studies<br><br>N=127,724 | No serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | Studies compared **high vs. low levels of physical activity** (as defined by each study, and inconsistent between studies). Of the 5/12 prospective cohort studies that were pooled two studies used self-report of light PA whereas 3 studies used accelerometer-measured light PA. Light PA was defined variably including 100-2019 counts/min, 100-1040 counts/min, using Freedson cutpoints, MET>1.5 – 2.99, or self-report light activity (e.g., very easy). Most studies were among adults ≥50 years.<br><br>A pooled analysis of 5 studies reporting all-cause mortality found a statistically significant reduced risk of **all-cause mortality** for the highest vs. lowest levels of **light intensity physical activity** (HR = 0.71 [95% CI 0.62 to 0.83], 5 studies). | LOW[c] |
| Dinu 2019 *(19)*<br><br>Low | 11 prospective cohort studies<br><br>N=231,259 | No serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | All studies evaluated the effects of **active commuting** (cycling 5 studies, walking 3 studies, mixed mode 3 studies) on health outcomes. Exposure levels of active commuting were variably reported as minutes spent walking or cycling for transportation per day, as dichotomized variables (yes or no), or as METs with the reference category as no active commuting in most studies. Follow-up ranged from 4 to 25 years.<br><br>Persons engaged in **active commuting** had a significantly lower risk of **all-cause mortality** compared with those participating in no active commuting (RR = 0.92 [95% CI 0.85 to 0.98], 11 studies). When the 3 studies that had the largest estimates of effects were removed from the analysis, the heterogeneity was reduced ($I^2$ of 67% to 11%) and the direction of effect changed (RR = 1.00 [95% CI, 0.96 and 1.04], 8 studies). | LOW[d] |

<table>
<tr><th rowspan="2">Systematic review evidence<br><br>Review credibility</th><th rowspan="2">No. of studies/ Study design<br><br>No. of participants</th><th colspan="5">Quality Assessment</th><th rowspan="2">Description of evidence<br><br>Summary of findings</th><th rowspan="2">Certainty</th></tr>
<tr><th>Risk of bias</th><th>Inconsistency</th><th>Indirectness †</th><th>Imprecision</th><th>Other</th></tr>
<tr><td>Ekelund 2019 (20)<br><br>Moderate</td><td>8 prospective cohort studies<br><br>N=36,383</td><td>No serious risk of bias</td><td>No serious inconsistency</td><td>No serious indirectness</td><td>No serious imprecision</td><td>Dose--response relationship</td><td>Harmonized meta-analysis from eight prospective cohort studies, including data from 3 large surveillance systems and 2 from unpublished data. Mean age in studies was 63 years with median follow-up of 5.8 years (range 3 to 14.5 years). All 8 studies used accelerometers to measure PA and SB; exposure variables differed within each study including total volume of PA (cpm), min/day spend in intensity-specific variables (sedentary <u><</u>100 cpm, light 101-1951 cpm, moderate to vigorous <u>></u>1952 cpm, vigorous <u>></u>5725 cpm), bouts of MVPA (10 or more minutes of consecutive readings <u>></u>1952 cpm). Data was categorized into quartiles with the least active quartile as the referent.<br><br>Compared with the lowest levels of PA, <u>any level of PA regardless of intensity</u> (i.e., total PA) was associated with a lower risk of mortality. The magnitude of risk for increasing quarter of total PA was least active (referent, 1.00), 2nd quarter (adjusted HR = 0.48 [95% CI, 0.43 to 0.54]), 3rd quarter (adjusted HR = 0.34 [95% CI, 0.26 to 0.45]), and 4th quarter (adjusted HR = 0.27 [95% CI, 0.23 to 0.32]). Higher levels of <u>light intensity PA, low light intensity PA, and high light intensity PA</u> were also significantly associated with reduced risk of death during follow-up as was <u>MVPA</u> (including when controlling for SB time) (table below).<br><br>
<table>
<tr><th colspan="5">Table 2 | Meta-analysis for associations between total physical activity, intensities of physical activity or sedentary time by quarters and all cause mortality</th></tr>
<tr><th rowspan="2">Variables</th><th colspan="4">Hazard ratios (95% CI) for all cause mortality*; No of participants; No of deaths</th></tr>
<tr><th>First quarter (least active)</th><th>Second quarter</th><th>Third quarter</th><th>Fourth quarter (most active)</th></tr>
<tr><td colspan="5">Model B†</td></tr>
<tr><td>Total physical activity (cpm)</td><td>1 (ref) (n=9096; 1187)</td><td>0.48 (0.43 to 0.54) (n=9105, 483)</td><td>0.34 (0.26 to 0.45) (n=9096, 265)</td><td>0.27 (0.23 to 0.32) (n=9086, 214)</td></tr>
<tr><td colspan="5">Physical activity intensity:</td></tr>
<tr><td>Light (min/d)</td><td>1 (ref) (n=9073; 1089)</td><td>0.60 (0.54 to 0.68) (n=9101; 511)</td><td>0.44 (0.38 to 0.51) (n=9090; 320)</td><td>0.38 (0.28 to 0.51) (n=9119; 229)</td></tr>
<tr><td>Low light (min/d)</td><td>1 (ref) (n=9066; 1010)</td><td>0.66 (0.56 to 0.77) (n=9106; 518)</td><td>0.47 (0.38 to 0.58) (n=9112; 353)</td><td>0.42 (0.34 to 0.52) (n=9099; 268)</td></tr>
<tr><td>High light (min/d)</td><td>1 (ref) (n=9054; 1159)</td><td>0.55 (0.49 to 0.63) (n=9120; 483)</td><td>0.38 (0.30 to 0.48) (n=9088; 278)</td><td>0.37 (0.32 to 0.46) (n=9113; 229)</td></tr>
<tr><td>Moderate to vigorous (min/d)</td><td>1 (ref) (n=9002; 1139)</td><td>0.64 (0.55 to 0.74) (n=9153; 468)</td><td>0.55 (0.40 to 0.74) (n=9123; 305)</td><td>0.52 (0.43 to 0.61) (n=9105; 237)</td></tr>
<tr><td>Sedentary (min/d)</td><td>1 (ref) (n=9102; 327)</td><td>1.28 (1.09 to 1.51) n=9105; 417)</td><td>1.71 (1.36 to 2.15) (n=9096; 562)</td><td>2.63 (1.94 to 3.56) (n=9080; 843)</td></tr>
<tr><td colspan="5">cpm=counts per minute.<br>Model A adjusted for sex (when applicable), age, and wear time (n=36852, 2304 deaths). Model B adjusted for sex (when applicable), age, body mass index, socioeconomic position, and wear time (n=36383, 2149 deaths). Model C additionally adjusted for covariates listed in table 1 (n=35 932, 2047 deaths).<br>*By Cox regression.<br>†Moderate-to-vigorous physical activity and sedentary time are mutually adjusted.</td></tr>
</table>
<br>Differences in min/day between the referent (least active) and 2nd quarter were broadly equal to 60 min/day of light intensity PA, 35 min/day of low light intensity PA, 25 min/day of high light intensity PA, and 5 min/day of MPVA.<br><br>A non-linear, dose-response association was found between all exposure variables and mortality (p<0.02 for all exposure variables)</td><td>HIGH[e]</td></tr>
</table>

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | (figure below). The maximal risk reduction for total PA was observed at about 300 cpm (adjusted HR = 0.34 [95% CI 0.27 to 0.43]). Maximal risk reductions for light intensity PA was ~375 min/day, low light intensity PA at ~325 min/day, high light intensity PA at ~80 min/day, and MVPA at ~24 min/day. No further risk reductions occurred with higher levels of activity except for low light intensity PA where the risk appeared to reduce further.<br><br><br>Fig 2 \| Dose-response associations between total physical activity (top left), light intensity physical activity (LPA) (top right), low LPA (middle left), high LPA (middle right), moderate-to-vigorous intensity physical activity (MVPA) (bottom left), and sedentary time (bottom right, data from REGARDS (Reasons for Geographic and Racial Differences in Stroke)[9] and FHS (Women's Health Study)[12] are only included for MVPA) and all cause mortality. Modelling performed using restricted cubic splines with knots at 25th, 50th, and 75th centiles of exposure specific distribution from medians of quarters (least to most active). The exposure reference is set as the median of the medians in the reference group (least active) (see supplementary table 3). Knot locations are available in supplementary table 8. cpm=counts per minute | |
| O'Donovan 2017[f] *(51)*<br><br>Good quality[g] | Pooled cohort analysis<br><br>N=37,059 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | Compared with those who **met PA guidelines[h]** and whose HDL-C was normal, all-cause mortality risk was elevated in those who did not meet PA guidelines and whose HDL-C was normal (adjusted HR = 1.37 [95% CI, 1.16 to 1.61]) and in those who did not meet PA guidelines and whose HDL-C was low (adjusted HR = 1.65 [95% CI 1.37 to 1.98]). | MODERATE[i] |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Siahpush 2019[j] *(63)*<br><br>Good quality[g] | Pooled cohort analysis<br><br>N=68,706 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | Smokers who reported **meeting aerobic and strengthening PA guidelines**[h] had significantly lower risk of all-cause mortality (adjusted HR = 0.71 [95% CI, 0.62 to 0.81]) than those not meeting either recommendation as did those meeting aerobic PA recommendations (adjusted HR = 0.81 [95% CI 0.75 to 0.88]) versus those not meeting either recommendation. There was no association between all-cause mortality and meeting strength recommendations (and not aerobic PA recommendations) vs. meeting neither recommendation (HR = 0.90 [95% CI, -.76 to 1.07]). | MODERATE[i] |
| Stamatakis 2018[k] *(65)*<br><br>Good quality[g] | Pooled cohort analysis<br><br>N=80,306 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | Dose-response relationship[l] | Adherence to both **aerobic and strengthening PA guidelines**[h] vs. not adhering to either (adjusted HR = 0.71 [95% CI 0.57 to 0.87]) and adherence to the strength exercise guideline[m] vs. not adhering (HR = 0.80 [95% CI, 0.70 to 0.91]) was associated with significantly reduced risk of all-cause mortality<br><br>Additionally, participation in any strength-promoting exercise vs. no strength-promoting exercise (adjusted HR = 0.77 [95% CI, 0.69 to 0.87]), as well as own-body-weight strength activities vs. none and gym-based strength activities vs. none were associated with a significantly reduced risk of all-cause mortality. | MODERATE[n] |

Abbreviations: ARD = absolute rate difference; CI = confidence interval; cpm = counts per minute; HDL-C = high-density lipoprotein cholesterol; HR = hazards ratio; LPA = light physical activity; MET =metabolic equivalent of task; min = minutes; MVPA = moderate-to-vigorous intensity PA; NR = not reported; PA = physical activity; RR = risk ratio; SB = sedentary behaviour

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence upgraded given no serious limitations in included evidence
[b] Certainty of evidence upgraded given no serious risk of bias of included studies and evidence of dose-response relationship; however, serious inconsistency (high between study variance, $I^2$>77%) present
[c] Certainty of evidence not upgraded given serious inconsistency in effects between studies and statistical heterogeneity and indirectness in comparisons of exposures
[d] Certainty of evidence not upgraded given serious risk of bias (not appropriately adjusting for confounding), serious inconsistency (heterogeneity) and indirectness in comparisons of exposures
[e] Certainty of evidence upgraded given no serious limitations in the body of evidence, individual participant-level data meta-analysis, and evidence of a dose response relationship
[f] Not a systematic review. Pooled analysis of nine cohorts of the Health Survey for England and the Scottish Health Survey and linked to the British National Health Service Central Registry for data on mortality
[g] Quality rated based on the Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses *(77)*
[h] 150 min/week of moderate-intensity leisure time PA, or at least 75 min/week of vigorous-intensity leisure-time PA, or an equivalent combination and performing strengthening exercises >2 times/week
[i] Certainty of evidence upgraded given no serious limitations in included evidence
[j] Not a systematic review. Pooled analysis of 1998-2009 National Health Index Survey and linked National Death Index
[k] Not a systematic review. Pooled analysis of 11 cohorts of the Health Survey for England and the Scottish Health Survey and linked to the British National Health Service Central Registry for data on mortality

[l] There was evidence of a trend for greater reduced risk for all-cause mortality when comparing high, low, and no weekly volume of any strength exercise and own-body-weight strength activity

[m] Performing strengthening exercises $\geq$2 times/week

[n] Certainty of evidence upgraded given no serious limitations in included evidence; some evidence of dose-response relationship but not judged to warrant further upgrading

### *Table B.1.b. CVD mortality: Association between physical activity and CVD mortality among adults (in alphabetical order by author)*

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

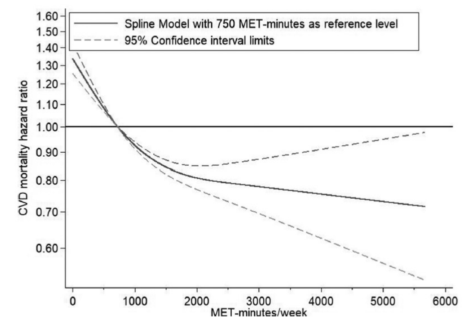
| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment**<br>**Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| Blond 2019 *(11)*<br><br>Moderate | 48 prospective cohort studies<br><br>N=NR | No serious risk of bias | Serious inconsistency | No serious indirectness | No serious imprecision | Possible publication bias<br><br>Evidence of a dose-response relationship | Five studies used accelerometers to measure PA while all other studies used self-reported PA. Eight measures included occupational PA. Most studies focused on MVPA or leisure-time PA.<br><br>An inverse relationship was found between **PA** and **CVD mortality** (*p* non-linearity <0.001). The mortality risk was lower for all PA levels above the recommended level compared with the recommended level (750 MET min/week). Compared with 750 MET min/week, those participating in 2000 MET min/week (4 hrs/week) had a statistically significantly lower risk of all-cause mortality (HR = 0.81 [95% CI, 0.77 to 0.85]) with an ARD = -5 deaths per 10,000 person years [95% CI, -6 to -4 deaths).<br><br><br>**Figure 3** Dose–response relationship between physical activity and cardiovascular disease (CVD) mortality. Dose–response relation b metabolic equivalent of task (MET) min/week (with 750 MET min/week as the reference) and mortality risk estimated with restricted cu regression and generalised least square trend estimation for summarised dose–response data. | MODERATE[a] |

**Table 1** Mortality HRs with 750 metabolic equivalent of task (MET) min/week as reference and estimated absolute rate differences per 100 person years

| **MET min/week** | | **0** | **500** | **1000** | **2000** | **3000** | **4000** | **5000** | **6000** |
|---|---|---|---|---|---|---|---|---|---|
| **Running (5 mph)*** | | **0 hour/week** | **1 hour/week** | **2 hours/week** | **4 hours/week** | **6 hours/week** | **8 hours/week** | **10 hours/week** | **12 hou** |
| CVD mortality | Studies | 15 | 18 | 18 | 17 | 8 | 2 | 2 | NA |
| | Participants† | 579 901 | 986 340 | 279 319 | 286 717 | 111 007 | 19 489 | 5488 | NA |
| | PY† | 7 721 115 | 9 761 494 | 3 860 943 | 3 796 251 | 1 165 769 | 274 344 | 65 089 | NA |
| | Total cases† | 12 318 | 30 196 | 8618 | 8661 | 3258 | 486 | 87 | NA |
| | HR (95% CI) | 1.34 (1.26 to 1.42) | 1.08 (1.07 to 1.10) | 0.93 (0.91 to 0.94) | 0.81 (0.77 to 0.85) | 0.78 (0.69 to 0.87) | 0.75 (0.63 to 0.91) | 0.73 (0.56 to 0.95) | NA |
| | ARD (95% CI)‡ | 8 (6 to 10) | 2 (2 to 2) | −2 (−2 to −1) | −5 (−6 to −4) | −5 (−8 to −3) | −6 (−9 to −2) | −7 (−11 to −1) | NA |



DRAFT Evidence profile – FOR CONSULTATION ONLY

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Dinu 2019 *(19)*<br><br>Low | 9 prospective cohort studies<br><br>N=177,239 | Serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | All studies evaluated the effects of mixed mode (cycling and/or walking) active commuting on health outcomes. Exposure levels of active commuting were variably reported as minutes spent walking or cycling for transportation per day, as dichotomized variables (yes or no), or as METs with the reference category as no active commuting in most studies. Follow-up ranged from 4 to 25 years.<br><br>There was no significant association between **active commuting** and **CVD mortality** compared with those participating in no active commuting (RR = 0.94 [95% CI 0.85 to 1.05], 9 studies). | LOW[b] |
| O'Donovan 2017[c] *(51)*<br><br>Good quality[d] | 9 cohort studies<br><br>N=37,059 | No serious risk of bias | No serious inconsistency | No serious indirectness | Serious imprecision | None | Compared with those who met PA guidelines[e] and whose HDL-C was normal, CVD mortality risk was not significantly elevated in those who did not meet PA guidelines and whose HDL-C was normal (adjusted HR = 1.11 [95% CI, 0.82 to 1.52]); CVD mortality risk was elevated among those who did not meet PA guidelines and whose HDL-C was low (adjusted HR = 1.63 [95% CI 1.16 to 2.27]) compared with those meeting recommendations and with normal HDL-C. | LOW[f] |
| Siahpush 2019[g] *(63)*<br><br>Good quality[d] | Pooled cohort analysis<br><br>N=68,706 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | Smokers who reported meeting aerobic and strengthening PA guidelines[h] (adjusted HR = 0.54 [95% CI, 0.39 to 0.76]), those meeting only aerobic PA guidelines (adjusted HR = 0.85 [95% CI 0.72 to 0.99]), and those meeting only strengthening exercise guidelines (HR = 0.63 [95% CI 0.43 to 0.93]) had significantly lower risk of CVD mortality than those not meeting both recommendations. | MODERATE[i] |
| Stamatakis 2018[j] *(65)*<br><br>Good quality[d] | Pooled cohort analysis<br><br>N=80,306 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | There was no association between participation in any strength exercises vs. no participation (adjusted HR = 0.88 [95% CI, 0.71 to 1.08]) or meeting vs. not meeting the strength exercise guideline[k] (adjusted HR = 0.92 [95% CI 0.72 to 1.12]) and CVD mortality, including analysis limited to own-bodyweight exercises and gym-based exercises. | MODERATE[i] |

Abbreviations: ARD = absolute rate difference; CI = confidence interval; CVD = cardiovascular disease; HDL-C = high-density lipoprotein cholesterol; HR = hazards ratio; MET =metabolic equivalent of task; min = minutes; MVPA = moderate-to-vigorous intensity physical activity; NR = not reported; RR = risk ratio; SB = sedentary behaviour

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence upgraded given no serious risk of bias of included studies and evidence of dose-response relationship; however, serious inconsistency (high between study variance, $I^2$>77%) present; possible small studies effects/publication bias not judged as sufficient to warrant additional downgrading
[b] Certainty of evidence not upgraded given serious risk of bias (not appropriately adjusting for confounding) and indirectness in comparisons of exposures
[c] Not a systematic review. Pooled analysis of 9 population-based cohorts

[d] Quality rated based on the Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses *(77)*
[e] 150 min/week of moderate-intensity leisure time PA, or at least 75 min/week of vigorous-intensity leisure-time PA, or any combination of moderate- and vigorous-intensity PA equivalent to at least 7.5 MET-h/week
[f] Certainty of evidence not upgraded given imprecision in estimates of effects
[g] Not a systematic review. Pooled analysis of 1998-2009 National Health Index Survey and linked National Death Index
[h] 150 min/week of moderate-intensity leisure time PA, or at least 75 min/week of vigorous-intensity leisure-time PA, or an equivalent combination and performing strengthening exercises >2 times/week
[i] Certainty of evidence upgraded given no serious limitations in included evidence
[j] Not a systematic review. Pooled analysis of 11 cohorts of the Health Survey for England and the Scottish Health Survey and linked to the British National Health Service Central Registry for data on mortality
[k] Performing strengthening exercises >2 times/week
[l] Certainty of evidence upgraded given no serious limitations in included evidence and evidence of dose-response relationship

***Table B.1.c. CVD incidence: Association between physical activity and CVD incidence among adults (in alphabetical order by author)***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | | |
| Dinu 2019 *(19)*<br><br>Low | 5 prospective cohort studies<br><br>N=183,872 | Serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | All studies evaluated the effects of mixed mode (cycling and/or walking) active commuting on health outcomes. Exposure levels of active commuting were variably reported as minutes spent walking or cycling for transportation per day, as dichotomized variables (yes or no), or as METs with the reference category as no active commuting in most studies. Follow-up ranged from 4 to 25 years.<br><br>Persons engaged in **active commuting** had a significantly lower risk of **CVD incidence** (coronary heart disease, stroke and heart failure) compared with those participating in no active commuting (RR = 0.91 [95% CI 0.83 to 0.99], 5 studies). | LOW[a] |

Abbreviations: CI = confidence interval; CVD = cardiovascular disease; MET = metabolic equivalents of task; PA = physical activity; RR = risk ratio

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence not upgraded given serious risk of bias (not appropriately adjusting for confounding) and indirectness in comparisons of exposures

***Table B.1.d. Cancer incidence: Association between physical activity and cancer incidence among adults (in alphabetical order by author)***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness†** | **Imprecision** | **Other** | | |
| Baumeister 2019 *(7)*<br><br>Moderate | 14 prospective cohort studies<br><br>N=2.39 million (2,738 cases) | No serious risk of bias | Serious inconsistency | No serious indirectness | No serious imprecision | None | Examination of the relationship between self-reported PA and liver cancer. Mean follow-up was 11.6 years (range 6-20 years); median age=45 years (range 20 to 93 years) at baseline.<br><br>PA was significantly inversely associated with **liver cancer risk**, comparing high levels of PA to low levels of PA (HR = 075 [95% CI, 0.63 to 0.89]). | LOW[a] |
| Behrens 2019 *(8)*<br><br>Moderate | 3 prospective cohort studies (N=12,605 cases), 5 case-control studies (N=1,295 cases) | Serious risk of bias[b] | No serious inconsistency | No serious indirectness | No serious imprecision[c] | None | Studies examined the relationship between PA and melanoma risk. Most studies examined recreational PA.<br><br>Cohort studies revealed a statistically significant positive association between high versus low physical activity and **melanoma risk** (RR= 1.27 [95% CI, 1.16 to 1.40]) whereas case-control studies yielded a statistically non-significant inverse risk estimate for physical activity and melanoma (RR = 0.85 [95% CI = 0.63–1.14]). | LOW[d] |
| Benke 2019 *(9)*<br><br>Moderate | 48 prospective cohort studies, 24 case-control studies (N=151,748 cases) | No serious risk of bias | Serious inconsistency | No serious indirectness | Serious imprecision | Possible publication bias | Evaluation of the association between physical activity and risk of prostate cancer. Mean age was 61 years and all studies used self-reported PA.<br><br>There was no significant association between PA and **total prostate cancer incidence** when comparing the highest level of PA to the lowest (RR=0.99 [95% CI, 0.94 to 1.04], 50 studies). There was no difference in effects when stratifying by study design (cohort vs. case-control). The corresponding RRs for advanced and non-advanced **prostate cancer incidence** were 0.92 (95% CI, 0.80 to 1.06) and 0.95 (95% CI, 0.85 to 1.07), respectively. | VERY LOW[e] |
| Liu 2019 *(39)*<br><br>Moderate | 20 prospective cohort studies | No serious risk of bias | Serious inconsistency | No serious indirectness | No serious imprecision | Possible publication bias | There was a significant inverse relationship found between PA and **lung cancer** when comparing higher to lower levels of PA. Compared with low levels of PA, the pooled RR was 0.83 [95% CI, 0.77 to 0.90]). Smokers with a high level of PA were associated with a 10% lower risk for lung cancer (RR = 0.90 [95% CI: 0.84, 0.97], while the association | VERY LOW[f] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (N=31,807 cases) | | | | | | was not significant among non-smokers (RR= 0.95 [95% CI: 0.88, 1.03]. | |

Abbreviations: CI = confidence interval; HR = hazards ratio; MET = metabolic equivalents of task; PA = physical activity; RR = risk ratio

[†] Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence not upgraded given serious inconsistency (direction and magnitude of effects of individual studies and I2>60%)
[b] With the exception of one case-control study, none of the studies controlled for sun sensitivity or sun exposure on an individual level, in addition to other sources of potential bias
[c] No serious imprecision evident for cohort studies; serious imprecision for estimate of effect among case-control studies
[d] Certainty of evidence not upgraded given serious risk of bias
[e] Certainty of evidence downgraded given serious inconsistency (direction and magnitude of effects and $I^2$>70%), serious imprecision, and possible publication bias
[f] Certainty of evidence downgraded given serious inconsistency (direction and magnitude of effects and $I^2$>70%) and possible publication bias

***Table B.1.e. Type 2 diabetes incidence: Association between physical activity and Type 2 diabetes incidence among adults***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness†** | **Imprecision** | **Other** | | |
| Boyer 2019 *(12)*<br><br>Low | 27 prospective cohort studies<br><br>N=1,150, 574 | No serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Studies examined the relationship between PA and type 2 diabetes in specific racial/ethnicity groups. Duration of follow-up ranged from 2 to 28 years. Method of diabetes ascertainment ranged considerably including medical records, reports of medication or insulin use, OGT tests, FBG, or self-report.<br><br>A reduced risk of **developing diabetes** was found when comparing the **highest vs. lowest levels of PA** among non-Hispanic whites (RR = 0.71 [95% CI 0.60 to 0.85], 8 studies, n=238,719), Asians (RR = 0.76 [95% CI 0.67 to 0.85], 16 studies, n=928,319), Hispanics (RR = 0.74 [95% CI, 0.64 to 0.84], 3 studies, n=10,817), and American Indians (RR = 0.73 [95% CI 0.60 to 0.88], 4 studies, n=7,022). The effect among non-Hispanic blacks was not statistically significant (RR = 0.91 [95% CI 0.76 to 1.08], 5 studies, n=30,452). | VERY LOW[a] |
| Dinu 2019 *(19)*<br><br>Low | 4 prospective cohort studies<br><br>N=102,077 | Serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | All studies evaluated the effects of mixed mode (cycling and/or walking) active commuting on health outcomes. Exposure levels of active commuting were variably reported as minutes spent walking or cycling for transportation per day, as dichotomized variables (yes or no), or as METs with the reference category as no active commuting in most studies. Follow-up ranged from 4 to 25 years.<br><br>There was no significant association between **active commuting** and **diabetes incidence** compared with those participating in no active commuting (RR = 0.0.78 [95% CI 0.60 to 1.03], 4 studies). | VERY LOW[b] |
| Paudel 2019 *(54)*<br><br>Low | 3 cross sectional studies<br><br>N=14,902 | Serious risk of bias | No serious inconsistency | Serious indirectness | Serious imprecision | None | Examination of the association between PA and incidence of T2D among South Asian adults. All 3 studies found no association between total PA and T2D. | VERY LOW[c] |

Abbreviations: CI = confidence interval; FBG = fasting blood glucose; OGT = oral glucose tolerance; PA = physical activity; NR = not reported; RR = risk ratio; T2D = type 2 diabetes

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence downgraded given serious inconsistency in direction of effects, serious indirectness in comparisons, and serious imprecision in pooled estimates of effects

[b] Certainty of evidence downgraded given serious risk of bias (not appropriately adjusting for confounding), serious inconsistency in effects between studies and statistical heterogeneity and indirectness in comparisons of exposures
[c] Certainty of evidence rated as very low according to authors given serious risk of bias and serious imprecision. Serious indirectness is also present given variability in comparisons

**Table B.1.e. Adiposity-related outcomes: Association between physical activity and measures of adiposity among adults, by comparison and author**

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| **Walking** | | | | | | | | |
| Paudel 2019 *(54)*<br><br>Low | 3 cross sectional studies<br><br>N=435 | Serious risk of bias | No serious inconsistency | Serious indirectness | Serious imprecision | None | Examination of the association between PA and measures of adiposity among South Asian adults. One study reported a protective association with walking and **BF%, FMI, and FFMI**, one study reported no association between walking with BMI, WC and FMI but found significant associations between cycling and BMI, BW, WC, and fat mass, and the last study found no association between increasing levels of walking and BMI or WC. | VERY LOW[a] |
| **Light-intensity PA** | | | | | | | | |
| Amagasa 2018 *(2)*<br><br>Low | 14 cross-sectional studies<br><br>1 cohort study<br><br>N=20,552 | No serious risk of bias | Serious inconsistency | No serious indirectness | Serious imprecision | None | **LIPA** was found to have a favourable association with **WC** in 8/12 cross-sectional studies and an inconsistent association with **BMI** in 4/10 cross-sectional studies. One cohort study found that women in the highest tertiles of LIPA time had **lower fat mass, BF%, and central fat** at 1 year compared with women in lowest and middle tertiles of LPA; no significant effects were found in **fat-free mass, BW, BMI, and WC**. | VERY LOW[b] |
| Chastin 2019 *(14)*<br><br>Moderate | 4 RCTs or CCTs<br><br>17 cross-sectional studies<br><br>1 prospective cohort<br><br>N=NR | No serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | Studies evaluated the association between **LIPA** (as defined by each study, and inconsistent between studies) and adiposity measures.<br><br>2/4 trials reported significant effects on measures of **fat mass** or **BF%**.<br><br>Cross-sectional studies showed "consistent reports across studies on the association between time spent in LIPA and adiposity markers; but the reported effect sizes were small and consistently stronger with increased absolute intensity of LIPA."<br><br>One cohort study showed a small decrease in **BW** to be associated with increased time spent in LIPA. | VERY LOW[c] |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| **High-intensity interval training** | | | | | | | | |
| Andreato 2019 *(4)*[d]<br><br>Moderate | 48 RCTs or pre-post studies<br><br>N=1,222 | Serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | Dose-response relationship[e] | Studies evaluated the association between **HIIT vs. MICT vs. controls** on anthropometric variables among adults with overweight or obesity. Mean follow-up was 10 weeks (range 2 to 24 weeks). In most studies, HIIT was performed 3 times per week; 30 studies evaluated cycling and 18 evaluation running/walking.<br><br>Compared with no exercise control groups, HIIT was significantly associated with decreased **body mass** (MD = -1.45 kg [95% CI -1.85 to -1.05 k], n=1,168), **BMI** (MD = -0.44 kg/m$^2$ [95% CI -0.59 to -0.30], n=990), **WC** (MD = -2.3 cm [95% CI, -3.1 to -1.4], n=671), and **BF%** (MD = -1.29% [95% CI -1.70 to -0.87], n=833). When comparing HIIT vs. MICT protocols that had similar energy expenditures or workloads, HIIT was associated with greater reduction in **body mass** than MICT (MD = -0.41 kg [95% CI -0.79 to -0.023); but there were no other differences between HIIT and MICT with similar protocols on **BMI, WC, or BF%.** | LOW[f] |
| Sultana 2019 *(70)*<br><br>Low | 21 RCTs<br><br>N=NR | Serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Studies evaluated the association between **low-volume HIIT** (<500 MET-min/week) performed for at least 4 weeks for a minimum of 2 days/week vs. a non-exercising control or MICT and measures of body composition. Most studies recruited adults with overweight or obesity, mean age ranged from 19 to 70 years. Exercise interventions ranged from 4 to 16 weeks, with most taking place for 12 weeks with exercise sessions performed 2 to 5 days/week.<br><br>No significant association was found between low-volume HIIT vs. non-exercising control groups for measures of **total body fat mass** (ES = -0.129 [95% CI, -0.468 to 0.210], 6 studies), **BF%** (ES = -0.063 [95% CI, -0.383 to 0.257], 7 studies), and **lean body mass** (ES = 0.050 [95% CI, -0.250 to 0.351], 8 studies) or between low-volume HIIT vs. MICT on **total body fat mass** (ES =-0.021 [95% CI, -0.272 to 0.231], 6 studies), **BF%** (ES = 0.005 [95% CI, -0.294 to 0.304], 7 studies) or **lean body mass** (ES = 0.030 [95% CI, -0.167 to 0.266], 11 studies). | VERY LOW[g] |

Abbreviations: ARD = absolute rate difference; BF% = percent body fat; BMI = body mass index; BW = body weight; CCT = controlled clinical trial; CI = confidence interval; cm = centimeters; DXA = dual-energy X-ray absorptiometry; ES = effect size; FMI = fat mass index; FFMI = fat-free mass index; HIIT = high-intensity interval training; HR = hazards ratio; kg = kilograms; LIPA = light-intensity physical activity; m = meters; MET =metabolic equivalent of task; MetS = metabolic syndrome; MICT = moderate-intensity continuous training; min = minutes; MVPA = moderate-to-vigorous intensity PA; NAFLD = non-alcoholic fatty liver disease; NR = not reported; PCOS = polycystic ovary syndrome; RCT = randomized controlled trial; RR = risk ratio; SB = sedentary behaviour; SIT = sprint interval training; WC = waist circumference

[†] Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence rated as very low according to authors given serious risk of bias and serious imprecision. Serious indirectness is also present given variability in comparisons
[b] Certainty of evidence not upgraded
[c] Certainty of evidence not upgraded given serious indirectness in comparisons of exposures and lack of detailed results, with most evidence from cross-sectional studies and inconsistency across RCTs and nonrandomized intervention studies
[d] Review by Wewege 2017 *(74)* included overlapping evidence and found consistent effects of HIIT vs. MICT on measures of adiposity among adults with overweight or obesity.
[e] A significant association was found between number of sessions and greater reductions in body mass
[f] Certainty of evidence downgraded given serious risk of bias of all included studies, including lack of control for participants' diets and total PA and serious indirectness given variability of exercise protocols and comparisons; review did not report results of RCTs separately (10 studies were 'adequately randomized')
[g] Certainty of evidence downgraded given serious risk of bias of all included studies, serious indirectness given variability of exercise protocols and comparisons, and serious imprecision in estimates of effect within individual studies and pooled effect sizes

### *Table B.1.f. Mental health outcomes: Association between physical activity and measures of mental health among adults, by comparison and author*

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | | |
| **Higher vs. lower or no PA** | | | | | | | | |
| Amagasa 2018 *(2)*<br><br>Low | 1 cross-sectional study<br><br>1 cohort study<br><br>N=2,254 | No serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | One cross-sectional study found that **higher vs. lower LPA** was associated with a lower risk of **psychological distress**. One cohort study for older adults in Taiwan showed that higher vs. lower LPA was associated with three dimensions of **well-being**: psychological, learning and growth, and social well-being. | VERY LOW[a] |
| Martinez-Dominguez 2018 *(47)*<br><br>Moderate | 10 RCTs<br><br>N=1,463 | No serious risk of bias | No serious inconsistency | No serious indirectness | Serious imprecision | None | Studies evaluated the effects of **exercise interventions that were at least 6 weeks in duration** vs. no exercise control groups reporting symptoms of anxiety among middle-aged and older women (mean age range, 54 to 78 years).<br><br>Exercise interventions lasting 12 weeks to 4 months were associated with reduced **symptoms of anxiety** vs. no exercise control groups among women (SMD = -0.42 [95% CI, -0.81 to -0.02], 8 RCTs); however, no significant association was seen between exercise interventions lasting 6 to 14 months) and symptoms of anxiety among women (SMD = -0.03 [95% CI, -0.18 to 0.13], 7 RCTs). | MODERATE[b] |
| Perez-Lopez 2017 *(55)*<br><br>Moderate | 11 RCTs<br><br>N=1,943 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | None | Studies evaluated the effects of **exercise interventions that were at least 6 weeks in duration** vs. no exercise control groups reporting symptoms of depression among middle-aged and older women (mean age range, 44 to 66 years).<br><br>Exercise interventions lasting 12 weeks to 4 months were associated with reduced **symptoms of depression** vs. no exercise control groups among women (SMD = -0.44 [95% CI, -0.69 to -0.18], 5 RCTs) as were exercise interventions lasting 6 to 14 months (SMD = -0.29 [95% CI, -0.49 to -0.09], 6 RCTs). | HIGH[c] |

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | | |
| Schuch 2018 *(61)*<br><br>High | 49 prospective cohort studies<br><br>N=266,939 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | Possible public ation bias | Studies examined the prospective relationship between **PA** and incident depression. All but one study relied on self-reported PA. Average follow-up was 7.4 years.<br><br>Compared with those with low levels of PA, adults with high levels of PA had lower odds of **developing depression** (adjusted OR = 0.78 [95% CI, 0.70 to 0.87] as did older adults with high levels of PA (adjusted OR = 0.79 [95% CI, 0.72 to 0.86]). | MODERATE[d] |
| Schuch 2019 *(60)*<br><br>Moderate | 13 prospective cohort studies<br><br>N=75,831 | No serious risk of bias | No serious inconsistency | No serious indirectness | No serious imprecision | Possible public ation bias | Studies examined the prospective relationship between **PA** and incident depression. All studies relied on self-reported PA. Average follow-up was 3.5 years.<br><br>Compared with those with low levels of PA, adults with high levels of PA had lower odds of **developing anxiety** (adjusted OR = 0.81 [95% CI, 0.69 to 0.95]. | MODERATE[d] |
| **Resistance training** | | | | | | | | |
| Gordon 2017 *(26)*<br><br>Low | 16 RCTs<br><br>N=922 | No serious risk of bias | Serious inconsistency | No serious indirectness | Serious imprecision | None | Studies evaluated the effect of **resistance training** vs. a non-active control group on measures of symptoms of anxiety. Participants were mean age 43 years. Anxiety symptoms were the primary outcomes in 9/16 studies; most frequently reported measure of anxiety was the State-Trait Anxiety Inventory. Mean intervention length was 11 weeks and intervention frequency ranged from 2 to 5 days/week.<br><br>Resistance training was found to be associated with significantly reduce **symptoms of anxiety** vs. non-active control groups (ES = 0.31 [95% CI, 0.17 to 0.44]); larger effects were seen among studies of healthy samples (ES = 0.50 [95% CI, 0.22 to 0.78]) vs. those with a physical or mental illness (ES = 0.19 [95% CI, 0.06 to 0.31]), although confidence intervals overlapped between groups. Effect sizes did not significantly vary according to other population, intervention, or study characteristics. No significant difference was found between studies examining resistance training vs. aerobic exercise training. | LOW[e] |
| Gordon 2018 *(25)*<br><br>Low | 33 RCTs<br><br>N=1,877 | No serious risk of bias[f] | Serious inconsistency | No serious indirectness | Serious imprecision | Possible public ation bias | Studies evaluated the effect of **resistance training** vs. a non-active control group on measures of symptoms of depression. Participants were mean age 52 years. Depressive symptoms were the primary outcomes in 18/33 studies; most frequently reported measure of anxiety was the Beck Depression Inventory. Mean intervention length | VERY LOW[g] |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | was 16 weeks and intervention frequency ranged from 2 to 7 days/week with 3 days/week the most common intensity.<br><br>Resistance training was found to be associated with significantly reduce **symptoms of depression** vs. non-active control groups (ES = 0.66 [95% CI, 0.48 to 0.83]). No significant difference was found between studies examining resistance training vs. aerobic exercise training. | |

Abbreviations: CI = confidence interval; ES = effect size; OR = odds ratio; PA = physical activity; RCT = randomized controlled trial; SMD = standardized mean difference

[†] Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence not upgraded
[b] Certainty of evidence downgraded given serious imprecision in study-specific and pooled estimates of effects
[c] Certainty of evidence downgraded given some evidence of inconsistency and indirectness in outcome measures
[d] Certainty of evidence upgraded given no major limitations in body of evidence; possible small studies effect not judged to warrant downgrading
[e] Certainty of evidence downgraded given serious inconsistency in direction of effects and serious imprecision in effect estimates. Furthermore, pooled estimates include multiple estimates per study for different measures
[f] Effects were significantly smaller when outcome assessment was blinded compared with when outcome assessment was not blinded
[g] Certainty of evidence downgraded given serious inconsistency in direction of effects, serious imprecision in effect estimates, and presence of small studies effect. Furthermore, pooled estimates include multiple estimates per study for different measures

***Table B.1.g. Cognitive function outcomes: Association between physical activity and measures of cognitive function among adults***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | | |
| Amagasa 2018 *(2)*<br><br>Low | 2 cross-sectional studies<br><br>N=435 | No serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | Two cross-sectional studies among older adults (mean age 64 and 65 years) that studied objectively measured LPA (as a continuous measure or vs. replacing 30 min of SB with LPA.<br><br>One study found that LPA was significantly associated with higher **cognitive functioning** whereas the other study found no associations between LPA and **spatial working memory and task switching**. | VERY LOW[a] |
| Brasure 2018 *(13)*<br><br>High | 14 RCTs<br><br>N=2,824 | No serious risk of bias[b] | Serious inconsistency | Serious indirectness | Serious imprecision | None | **Multicomponent physical activity interventions** (including flexibility, strength, balance, endurance, and aerobic training) were tested in 4 trials (n=1,885). All trials included older adults aged >60 years without cognitive impairment and represented mostly white women. A wide range of neuropsychological tests were used to assess **cognitive function**; only 3/25 comparisons showed a statistically significant benefits with multicomponent PA interventions compared with attention controls, including one trial that report no difference in the **incidence of MCI or dementia** between groups at 2 years. Six trials (n=531) tested **aerobic training** vs. attention controls in healthy older adults. One study found that older adults in the aerobic exercise group were significantly less likely to receive a **dementia diagnosis** at 18 months; 11/35 comparisons showed statistically significant benefit on **measures of cognitive function** whereas 24/35 showed no statistically significant difference between groups. Three trials **examined resistance training** vs. usual care among frail, older adults. No trial reported diagnostic outcomes; less than a third of comparisons favored the interventions on measures of e**xecutive function, attention and processing speed, and memory**. One small trial tested **tai chi** vs. attention control in older adults aged 60-79 years; 1/2 outcomes for **executive function, attention, and processing speed** showed a significant benefit. | LOW[c] |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Engeroff 2018 *(21)*<br><br>Moderate | 9 cross-sectional studies<br><br>14 longitudinal<br><br>N=11,707 | No serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Most PA was self-reported using questionnaires not previously validated, and all measures of PA were different between studies. All studies measured cognitive function among older adults aged >60 years.<br><br>There was an inconsistent association between **<u>MVPA</u>** and **global cognitive function**; 3/4 longitudinal studies showed no association between lifetime PA and MMSE scores whereas 1/4 longitudinal study found showed a beneficial association between levels of PA at age 74 years and MMSE scores at age 84 years. Most cross-sectional studies found no association between PA and measures of global cognitive function. There was mixed evidence on the relationship between PA and the specific cognitive domains of **executive function and memory,** but no evidence of an association with **attention or working memory.** | VERY LOW[d] |
| Northey 2018 *(50)*<br><br>Moderate | 39 RCTs<br><br>N=NR | Serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | Studies evaluated relationship between **<u>PA interventions of at least 4 weeks</u>** and cognitive function measures among adults aged 50 years and older. Interventions included aerobic exercise (18 studies), resistance training (13 studies), multicomponent training (10 studies), tai chi (4 studies) and yoga (2 studies).<br><br>A multi-level analysis combining multiple measures of cognitive per study (333 dependent effect sizes in 36 studies) found a significant effect of physical activity interventions vs. no PA on measures of cognition (SMD = 0.29 [95% CI 0.17 to 0.41]). | MODERATE[e] |
| Rathrore 2017 *(57)*<br><br>Low | 15 RCTs<br><br>N=1,315 | No serious risk of bias | No serious inconsistency | Serious indirectness | Serious imprecision | None | Highly heterogenous studies including sample populations (7 studies among youth 5-17-years, 3 studies among adults 18-64 years, and 5 studies among older adults >65 years. Seven studies evaluated acute PA (1 session) whereas eight studies evaluated chronic PA (more than 1 PA sessions from 4 weeks to 6 months). Review was limited to **working memory performance**.<br><br>10/15 studies reported a statistically significant improvement in **working memory performance** among those in a **<u>physical activity intervention</u>** vs. no PA. Chronic PA interventions (ES = 0.27 [95% CI, 0.12 to 0.42], 8 RCTS, n=1,139) were significantly associated with improvements in working memory performance in pooled analysis compared with no exercise. There was no association between acute | LOW[f] |

| | | | | | | | | |
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| | | | | | | | PA interventions vs. no PA on working memory (ES = -0.15 [95% CI, -0.33 to -0.63], 7 RCTs, n=1,098). | |

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Stanmore 2017 *(66)*<br><br>Low | 17 RCTs<br><br>N=926 | Serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Mean age 69 years (range = 17-85 years), six studies were among clinical samples among patients with Parkinson's , MCI, sub-acute stroke, or schizophrenia and one study was among healthy adolescents. All interventions used active video games/exergames that lasted an average of 10 weeks (range = 4-24 weeks) with an average of 3.2 sessions per week for 15-60 min of exercise per session.<br><br>**Exergames** were significantly associated with improved **global cognitive function** vs. no exergame control conditions in pooled analysis (ES = 0.436 [95% CI 0.18 to 0.69], 17 RCTs, n=926). Results were consistent when stratified by type of control group (attention controls only, PA intervention controls), population (clinical, non-clinical, and older adults only), and length of intervention (<12 weeks, >12 weeks). Statistically significant effects were also seen for individual domains of cognitive function including **executive function, task-switching, inhibitory control, and attentional processing speed**; but were not found for **working memory, reasoning, verbal learning and memory, spatial learning and memory, and language.** | VERY LOW[g] |

Abbreviations: CI = confidence interval; ES = effect size; LPA = light physical activity; MCI = mild cognitive impairment; MMSE = mini-mental state exam; NR = not reported; PA = physical activity; RCT = randomized clinical trial; SB = sedentary behaviour

[†] Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence not upgraded
[b] Review was limited to studies with low to moderate risk of bias, although review authors notes a medium rating for study limitations
[c] Strength of evidence rated as Low by review authors for multicomponent physical activity interventions given indirectness in outcome measures, unknown consistency, and imprecision. All other interventions were rated as having Insufficient strength of evidence given limited data.
[d] Certainty of evidence downgraded given serious inconsistency in measures of effects within and between studies and across domain-specific measures of cognition, serious indirectness in measures of physical activity and cognitive function, and serious imprecision
[e] Certainty of evidence assigned by review authors as Moderate owing to the level of uncertainty across each domain of the risk of bias tool
[f] Certainty of evidence related to chronic (>1 session) PA interventions; downgraded due to serious indirectness in outcome measures and serious imprecision of effects in individual trials and pooled effect
[g] Certainty of evidence downgraded given serious risk of bias in included evidence, serious inconsistency ($I^2$>60% in all pooled analysis), serious indirectness (heterogeneous comparisons and outcome measures), and serious imprecision in effect estimates

***Table B.1.h. Sleep outcomes: Association between physical activity and sleep outcomes among adults***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| Systematic review evidence<br><br>Review credibility | No. of studies/ Study design<br><br>No. of participants | Quality Assessment | | | | | Description of evidence<br><br>Summary of findings | Certainty |
|---|---|---|---|---|---|---|---|---|
| | | Risk of bias | Inconsistency | Indirectness † | Imprecision | Other | | |
| Kovacevic 2018 *(36)*<br><br>Moderate | 10 RCTS<br><br>N=NR | Serious risk of bias | Serious inconsistency | Serious indirectness | No serious imprecision | None | Studies evaluated the effects of **resistance training** vs. no intervention or other exercise intervention on sleep outcomes. Seven studies compared resistance training with a non-exercise control group and 3 studies compared the effects of aerobic exercise plus resistance training vs. aerobic exercise alone. Variability in study populations included those with mental health symptoms or diagnoses, older adults, nursing home residents, and adults with co-morbid health conditions (fibromyalgia, heart failure and sleep apnoea, breast cancer), mean age was 58 years.<br><br>1/3 studies found a significant effect of resistance training vs. no exercise on subjective measures of **sleep quantity**; 5/7 studies reported significant improvement in subjective measures of **sleep quality**. In studies comparing aerobic exercise plus resistance training vs. aerobic exercise alone, 1/1 study found no effect on **sleep quantity**. 2/2 studies found no effect on objective measures of **sleep quality** whereas 1/1 study found a significant effect on subjective measures of sleep quality. | LOW[a] |
| Perez-Lopez 2017 *(55)*<br><br>Moderate | 3 RCTs<br><br>N=469 | No serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Studies evaluated the effects of **exercise interventions that were at least 6 weeks in duration** vs. no exercise control groups reporting symptoms of insomnia among middle-aged and older women.<br><br>Exercise interventions were associated with reduced **symptoms of insomnia** vs. no exercise control groups among women (SMD = -0.52 [95% CI, -1.02 to -0.02], 3 RCTs). | LOW[b] |
| Robbins 2019 *(58)*<br><br>Low | 5 pre-post studies<br><br>N=NR | Serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | Studies evaluated the effects of **any workplace intervention**, including PA or yoga, on measures of sleep. 1/5 studies found a significant improvement in self-reported **sleep quality** following a yoga intervention; no studies reported significant improvement in self-reported **sleep quantity** following the intervention. | VERY LOW[c] |
| Stutz 2019 *(68)*<br><br>Moderate | 23 crossover studies<br><br>N=275 | Serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Studies evaluated the effects of **one single session of exercise close to usual bedtime** (less than 4 hours before usual bedtime) on various measures of sleep. All studies enrolled healthy or good sleepers, except one study that enrolled adults with self-reported sleep difficulties. Adults included sedentary individuals as well as trained | VERY LOW[d] |

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|---|---|---|---|---|---|---|---|---|
| | | | | | | | athletes. Most interventions were cycling or running, with an average duration of 87 minutes.<br><br>Compared with no-exercise, one session of PA ending 12 minutes to 4 hours before bedtime significantly increased **REM latency and slow-wave sleep, and decreased stage 1 sleep. N**o effects were found for **SOL, TST, SE, WASO, stage 2, 3, and 4 sleep, REM sleep, or subjective sleep quality.** | |

Abbreviations: CI = confidence interval; NR = not reported PA = physical activity; RCT = randomized controlled trial; REM = rapid eye movement; SE = sleep efficiency; SMD = standardized mean difference; SOL = sleep onset latency; TST = total sleep time; WASO = wake after sleep onset

[†] Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence downgraded given serious risk of bias, serious inconsistency of effects, and serious indirectness in measures, interventions, and variability in populations
[b] Certainty of evidence downgraded given serious inconsistency ($I^2$=81%), serious indirectness in outcome measure, and imprecision in estimate of effect
[c] Certainty of evidence downgraded given serious risk of bias and serious indirectness in measures of sleep as well as interventions
[d] Certainty of evidence downgraded given serious risk of bias, serious inconsistency within and between studies in measures of sleep, serious indirectness in measures of sleep as well as interventions, and serious imprecision in estimates of effects

***Table B.1.i. Incidence of hypertension: Association between physical activity and incidence of hypertension among adults***

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness†** | **Imprecision** | **Other** | | |
| Paudel 2019 *(54)*<br><br>Low | 5 cross sectional studies<br><br>N=10,344 | Serious risk of bias | No serious inconsistency | Serious indirectness | Serious imprecision | None | Examination of the association between **PA** and **incident hypertension** among South Asian adults. Two studies found lower odds of hypertension among those with mild or moderate levels of PA compared with a sedentary group and higher (≥30 hrs/week) vs. lower (<10 hrs/week) of walking. One study found the prevalence of hypertension was lower among persons with moderate levels of occupational PA whereas another study found no association between levels of occupational PA and hypertension. One study saw higher prevalence of hypertension among those with low vs. high levels of total PA. | VERY LOW[a] |

Abbreviations: hrs = hours; PA = physical activity

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence rated as very low according to authors given serious risk of bias and serious imprecision. Serious indirectness is also present given variability in comparisons

### *Table B.1.j. Health-related quality of life: Association between physical activity and measures of HRQOL among adults*

See the Supplementary materials for description of evidence and conclusions of US PAGAC by outcome

| **Systematic review evidence**<br><br>**Review credibility** | **No. of studies/ Study design**<br><br>**No. of participants** | **Quality Assessment** | | | | | **Description of evidence**<br><br>**Summary of findings** | **Certainty** |
|---|---|---|---|---|---|---|---|---|
| | | **Risk of bias** | **Inconsistency** | **Indirectness †** | **Imprecision** | **Other** | | |
| Perez-Lopez 2017 *(55)*<br><br>Moderate | 3 RCTs<br><br>N=189 | No serious risk of bias | Serious inconsistency | Serious indirectness | Serious imprecision | None | Studies evaluated the effects of **exercise interventions that were at least 6 weeks in duration** vs. no exercise control groups reporting symptoms of depression among middle-aged and older women.<br><br>Exercise interventions was not associated with reduced **measures of quality of life** vs. no exercise control groups among women (SMD = -0.27 [95% CI, -1.08 to 0.54], 3 RCTs). | LOW[a] |
| Wang 2017<br><br>Low | 4 RCTs<br><br>N=314 | No serious risk of bias | No serious inconsistency | Serious indirectness | No serious imprecision | None | Evaluation of **Tai Chi** exercise in perimenopausal women on measures of the SF-36. Studies represented women aged 45 and older; most with low bone mass or osteopenia. There was no consistent effect of Tai Chi vs. no Tai Chi across all 8 subscales on the SF-36. | MODERATE[b] |

Abbreviations: CI = confidence interval; RCT = randomized clinical trial; SF-36 = short-form 36 quality-of-life instrument; SMD = standardized mean difference

† Serious indirectness indicates measurement of intermediate/indirect outcomes or heterogeneity in exposures and comparisons assessed; certainty of evidence was not always downgraded for indirectness if it was not judged to impact the certainty in the findings for the outcome evaluated in the review

[a] Certainty of evidence downgraded given serious inconsistency ($I^2$=85%), serious indirectness in outcome measure, and imprecision in estimate of effect

[b] Certainty of evidence downgraded given serious indirectness in measures of effect (subscales vs. domain-specific measures of SF-36)

## APPENDIX 2. DATA EXTRACTIONS OF INCLUDED EVIDENCE (IN ALPHABETICAL ORDER BY AUTHOR)

<table>
<tr><td colspan="2">SR/MA<br>Citation: Amagasa, S., Machida, M., Fukushima, N., Kikuchi, H., Takamiya, T., Odagiri, Y., & Inoue, S. (2018). Is objectively measured light-intensity physical activity associated with health outcomes after adjustment for moderate-to-vigorous physical activity in adults? A systematic review. International Journal of Behavioral Nutrition and Physical Activity, 15(1), 65.</td></tr>
<tr><td>Purpose: to systematically examine associations of objectively assessed LPA and health outcomes after adjustment for MVPA in adults</td><td rowspan="5">Abstract:<br>Background: An increasing number of studies have demonstrated that light-intensity physical activity (LPA) confers health benefits after adjustment for moderate-to-vigorous physical activity (MVPA). The purpose of this systematic review was to summarize existing epidemiological evidence on associations of objectively measured LPA with health outcomes in adults.<br>Methods: This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. We searched on PubMed, Web of Science, CINAL, and Cochrane Library for articles analysing the association between objectively determined LPA and health outcomes that were published up to January 2017. Data were extracted regarding authors, publication year, country of survey, study setting, number of participants, study design, physical activity (PA) assessment (type of accelerometer and intensity), health outcomes, confounders, and results (summary measures and association). A coding system was used to summarize the results.<br>Results: Of the 3254 studies identified, 24 cross-sectional and 6 longitudinal studies were included in this review. Most of the studies targeted the Western population. LPA was inversely associated with all-cause mortality risk and associated favorably with some cardiometabolic risk factors including waist circumference, triglyceride levels, insulin, and presence of metabolic syndrome. Only a small amount of data were available on mental health and cognitive function.<br>Conclusions: LPA appears to be beneficially associated with important health outcomes after adjustment for MVPA in the adult population. Although current global PA guidelines recommend only MVPA, promoting LPA may confer additional health benefits.</td></tr>
<tr><td>Timeframe: inception to February 2, 2017</td></tr>
<tr><td>Total # studies included: 30</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) objectively measured LPA</td></tr>
<tr><td>Outcomes addressed: health outcomes & ACM</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Andreato LV, Esteves JV, Coimbra DR, Moraes AJ, de Carvalho T. The influence of high-intensity interval training on anthropometric variables of adults with overweight or obesity: a systematic review and network meta-analysis. Obesity reviews. 2019 Jan;20(1):142-55; https://doi-org.ezproxy1.library.usyd.edu.au/10.1111/obr.12766</td></tr>
<tr><td>Purpose: to evaluate the influence of HIIT on anthropometric variables of adults afflicted with overweight or obesity</td><td rowspan="5">Abstract:<br>Objective<br>The goal of this study was to evaluate the influence of high-intensity interval training (HIIT) on anthropometric variables in adults afflicted with overweight or obesity and to compare the effects with those of moderate-intensity continuous training.<br>Methods<br>A computer literature search was performed for HIIT intervention studies that evaluated anthropometric variables in adults afflicted with overweight or obesity.<br>Results<br>Of the 857 articles retrieved in the electronic search, 48 met the inclusion criteria. The analyses demonstrated that HIIT was effective in decreasing body mass (−1.45 kg [95% CI: −1.85 to −1.05 kg]), body mass index (−0.44 kg m−2 [95% CI: −0.59 to −0.30 kg m−2]), waist circumference (−2.3 cm [95% CI: −3.1 to −1.4 cm]), waist/hip ratio (−0.01 [95% CI: −0.02 to −0.00]), body fat percentage (−1.29% [95% CI: −1.70% to −0.87%]) and abdominal visceral fat area (−6.83 cm2 [95% CI: −11.95 to −1.71 cm2]). When considering equalization between the two methods (energy expenditure or workload matched), no differences were found in any measure except body mass (for which HIIT was superior).<br>Conclusions<br>High-intensity interval training and moderate-intensity continuous training results were similar, particularly when equalization between the two methods was considered. Thus, HIIT can be used as a secondary method for the treatment of obesity in adults.</td></tr>
<tr><td>Timeframe: inception to May 2018</td></tr>
<tr><td>Total # studies included: 48 intervention study (10 RCT, 38 n-RCT)</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) also compared with moderate-intensity continuous training</td></tr>
<tr><td>Outcomes addressed: body mass, BMI, waist circumference, waist/hip ratio or body composition</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Baumeister SE, Leitzmann MF, Linseisen J, Schlesinger S. Physical Activity and the Risk of Liver Cancer: A Systematic Review and Meta-Analysis of Prospective Studies and a Bias Analysis. JNCI J Natl Cancer Inst (2019) 111(11): djz111.</td></tr>
<tr><td>Purpose: The aim of this study was to synthesize prospective observational studies on the association of physical activity and liver cancer risk by means of a systematic review and meta-analysis.</td><td rowspan="5">Abstract: Background: Physical inactivity is an established risk factor for several cancers of the digestive system and female reproductive organs, but the evidence for liver cancers is less conclusive. Methods: The aim of this study was to synthesize prospective observational studies on the association of physical activity and liver cancer risk by means of a systematic review and meta-analysis. We searched Medline, Embase, and Scopus from inception to January 2019 for prospective studies investigating the association of physical activity and liver cancer risk. We calculated mean hazard ratios (HRs) and 95% confidence intervals (CIs) using a random-effects model. We quantified the extent to which an unmeasured confounder or an unaccounted selection variable could shift the mean hazard ratio to the null. Results: Fourteen prospective studies, including 2738 liver cancers, were included in the systematic review and meta-analysis. The mean hazard ratio for high compared with low physical activity was 0.75 (95% CI=0.63 to 0.89; 95% prediction interval=0.52 to 1.07; I2=64.2%).We estimated that 67.6% (95% CI=56.6% to 78.5%) of all true effect estimates would have a hazard ratio less than 0.8. Bias analysis suggested than an unobserved confounder would have to be associated with a 1.99-fold increase in the risk of physical activity or liver cancer to explain away the observed mean hazard ratio. An unaccounted for selection variable would have to be related to exposure and endpoint with a relative risk of 1.58 to explain away the mean hazard ratio. Conclusions: Physical activity is inversely related to the risk of liver cancer. Further studies with objectively measured physical activity and quasi-experimental designs addressing confounding are needed.</td></tr>
<tr><td>Timeframe: Inception to Jan 23 2019</td></tr>
<tr><td>Total # studies included: 14 cohort studies</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Self-reported PA by type</td></tr>
<tr><td>Outcomes addressed: Liver</td></tr>
<tr><td>Populations Analyzed: Adults</td><td>Author-Stated Funding Source: No funding received for this paper.</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Behrens G, Niedermaier T, Berneburg M, Schmid D, Leitzmann MF. Physical activity, cardiorespiratory fitness and risk of cutaneous malignant melanoma: Systematic review and meta analysis. PLoS ONE 2018; 13(10): e0206087. https://doi. org/10.1371/journal.pone.0206087</td></tr>
<tr><td>Purpose:<br><br>Timeframe:<br>Inception to March 29, 2018<br><br>Total # studies included: 21 cohort studies<br><br>Other details (e.g. definitions used, exclusions etc)<br>Self-reported PA by type<br><br>Outcomes addressed:<br>Melanoma</td><td>Abstract:<br>Background<br>Numerous epidemiologic studies have examined the relation of physical activity or cardiorespiratory fitness to risk of cutaneous melanoma but the available evidence has not yet been quantified in a systematic review and meta-analysis.<br>Methods<br>Following the preferred reporting items for systematic reviews and meta-analyses (PRISMA), we identified 3 cohort studies (N = 12,605 cases) and 5 case-control studies (N = 1,295 cases) of physical activity and melanoma incidence, and one cohort study (N = 49 cases) of cardiorespiratory fitness and melanoma risk.<br>Results<br>Cohort studies revealed a statistically significant positive association between high versus low physical activity and melanoma risk (RR = 1.27, 95% CI = 1.16–1.40). In contrast, case control studies yielded a statistically non-significant inverse risk estimate for physical activity and melanoma (RR = 0.85, 95% CI = 0.63–1.14; P-difference = 0.02). The only available cohort study of cardiorespiratory fitness and melanoma risk reported a positive but statistically not significant association between the two (RR = 2.19, 95% CI = 0.99–4.96). Potential confounding by ultraviolet (UV) radiation-related risk factors was a major concern in cohort but not case-control studies.<br>Conclusions<br>It appears plausible that the positive relation of physical activity and ardiorespiratory fitness to melanoma observed in cohort studies is due to residual confounding by UV radiation related risk factors.</td></tr>
<tr><td>Populations Analyzed: Adults</td><td>Author-Stated Funding Source: No funding received for this paper.</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Benke IN, Leitzmann MF, Behrens, G, Schmid D. Physical activity in relation to risk of prostate cancer: a systematic review and meta-analysis. Annals of Oncology 2018; 29: 1154–1179, doi:10.1093/annonc/mdy073</td></tr>
<tr><td>Purpose: This study aims to quantitatively summarize observational studies relating physical activity (PA) to PCa incidence and mortality.</td><td rowspan="5">Abstract:<br>Background: Prostate cancer (PCa) is one of the most common cancers among men, yet little is known about its modifiable risk and protective factors. This study aims to quantitatively summarize observational studies relating physical activity (PA) to PCa incidence and mortality.<br>Materials and methods: Published articles pertaining to PA and PCa incidence and mortality were retrieved in July 2017 using the Medline and EMBASE databases. The literature review yielded 48 cohort studies and 24 case–control studies with a total of 151 748 PCa cases. The mean age of the study participants at baseline was 61 years.<br>Results: In random-effects models, comparing the highest versus the lowest level of overall PA showed a summary relative risk (RR) estimate for total PCa incidence close to the null [RR=0.99, 95% confidence interval (CI)=0.94–1.04]. The corresponding RRs for advanced and non-advanced PCa were 0.92 (95% CI=0.80–1.06) and 0.95 (95% CI=0.85–1.07), respectively. We noted a<br>statistically significant inverse association between long-term occupational activity and total PCa (RR=0.83, 95% CI=0.71–0.98, n studies=13), although that finding became statistically non-significant when individual studies were removed from the analysis. When evaluated by cancer subtype, an inverse association with long-term occupational activity was noted for nonadvanced/<br>non-aggressive PCa (RR=0.51, 95% CI=0.37–0.71, n studies=2) and regular recreational activity was inversely related to advanced/aggressive PCa (RR=0.75, 95% CI=0.60–0.95, n studies=2), although these observations are based on a low number of studies. Moreover, PA after diagnosis was related to reduced risk of PCa mortality among survivors of PCa (summary RR based on four studies=0.69, 95% CI=0.55–0.85).<br>Conclusions: Whether PA protects against PCa remains elusive. Further investigation taking into account the complex clinical and pathologic nature of PCa is needed to clarify the PA and PCa incidence relation. Moreover, future studies are needed to confirm whether PA after diagnosis reduces risk of PCa mortality.</td></tr>
<tr><td>Timeframe: Inception to July 2017</td></tr>
<tr><td>Total # studies included: 48 cohort studies and 24 case-control studies</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Self-reported PA by type, timing and dose</td></tr>
<tr><td>Outcomes addressed: Prostate cancer</td></tr>
<tr><td>Populations Analyzed: Adults</td><td>Author-Stated Funding Source: No funding received for this paper.</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Blond K, Brinkløv CF, Ried-Larsen M, Crippa A, Grøntved A. Association of high amounts of physical activity with mortality risk: a systematic review and meta-analysis. British journal of sports medicine. 2019;bjsports-2018.</td></tr>
<tr><td>Purpose: To clarify if there is a greater all cause and cause specific mortality risk associated with high levels of physical activity above the recommended amounts.</td><td rowspan="5">Abstract: Objectives To systematically review and analyse studies of high amounts of physical activity and mortality risk in the general population. Eligibility criteria Inclusion criteria related to follow-up (minimum 2 years), outcome (mortality from all causes, cancer, cardiovascular disease (CVD) or coronary heart disease), exposure (eg, a category of >1000 metabolic equivalent of task (MET) min/week), study design (prospective cohort, nested case control or case-cohort) and reports of cases and person years of exposure categories. Information sources Systematic searches were conducted in Embase and Pubmed from database inception to 2 March 2019. Risk of bias The quality of the studies was assessed with the Newcastle–Ottawa scale. Included studies From 31 368 studies identified, 48 were included. Two authors independently extracted outcome estimates and assessed study quality. Synthesis of results We estimated hazard ratios (HRs) using random effect restricted cubic spline dose–response meta-analyses. Compared with the recommended level of physical activity (750 MET min/ week), mortality risk was lower at physical activity levels exceeding the recommendations, at least until 5000 MET min/week for all cause mortality (HR=0.86, 95%CI 0.78 to 0.94) and for CVD mortality (HR=0.73, 95%CI 0.56 to 0.95). Strengths and limitations of evidence The strengths of this study include the detailed dose– response analyses, inclusion of 48 studies and examination of sources of heterogeneity. The limitations include the observational nature of the included studies and the inaccurate estimations of amount of physical activity. Interpretation Compared with the recommended level, mortality risk was lower at physical activity levels well above the recommended target range. Further, there was no threshold beyond which lifespan was compromised. Registration PROSPERO CRD42017055727</td></tr>
<tr><td>Timeframe: inception to 2 March 2019</td></tr>
<tr><td>Total # studies included: 48</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) MET min/week</td></tr>
<tr><td>Outcomes addressed: mortality from all causes and cardiovascular disease (CVD)</td></tr>
</table>

| **Meta-analysis**<br>**Citation:** Boyer W.R., Churilla J.R., Ehrlich S.F., Crouter S.E., Hornbuckle L.M., Fitzhugh E.C. Protective role of physical activity on type 2 diabetes:Analysis of effect modification by race–ethnicity, *Journal of Diabetes;* 2018, 10166–178 | |
|---|---|
| **Purpose:** to compile the evidence from prospective cohort studies on potential effect modification of the aerobic PA and T2D risk relationship by race–ethnic groups; a second analysis was conducted to assess the overall effect of meeting the 2008 DHHS moderate-intensity aerobic PA recommend-ation on T2D risk. | **Abstract:**<br>**Background:** It is well known physical activity (PA) plays a role in the prevention of type 2 diabetes (T2D). However, the extent to which PA may affect T2D risk among different race–ethnic groups is unknown. Therefore, the aim of the present study was to systematically examine the effect modification of race–ethnicity on PA and T2D.<br><br>**Methods:** The PubMed and Embase databases were systematically searched through June 2016. Study assessment for inclusion was conducted in three phases: title review (n = 13 022), abstract review (n = 2200), and full text review (n = 265). In all, 27 studies met the inclusion criteria and were used in the analysis. Relative risks (RRs) and 95% confidence intervals (CIs) were extracted and analyzed using Comprehensive Meta-Analysis software. All analyses used a random-effects model.<br><br>**Results: A significant protective summary RR, comparing the most active group with the least active PA group, was found for non-Hispanic White (RR 0.71, 95% CI 0.60–0.85), Asians (RR 0.76, 95% CI 0.67–0.85), Hispanics (RR 0.75, 95% CI 0.64–0.89), and American Indians (RR 0.73, 95% CI 0.60–0.88). The summary effect for non-Hispanic Blacks (RR 0.91, 95% CI 0.76–1.08) was not significant**.<br><br>**Conclusions:** The results of the present study indicate that PA (comparing most to least active groups) provides significant protection from T2D, with the exception of non-Hispanic Blacks. The results also indicate a need for race–ethnicity-specific reporting of RRs in prospective cohort studies that incorporate multiethnic samples. |
| **Timeframe:** Inception through June 2016 | |
| **Total # studies included:** 27 | |
| **Other details (e.g. definitions used, exclusions etc):** assessed aerobic based PA; published or available in English; prospective cohort studies; assessed and reported the race–ethnicity specific relative risks (RR) for T2D; adjusted risk estimates for age; and allowed for the determination of a most versus least physically active group | |
| **Outcomes addressed:** Race–ethnicity specific relative risks (RR) for T2D; | |
| **Population analysed:** Adults (age ≥18 years) at the time of follow-up | **Author-Stated Funding Source:** None declared. |

<table>
<tr><td colspan="2">Systematic review<br>Citation: Brasure M, Desai P, Davila H, Nelson VA, Calvert C, Jutkowitz E, et al. Physical activity interventions in preventing cognitive decline and alzheimer-type dementia a systematic review. Ann Intern Med. 2018;168(1):30–8.</td></tr>
<tr><td>Purpose: To assess the effectiveness of physical activity interventions in slowing cognitive decline and delaying the onset of cognitive impairment and dementia in adults without diagnosed cognitive impairments<br><br>Timeframe: January 2009 – July 2017<br><br>Total # studies included: 32<br><br>Author-stated inclusion criteria: We included randomized controlled trials of physical activity interventions with any sample size and large (n > 500) prospective quasi-experimental cohort studies with comparator groups if they enrolled adults without diagnosed cognitive impairments, had follow-up of at least 6 months, were published in English, and reported 1 of our preselected primary or intermediate outcomes. We excluded trials enrolling pure subgroups of patients with major medical conditions or conditions that may explain changes in cognitive function (namely stroke, Parkinson disease, cancer, and traumatic brain injury).<br><br>Outcomes addressed:<br>Main: Mild cognitive impairment or dementia<br>Other: cognitive function (executive function, attention, processing speed and memory</td><td>Abstract:<br>BACKGROUND: The prevalence of cognitive impairment and dementia is expected to increase dramatically as the population ages, creating burdens on families and health care systems.<br>PURPOSE: To assess the effectiveness of physical activity interventions in slowing cognitive decline and delaying the onset of cognitive impairment and dementia in adults without diagnosed cognitive impairments.<br>DATA SOURCES: Several electronic databases from January 2009 to July 2017 and bibliographies of systematic reviews.<br>STUDY SELECTION: Trials published in English that lasted 6 months or longer, enrolled adults without clinically diagnosed cognitive impairments, and compared cognitive and dementia outcomes between physical activity interventions and inactive controls.<br>DATA EXTRACTION: Extraction by 1 reviewer and confirmed by a second; dual-reviewer assessment of risk of bias; consensus determination of strength of evidence.<br>DATA SYNTHESIS: Of 32 eligible trials, 16 with low to moderate risk of bias compared a physical activity intervention with an inactive control. Most trials had 6-month follow-up; a few had 1- or 2-year follow-up. Evidence was insufficient to draw conclusions about the effectiveness of aerobic training, resistance training, or tai chi for improving cognition. Low-strength evidence showed that multicomponent physical activity interventions had no effect on cognitive function. Low-strength evidence showed that a multidomain intervention comprising physical activity, diet, and cognitive training improved several cognitive outcomes. Evidence regarding effects on dementia prevention was insufficient for all physical activity interventions.<br>LIMITATION: Heterogeneous interventions and cognitive test measures, small and underpowered studies, and inability to assess the clinical significance of cognitive test outcomes.<br>CONCLUSION: Evidence that short-term, single-component physical activity interventions promote cognitive function and prevent cognitive decline or dementia in older adults is largely insufficient. A multidomain intervention showed a delay in cognitive decline (low-strength evidence).</td></tr>
<tr><td>Populations analysed: adults without diagnosed cognitive impairments</td><td>Author-stated funding source: This review was funded by the National Institute on Aging and AHRQ. These agencies and members of the National Academies Committee on Preventing Dementia and Cognitive Impairment helped refine the scope and reviewed a draft report of findings. The authors are solely responsible for the content preparation, writing of the manuscript, and decision to submit the manuscript for publication.</td></tr>
</table>

| | |
|---|---|
| **SR/MA**<br>**Citation:** Chastin, S. F., De Craemer, M., De Cocker, K., Powell, L., Van Cauwenberg, J., Dall, P., ... & Stamatakis, E. (2019). How does light-intensity physical activity associate with adult cardiometabolic health and mortality? Systematic review with meta-analysis of experimental and observational studies. *Br J Sports Med*, *53*(6), 370-376. | |
| **Purpose:** to synthesise evidence from observational and experimental studies and to quantify the effect of LIPA on acute and long-term cardiometabolic health through meta-analysis. | **Abstract:**<br>Aim To assess the relationship between time spent in light physical activity and cardiometabolic health and mortality in adults.<br>Design Systematic review and meta-analysis.<br>Data sources Searches in Medline, Embase, PsycInfo, CINAHL and three rounds of hand searches. Eligibility criteria for selecting studies Experimental (including acute mechanistic studies and physical activity intervention programme) and observational studies (excluding case and case–control studies) conducted in adults (aged ≥18 years) published in English before February 2018 and reporting on the relationship between light physical activity (<3 metabolic equivalents) and cardiometabolic health outcomes or all-cause mortality. Study appraisal and synthesis Study quality appraisal with QUALSYST tool and random effects inverse variance meta-analysis.<br>Results Seventy-two studies were eligible including 27 experimental studies (and 45 observational studies). Mechanistic experimental studies showed that short but frequent bouts of light-intensity activity throughout the day reduced postprandial glucose (−17.5%; 95% CI −26.2 to −8.7) and insulin (−25.1%; 95% CI −31.8 to −18.3) levels compared with continuous sitting, but there was very limited evidence for it affecting other cardiometabolic markers. Three light physical activity programme intervention studies (n ranging from 12 to 58) reduced adiposity, improved blood pressure and lipidaemia; the programmes consisted of activity of >150 min/week for at least 12 weeks. Six out of eight prospective observational studies that were entered in the meta-analysis reported that more time spent in daily light activity reduced risk of all-cause mortality (pooled HR 0.71; 95% CI 0.62 to 0.83).<br>Conclusions Light-intensity physical activity could play a role in improving adult cardiometabolic health and reducing mortality risk. Frequent short bouts of light activity improve glycaemic control. Nevertheless, the modest volume of the prospective epidemiological evidence base and the moderate consistency between observational and laboratory evidence inhibits definitive conclusions. |
| **Timeframe:** from inception to February 2018 | |
| **Total # studies included:** 31 (8 for ACM) | |
| **Other details (e.g. definitions used, exclusions etc)** light physical activity (<3 metabolic equivalents) | |
| **Outcomes addressed:** cardiometabolic health outcomes or all-cause mortality | |

<table>
<tr><td colspan="2">SR/MA<br>Citation: Dinu, M., Pagliai, G., Macchi, C., & Sofi, F. (2019). Active commuting and multiple health outcomes: a systematic review and meta-analysis. Sports Medicine, 49(3), 437-452.</td></tr>
<tr><td>Purpose: To evaluate the relationship between active commuting and all-cause mortality, cardiovascular disease, cancer and diabetes.</td><td rowspan="5">Abstract:<br>Background Active commuting is associated with greater physical activity, but there is no consensus on the actual beneficial effects of this type of physical activity on health outcomes.<br>Objective To examine the association between active commuting and risk of all-cause mortality, incidence and mortality from cardiovascular diseases, cancer and diabetes through meta-analysis.<br>Methods A comprehensive search of MEDLINE, Embase, Google Scholar, Web of Science, The Cochrane Library, Transport Research International Documentation database, and reference lists of included articles was conducted. Only prospective cohort studies were included.<br>Results Twenty-three prospective studies including 531,333 participants were included. Participants who engaged in active commuting had a significantly lower risk of all-cause mortality [relative risk (RR) 0.92, 95% CI 0.85–0.98] and cardiovascular disease incidence (RR 0.91; 95% CI 0.83–0.99). There was no association between active commuting and cardiovascular disease mortality and cancer. Participants who engaged in active commuting had a 30% reduced risk of diabetes (RR 0.70; 95% CI 0.61–0.80) in three studies after removal of an outlying study that affected the heterogeneity of the results. Subgroup analyses suggested a significant risk reduction (− 24%) of all-cause mortality (RR 0.76; 95% CI 0.63–0.94) and cancer mortality (− 25%; RR 0.75; 95% CI 0.59–0.895) among cycling commuters.<br>Conclusion People who engaged in active commuting had a significantly reduced risk of all-cause mortality, cardiovascular<br>disease incidence and diabetes.</td></tr>
<tr><td>Timeframe: MEDLINE (source: PubMed, 1966 to February 2018), Embase (1980 to February 2018)</td></tr>
<tr><td>Total # studies included: 23</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) only prospective cohort studies included</td></tr>
<tr><td>Outcomes addressed: all-cause mortality, cardiovascular disease, cancer and diabetes</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Ekelund, U., Tarp, J., Steene-Johannessen, J., Hansen, B. H., Jefferis, B., Fagerland, M. W., ... & Larson, M. G. (2019). Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. bmj, 366, l4570.</td></tr>
<tr><td>Purpose: to examine the association between accelerometer measured physical activity and sedentary time and all cause mortality<br><br>Timeframe: from inception to 31 July 2018<br><br>Total # studies included: 8<br><br>Other details (e.g. definitions used, exclusions etc) prospective cohort studies that assessed sedentary time and physical activity by accelerometry<br><br>Outcomes addressed: all cause mortality</td><td>Abstract:<br>Objective To examine the dose-response associations between accelerometer assessed total physical activity, different intensities of physical activity, and sedentary time and all cause mortality. Design Systematic review and harmonised meta-analysis. Data sources PubMed, PsycINFO, Embase, Web of Science, Sport Discus from inception to 31 July 2018. Eligibility criteria Prospective cohort studies assessing physical activity and sedentary time by accelerometry and associations with all cause mortality and reported effect estimates as hazard ratios, odds ratios, or relative risks with 95% confidence intervals. Data extraction and analysis Guidelines for meta-analyses and systematic reviews for observational studies and PRISMA guidelines were followed. Two authors independently screened the titles and abstracts. One author performed a full text review and another extracted the data. Two authors independently assessed the risk of bias. Individual level participant data were harmonised and analysed at study level. Data on physical activity were categorised by quarters at study level, and study specific associations with all cause mortality were analysed using Cox proportional hazards regression analyses. Study specific results were summarised using random effects meta-analysis. Main outcome measure All cause mortality. Results 39 studies were retrieved for full text review; 10 were eligible for inclusion, three were excluded owing to harmonisation challenges (eg, wrist placement of the accelerometer), and one study did not participate. Two additional studies with unpublished mortality data were also included. Thus, individual level data from eight studies (n=36383; mean age 62.6 years; 72.8% women), with median follow-up of 5.8 years (range 3.0-14.5 years) and 2149 (5.9%) deaths were analysed. Any physical activity, regardless of intensity, was associated with lower risk of mortality, with a non-linear dose-response. Hazards ratios for mortality were 1.00 (referent) in the first quarter (least active), 0.48 (95% confidence interval 0.43 to 0.54) in the second quarter, 0.34 (0.26 to 0.45) in the third quarter, and 0.27 (0.23 to 0.32) in the fourth quarter (most active). Corresponding hazards ratios for light physical activity were 1.00, 0.60 (0.54 to 0.68), 0.44 (0.38 to 0.51), and 0.38 (0.28 to 0.51), and for moderate-to-vigorous physical activity were 1.00, 0.64 (0.55 to 0.74), 0.55 (0.40 to 0.74), and 0.52 (0.43 to 0.61). For sedentary time, hazards ratios were 1.00 (referent; least sedentary), 1.28 (1.09 to 1.51), 1.71 (1.36 to 2.15), and 2.63 (1.94 to 3.56). Co nclusion Higher levels of total physical activity, at any intensity, and less time spent sedentary, are associated with substantially reduced risk for premature mortality, with evidence of a non-linear dose-response pattern in middle aged and older adults.</td></tr>
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<tr><td colspan="2">Systematic review<br>Citation: Engeroff T, Ingmann T, Banzer W. Physical Activity Throughout the Adult Life Span and Domain-Specific Cognitive Function in Old Age: A Systematic Review of Cross-Sectional and Longitudinal Data. Sport Med. 2018;48(6):1405–36.</td></tr>
<tr><td>Purpose: To study associations between adherence to leisure PA during adulthood and domain-specific cognitive function in old age.</td><td rowspan="5">Abstract:<br>BACKGROUND: A growing body of literature suggests that physical activity might alleviate the age-related neurodegeneration and decline of cognitive function. However, most of this evidence is based on data investigating the association of exercise interventions or current physical activity behavior with cognitive function in elderly subjects.<br>OBJECTIVE: We performed a systematic review and hypothesize that physical activity during the adult life span is connected with maintained domain-specific cognitive functions during late adulthood defined as age 60+ years.<br>METHODS: We performed a systematic literature search up to November 2017 in PubMed, Web of Science, and Google Scholar without language limitations for studies analyzing the association of leisure physical activity during the adult life span (age 18+ years) and domain-specific cognitive functions in older adults (age 60+ years).<br>RESULTS: The literature review yielded 14,294 articles and after applying inclusion and exclusion criteria, nine cross-sectional and 14 longitudinal studies were included. Moderate- and vigorous-intensity leisure physical activity was associated with global cognitive function and specific cognitive domains including executive functions and memory but not attention or working memory. Most studies assessed mid- to late-adulthood physical activity, thus information concerning the influence of young adult life-span physical activity is currently lacking.<br>CONCLUSIONS: Observational evidence that moderate- and vigorous-intensity leisure physical activity is beneficially associated with maintained cognitive functions during old age is accumulating. Further studies are necessary to confirm a causal link by assessing objective physical activity data and the decline of cognitive functions at multiple time points during old age.</td></tr>
<tr><td>Timeframe: Inception – November 2017</td></tr>
<tr><td>Total # studies included: 23</td></tr>
<tr><td>Author-stated inclusion criteria:<br>To be included in our analysis, studies had to assess (1) leisure PA during a time point or time span of adulthood (age 18? years), and (2) cognitive function during a time point or time span of old age, defined as a sample mean age of 60?years (either in the overall sample or a subsample analysis). To define long-term effects, C 10 years should separate at least one time point of leisure PA behavior and cognitive function assessment. Participants (either the overall sample or a subsample that was analyzed separately) should have no cognitive impairments or mental illnesses.<br>Author-stated leisure time physical activity definition:<br>Leisure PA included all activities that people participated in during their free time and that were not work related and did not involve life maintenance tasks such as housecleaning.</td></tr>
<tr><td>Outcomes addressed:<br>Cognitive function was defined as an assessment/ outcome that indicates the performance or decline in (1) a definable cognitive domain, or (2) multiple cognitive domains, or (3) overall/global cognitive function.</td></tr>
<tr><td>Populations analysed: adults without diagnosed cognitive impairments</td><td>Author-stated funding source: No sources of funding were used to assist in the preparation of this article.</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Gordon B., McDowell C., Lyons M., Herring M., The Effects of Resistance Exercise Training on Anxiety: A Meta-Analysis and Meta-Regression Analysis of Randomized Controlled Trials. Sports Med. 2017); 47:2521–2532.</td></tr>
<tr><td>Purpose: To estimate the population effect size for resistance exercise training (RET) effects on anxiety</td><td rowspan="5">Abstract:<br><br>Background: The salutary effects of resistance exercise training (RET) are well established, including increased strength and function; however, less is known regarding the effects of RET on mental health outcomes. Aerobic exercise has well-documented positive effects on anxiety, but a quantitative synthesis of RET effects on anxiety is needed. Objectives: To estimate the population effect size for resistance exercise training (RET) effects on anxiety and to determine whether variables of logical, theoretical, and/or prior empirical relation to anxiety moderate the overall effect. Methods: Thirty-one effects were derived from 16 articles published before February 2017, located using Google Scholar, MEDLINE, PsycINFO, PubMed, and Web of Science. Trials involved 922 participants (mean age = 43 ± 21 years, 68% female/32% male) and included both randomization to RET ( n = 486) or a non-active control condition ( n = 436), and a validated anxiety outcome measured at baseline, mid-, and/or post-intervention. Hedges' d effect sizes were computed and random effects models were used for all analyses. Meta-regression quantified the extent to which participant and trial characteristics moderated the mean effect. Results: RET significantly reduced anxiety symptoms ($\Delta = 0.31$, 95% CI 0.17-0.44; $z = 4.43$; $p < 0.001$). Significant heterogeneity was not indicated ( $Q(30) = 40.5$, $p > 0.09$; I = 28.3%, 95% CI 10.17-42.81); sampling error accounted for 77.7% of observed variance. Larger effects were found among healthy participants ($\Delta = 0.50$, 95% CI 0.22-0.78) compared to participants with a physical or mental illness ($\Delta = 0.19$, 95% CI 0.06-0.31, $z = 2.16$, $p < 0.04$). Effect sizes did not significantly vary according to sex ( $\beta = -0.31$), age ( $\beta = -0.10$), control condition ( $\beta = 0.08$), program length ( $\beta = 0.07$), session duration ( $\beta = 0.08$), frequency ( $\beta = -0.10$), intensity ( $\beta = -0.18$), anxiety recall time frame ( $\beta = 0.21$), or whether strength significantly improved ( $\beta = 0.19$) (all $p \geq 0.06$). Conclusions: RET significantly improves anxiety symptoms among both healthy participants and participants with a physical or mental illness. Improvements were not moderated by sex, or based on features of RET. Future trials should compare RET to other empirically-supported therapies for anxiety.</td></tr>
<tr><td>Timeframe: From inception to February 20</td></tr>
<tr><td>Total # studies included: 16</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc): RCTs to either a RET intervention or a non-active control condition, and an anxiety outcome measured at baseline and at mid- and/or post-intervention</td></tr>
<tr><td>Outcomes addressed: Anxiety measured using: Profile of mood states-tension, Hopkins symptom checklist, State-Trait Anxiety Inventory, Mental Health Functioning Index-Anxiety, Hospital Anxiety and Depression Scales, Depression, Anxiety and Stress Scale-21, Brunel Mood Scale-Tension, Generalized Anxiety Disorder</td></tr>
<tr><td>Population analysed: All ages, including children and adolescents, patient groups, older adults and some with mental health concerns.</td><td>Author-Stated Funding Source: No sources of funding were used to assist in the conduct of this analysis or the preparation of this article.</td></tr>
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| **Meta-analysis**<br>**Citation:** Gordon B.R., McDowell C.P., Hallgren M., Meyer M., Lyon M., Herring M.P. Association of Efficacy of Resistance Exercise Training With Depressive Symptoms: Meta-analysis and Meta-regression Analysis of Randomized Clinical Trials. *JAMA Psychiatry.* 2018;75(6):566-576. | |
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| **Purpose:** To estimate the association of efficacy of resistive exercise training (RET) with depressive symptoms.<br>**Timeframe: P**ublished before August 2017<br>**Total # studies included:** 33<br>**Other details (e.g. definitions used, exclusions etc):** Peer-reviewed publication, clinical trials, randomized allocation to either an RET intervention or a nonactive control condition, and a validated self-report or clinician-rated measure of depressive symptoms assessed at baseline and at mid-intervention and/or postintervention. No multi-component studies included. Interventions ranged between 6 and 52 weeks.<br>**Outcomes addressed:** Measures of depressive symptoms using: Beck Depression Inventory; Brunel Mood Scale Cardiac Depression Scale; Center for Epidemiologic Studies Depression Scale, Depression Adjective Checklist, Depression, Anxiety and Stress Scale; GDS, Geriatric Depression Scale, Hospital Anxiety and Depression Scale, Hamilton Rating Scale for Depression, Major Depression Inventory, Mental HealthFunctioning Index, Profile of Mood States, Hopkins Symptom Checklist | **Abstract:**<br><br>**Importance:** The physical benefits of resistance exercise training (RET) are well documented, but less is known regarding the association of RET with mental health outcomes. To date, no quantitative synthesis of the antidepressant effects of RET has been conducted. **Objectives:** To estimate the association of efficacy of RET with depressive symptoms and determine the extent to which logical, theoretical, and/or prior empirical variables are associated with depressive symptoms and whether the association of efficacy of RET with depressive symptoms accounts for variability in the overall effect size. **Data Sources:** Articles published before August 2017, located using Google Scholar, MEDLINE, PsycINFO, PubMed, and Web of Science. Study Selection: Randomized clinical trials included randomization to RET (n = 947) or a nonactive control condition (n = 930). **Data Extraction and Synthesis**: Hedges d effect sizes were computed and random-effects models were used for all analyses. Meta-regression was conducted to quantify the potential moderating influence of participant and trial characteristics. **Main Outcomes and Measures:** Randomized clinical trials used validated measures of depressive symptoms assessed at baseline and mid-intervention and/or postintervention. Four primary moderators were selected a priori to provide focused research hypotheses about variation in effect size: total volume of prescribed RET, whether participants were healthy or physically or mentally ill, whether or not allocation and/or assessment were blinded, and whether or not the RET intervention resulted in a significant improvement in strength. **Results:** Fifty-four effects were derived from 33 randomized clinical trials involving 1877 participants. **Resistance exercise training was associated with a significant reduction in depressive symptoms with a moderate-sized mean effect of 0.66 (95% CI, 0.48-0.83; z = 7.35; P < .001).** Significant heterogeneity was indicated (total Q = 216.92, df = 53; P < .001; I2 = 76.0% [95% CI, 72.7%-79.0%]), and sampling error accounted for 32.9% of observed variance. The number needed to treat was 4. Total volume of prescribed RET, participant health status, and strength improvements were not significantly associated with the antidepressant effect of RET. However, smaller reductions in depressive symptoms were derived from randomized clinical trials with blinded allocation and/or assessment. **Conclusions and Relevance:** Resistance exercise training significantly reduced depressive symptoms among adults regardless of health status, total prescribed volume of RET, or significant improvements in strength. Better-quality randomized clinical trials blinding both allocation and assessment and comparing RET with other empirically supported treatments for depressive symptoms are needed. |
| **Population analysed:** Adults what were either | **Author-Stated Funding Source:** None reported. |

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| older, or were overweight or obese, or may have had some or other medical condition (T2DM, Cancer, Fibromyalgia etc), and one study with law enforcement officers and one study with participants with major depressive disorder | |

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<tr><td colspan="2">SR/MA<br>Citation: Hidayat K, Zhou H-J, Shi B-M. Influence of physical activity at a young age and lifetime physical activity on the risks of 3 obesity-related cancers: systematic review and meta-analysis of observational studies. Nutrition Reviews 2019 doi: 10.1093/nutrit/nuz024</td></tr>
<tr><td>Purpose: The present systematic review and meta-analysis of observational studies was performed in accordance with the MOOSE guidelines to determine whether physical activity at a young age and lifetime physical activity may lower the risks of breast cancer, colon cancer, and endometrial cancer.</td><td rowspan="5">Abstract: Context: Excess weight has been linked to increased risks of 13 types of cancers. Physical activity is a non-nutritional modifiable lifestyle factor that is not only crucial for weight control but is also known to regulate hormones and metabolic pathways that may contribute to carcinogenesis. There is solid evidence that being physically active during middle and late adulthood lowers the risks of 3 obesity-related cancers, namely breast cancer, colon cancer, and endometrial cancer. However, the associations between physical activity at a young age (childhood, adolescence, and young adulthood; age 5 to _30 yr) and lifetime physical activity and the risks of breast cancer, colon cancer, and endometrial cancer are less defined. Objective: The present systematic review and meta-analysis of observational studies was performed in accordance with the MOOSE guidelines to determine whether physical activity at a young age and lifetime physical activity may lower the risks of breast cancer, colon cancer, and endometrial cancer. Data sources: The PubMed and Web of Science databases were searched for relevant observational studies published from inception to July 2018. Study selection: Observational studies (prospective cohort, case cohort, nested case-control, historical cohort, and case-control) were considered relevant if they investigated the association between physical activity at a young age or lifetime physical activity and the risks of developing selected cancers. Data extraction: A random-effects meta-analysis was performed to generate the summary relative risk (RR) with 95%CI for the highest vs the lowest category of physical activity of any type. Results: Eighty publications were included in the present meta-analysis. Higher physical activity at a young age was associated with lower risks of breast cancer (RR 0.81, 95%CI 0.76, 0.87) and colon cancer (RR 0.67, 95%CI 0.50, 0.88). Similarly, lifetime physical activity was inversely associated with the risks of breast cancer (RR 0.79, 95%CI 0.72, 0.86) and colon cancer (RR 0.75, 95%CI 0.69, 0.82). For breast cancer, menopausal status did not appear to modify the observed inverse association. The benefit with respect to endometrial cancer risk reduction was only observed with higher lifetime physical activity (RR 0.77, 95%CI 0.67, 0.88), not with higher physical activity at a young age (RR 0.89, 95%CI 0.73, 1.07). Conclusions: Being physically active over a lifetime, starting from early childhood, may lower the risks of developing breast cancer, colon cancer, and endometrial cancer.</td></tr>
<tr><td>Timeframe: Inception to July 2019</td></tr>
<tr><td>Total # studies included: 80</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Self-reported PA by type</td></tr>
<tr><td>Outcomes addressed: Breast, colon, endometrial cancer</td></tr>
<tr><td>Populations Analyzed: Adults</td><td>Author-Stated Funding Source: This study was supported by grants from Suzhou Science and Technology Bureau (No. SYS201741).</td></tr>
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<tr><td colspan="2">SR/MA<br>Citation: Kovacevic A, Mavros Y, Heisz JJ, Singh MA. The effect of resistance exercise on sleep: a systematic review of randomized controlled trials. Sleep medicine reviews. 2018 Jun 1;39:52-68. https://doi-org.ezproxy1.library.usyd.edu.au/10.1016/j.smrv.2017.07.002</td></tr>
<tr><td>Purpose: to review the effects of acute and chronic resistance exercise on sleep quantity and quality.</td><td rowspan="5">Abstract:<br>Impaired sleep quality and quantity are associated with future morbidity and mortality. Exercise may be an effective non-pharmacological intervention to improve sleep, however, little is known on the effect of resistance exercise. Thus, we performed a systematic review of the literature to determine the acute and chronic effects of resistance exercise on sleep quantity and quality. Thirteen studies were included. Chronic resistance exercise improves all aspects of sleep, with the greatest benefit for sleep quality. These benefits of isolated resistance exercise are attenuated when resistance exercise is combined with aerobic exercise and compared to aerobic exercise alone. However, the acute effects of resistance exercise on sleep remain poorly studied and inconsistent. In addition to the sleep benefits, resistance exercise training improves anxiety and depression. These results suggest that resistance exercise may be an effective intervention to improve sleep quality. Further research is needed to better understand the effects of acute resistance exercise on sleep, the physiological mechanisms underlying changes in sleep, the changes in sleep architecture with chronic resistance exercise, as well its efficacy in clinical cohorts who commonly experience sleep disturbance. Future studies should also examine time-of-day and dose–response effects to determine the optimal exercise prescription for sleep benefits.</td></tr>
<tr><td>Timeframe: inception to 20 June 2016</td></tr>
<tr><td>Total # studies included: 13</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) RCT or randomized crossover trial.</td></tr>
<tr><td>Outcomes addressed: sleep, wakefulness, daytime drowsiness, use of sleep remedies</td></tr>
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<tr><td colspan="2">SR/MA<br>Citation: Liu Y, Li Y, Bai Y-P, Fan X-X. Association Between Physical Activity and Lower Risk of Lung Cancer: A Meta-Analysis of Cohort Studies. Front. Oncol. 2019; 9:5. doi: 10.3389/fonc.2019.00005</td></tr>
<tr><td>Purpose: We aimed to investigate the relationship between physical activity and risk of lung cancer in men and women, as well as other high-risk populations such as cigarette smokers.</td><td rowspan="5">Abstract: Background: Epidemiological evidences regarding the association between physical activity and the risk of lung cancer are still controversial.<br>Objectives: We aimed to investigate the relationship between physical activity and risk of lung cancer in men and women, as well as other high-risk populations such as cigarette smokers.<br>Methods: We conducted a meta-analysis of cohort studies to evaluate the association between physical activity and risk of lung cancer. Relevant studies were identified by searching PubMed and Web of Knowledge through August 2018. Study-specific relative risk (RR) with 95% confidence interval (CI) were pooled using random effect model when significant heterogeneity was detected.<br>Results: Twenty cohort studies with a total of 2,965,811 participants and 31,807 lung cancer cases were included. There was an inverse association between the physical activity and risk of lung cancer. Compared with the low level of physical activity, the pooled RR was 0.83 (95%CI: 0.77, 0.90), with significant heterogeneity ($I2$ = 62.6%, $P$ heterogeneity < 0.001). The corresponding pooled RRs were 0.90 (95%CI: 0.82, 0.99) for women and 0.81 (95%CI: 0.73, 0.90) for men. Smokers with a high level of physical activity were associated with a 10% lower risk for lung cancer (RR = 0.90, 95% CI: 0.84, 0.97), while the association was not significant among non-smokers (RR = 0.95, 95% CI: 0.88, 1.03). Subgroups analysis stratified by whether the studies adjusted for smoking intensity and durations yielded the same magnitude of RR. However, the RR for subgroups without adjustment for dietary factors was 0.74 (95%CI: 0.71, 0.77), which was significantly lower than that with dietary factors adjusted (RR = 0.89, 95%CI: 0.84, 0.95).<br>Conclusions: Increased physical activity might be associated with lower risk of lung cancer. Such inverse association was identified among smokers rather than non-smokers. Large interventional studies are expected to further verify these findings.</td></tr>
<tr><td>Timeframe: Inception to August 2018</td></tr>
<tr><td>Total # studies included: 21 cohort studies</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Self-reported PA by type</td></tr>
<tr><td>Outcomes addressed: Lung</td></tr>
<tr><td>Populations Analyzed: Adults</td><td>Author-Stated Funding Source: No funding received for this paper.</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: S. J. Martínez-Domínguez, H. Lajusticia, P. Chedraui, F. R. Pérez-López & for the Health Outcomes and Systematic Analyses (HOUSSAY) Project (2018) The effect of programmed exercise over anxiety symptoms in midlife and older women: a meta-analysis of randomized controlled trials, Climacteric, 21:2, 123-131,</td></tr>
<tr><td>Purpose: To evaluate the effect of programmed exercise, for at least 6 weeks, as compared to no intervention over mild or low to moderate anxiety symptoms on anxiety symptoms (AS) in mid-aged and older women.</td><td rowspan="5">We aimed to perform a systematic review and meta-analysis in order to clarify the effect of programmed exercise over mild-to-moderate anxiety symptoms (ASs) in midlife and older women. A structured search of PubMed, Medline, Web of Science, Scopus, Embase, Cochrane Library, Scielo, and the US, UK and Australian Clinical Trials databases (from inception through July 27, 2017) was performed, with no language restriction using the following terms: 'anxiety', 'anxiety symptoms', 'exercise', 'physical activity', 'menopause', and 'randomized controlled trial' (RCTs) in mid-aged and older women. We assessed RCTs that compared the effect of exercise for at least 6 weeks versus no intervention over ASs as outcome (as defined by trial authors). Exercise was classified according to duration as 'mid-term exercise intervention' (MTEI; for 12 weeks to 4 months), and 'long-term exercise intervention' (LTEI; for 6-14 months). Mean +/- standard deviations of changes for ASs, as assessed with different questionnaires, were extracted to calculate Hedges' g and then used as effect size for meta-analyses. Standardized mean differences (SMDs) of ASs after intervention were pooled using a random-effects model. Ten publications were included for analysis related to 1463 midlife and older women (minimum age 54.2 +/- 3.5 and maximum age 77.6 +/- 5.4 years). Eight MTEIs were associated with a significant reduction of ASs (SMD = -0.42; 95% CI -0.81 to -0.02) as compared to controls. There was no reduction of ASs in seven LTEIs (SMD = -0.03; 95% CI -0.18 to 0.13). It can be concluded that MTEIs of low-to-moderate intensity seem to improve mild-moderate ASs in midlife and older women.<br><br>(*Low intensity more effective than moderate intensity)</td></tr>
<tr><td>Timeframe: From inception through July 27, 2017</td></tr>
<tr><td>Total # studies included: 10</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc): RCTs only; Programmed exercise was classified according to duration as ‘midterm exercise intervention’ (MTEI; from 12 weeks to 4 months) or ‘long-term exercise intervention’ (LTEI; from 6 to 14 months). Exercise intensity was classified as low (walking, yoga, and progressive exercise) or moderate (aerobic exercise and cardiovascular training).</td></tr>
<tr><td>Outcomes addressed: AS measured with standard instrument including: Beck Depression Inventory. State-Trait Anxiety Inventory, Brief Symptom Inventory, Women’s Health Questionnaire, Hospital Anxiety and Depression Scale, Generalized Anxiety Disorder Questionnaire, Depression, Anxiety and Stress Scale.</td></tr>
<tr><td>Population analysed: Otherwise healthy women aged 40 or more</td><td>Author-Stated Funding Source: None</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Northey JM, Cherbuin N, Pumpa KL, Smee DJ, Rattray B. Exercise interventions for cognitive function in adults older than 50: A systematic review with meta-Analysis. Br J Sports Med. 2018;52(3):154–60.</td></tr>
<tr><td>Purpose: To determine if physical exercise is effective in improving cognitive function in middle to older adults.<br><br>Timeframe: Inception – November 2016<br><br>Total # studies included: 43<br><br>Author-stated inclusion criteria:<br>Studies were included from the initial search if they strictly met the following criteria: (1) studies of community dwelling men or women aged 50 years or older. Because criteria for diagnosing cognitive ability (eg, the presence of mild cognitive impairment (MCI)) differ between studies and prior reviews,8 there were no limitations on baseline cognitive status. However, studies which included clinical samples with other neurological (eg, stroke) or mental illnesses (eg, depression) were excluded. (2) A structured exercise programme of any mode, duration, frequency or intensity. Exercise programmes that were not explicitly stated as fully supervised, or of <4 weeks, were excluded. Studies must have allowed the isolated effects of exercise to be measured. (3) A control group could include no contact, waiting list, attention control, sham exercise or alternative active treatment. (4) At least one outcome measure of cognition, measured at baseline and follow-up by any validated neuropsychological test of cognition. (5) The study design was strictly limited to RCTs. (6) A trial must have been published in a peer-reviewed journal.<br><br>Outcomes addressed:<br>Cognition</td>
<td>Abstract:<br>BACKGROUND: Physical exercise is seen as a promising intervention to prevent or delay cognitive decline in individuals aged 50 years and older, yet the evidence from reviews is not conclusive.<br>OBJECTIVES: To determine if physical exercise is effective in improving cognitive function in this population.<br>DESIGN: Systematic review with multilevel meta-analysis.<br>DATA SOURCES: Electronic databases Medline (PubMed), EMBASE (Scopus), PsychINFO and CENTRAL (Cochrane) from inception to November 2016.<br>ELIGIBILITY CRITERIA: Randomised controlled trials of physical exercise interventions in community-dwelling adults older than 50 years, with an outcome measure of cognitive function.<br>RESULTS: The search returned 12 820 records, of which 39 studies were included in the systematic review. Analysis of 333 dependent effect sizes from 36 studies showed that physical exercise improved cognitive function (0.29; 95% CI 0.17 to 0.41; p<0.01). Interventions of aerobic exercise, resistance training, multicomponent training and tai chi, all had significant point estimates. When exercise prescription was examined, a duration of 45-60 min per session and at least moderate intensity, were associated with benefits to cognition. The results of the meta-analysis were consistent and independent of the cognitive domain tested or the cognitive status of the participants.<br>CONCLUSIONS: Physical exercise improved cognitive function in the over 50s, regardless of the cognitive status of participants. To improve cognitive function, this meta-analysis provides clinicians with evidence to recommend that patients obtain both aerobic and resistance exercise of at least moderate intensity on as many days of the week as feasible, in line with current exercise guidelines.</td></tr>
<tr><td>Populations analysed: middle to older adults (>50 years)</td><td>Author-stated funding source: No funding source stated.</td></tr>
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<tr><td colspan="2">SR/MA<br>Citation: O'Donovan, G., Stensel, D., Hamer, M., & Stamatakis, E. (2017). The association between leisure-time physical activity, low HDL-cholesterol and mortality in a pooled analysis of nine population-based cohorts. European journal of epidemiology, 32(7), 559-566.</td></tr>
<tr><td>Purpose: to investigate associations between leisure-time physical activity, low HDL-C and mortality in a pooled analysis of nine population-based cohorts in Britain.</td><td rowspan="5">Abstract:<br>The objective of this study was to investigate associations between leisure-time physical activity, low high-density lipoprotein cholesterol (HDL-C) and mortality. Self-reported leisure-time physical activity, HDL-C concentration, and mortality were assessed in 37,059 adults in Health Survey for England and Scottish Health Survey. Meeting physical activity guidelines was defined as C150 min wk-1 of moderate-intensity activity, C75 min wk-1 of vigorous-intensity activity, or equivalent combinations. Low HDL-C was defined as \1.03 mmol L-1 . Cox proportional hazard models were adjusted for age, sex, smoking, total cholesterol, systolic blood pressure, body mass index, longstanding illness, and socioeconomic status. There were 2250 deaths during 326,016 person-years of follow-up. Compared with those who met physical activity guidelines and whose HDL-C was normal (reference group), all-cause mortality risk was not elevated in those who met physical activity guidelines and whose HDL-C concentration was low (hazard ratio: 1.07; 95% confidence interval: 0.75, 1.53). Compared with the reference group, all-cause mortality risk was elevated in those who did not meet physical activity guidelines and whose HDL-C was normal (1.37; 1.16, 1.61), and in those who did not meet physical activity guidelines and whose HDL-C was low (1.65; 1.37, 1.98). Cardiovascular disease mortality hazard ratios were similar, although confidence intervals were wider. There was no statistically significant evidence of biological interaction between physical inactivity and low HDL-C. This novel study supports the notion that leisure-time physical activity be recommended in those with low HDL-C concentration who may be resistant to the HDL-raising effect of exercise training</td></tr>
<tr><td>Timeframe: -</td></tr>
<tr><td>Total # studies included: 9</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) frequency and duration of participation in domestic physical activity (light and heavy housework, gardening, and do-it-yourself tasks); frequency, duration and pace of walking (slow, average, brisk, or fast); and participation in sports and exercises using a prompt card showing 10 main groups, including cycling, swimming, running, football, rugby, tennis, and squash.</td></tr>
<tr><td>Outcomes addressed: HDL-cholesterol, ACM, CVD mortality</td></tr>
</table>

<table>
<tr><td colspan="2">SR/MA<br>Citation: Paudel S, Owen AJ, Owusu-Addo E, Smith BJ. Physical activity participation and the risk of chronic diseases among South Asian adults: a systematic review and meta-analysis. Scientific reports. 2019;9(1):9771.</td></tr>
<tr><td>Purpose: To systematically review published, peer-reviewed literature to identify the association between PA domains (total, transport, household, occupational and leisure) and selected chronic diseases and their markers and provide summary estimates of the strength of associations among South Asian adults 40 years or older.</td><td rowspan="5">Abstract: South Asia specifc reviews on the role of physical activity (PA) domains on chronic disease prevention are lacking. This study aimed to systematically review published literature to identify the association between PA domains and chronic diseases and to provide summary estimates of the strength of association. Nine electronic databases were searched using the predefned inclusion criteria which included population (South Asian adults 40 years or older), exposure (PA or sedentary behaviour) and outcome (type 2 diabetes mellitus, breast cancer, colorectal cancer, coronary heart disease, stroke, vascular disease and musculoskeletal diseases and their markers). A random-efects metaanalysis was carried out for cardiometabolic outcomes whereas narrative synthesis was completed for other outcome variables. Inactive or less active South Asian adults were at 31% higher risk of being hypertensive. Likewise, the risk of cardiometabolic outcomes was 1.34 times higher among inactive adults. Household PA was found to have a protective efect on breast cancer risk. Total and leisure time PA had a protective efect on osteoporosis among males and females respectively. Contemporary studies with a longitudinal design, representative samples, valid and reliable assessment of diferent domains are needed to establish the role of PA in chronic disease prevention in the region.</td></tr>
<tr><td>Timeframe: between January 2000 and March 2018</td></tr>
<tr><td>Total # studies included: 9</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Routine PA</td></tr>
<tr><td>Outcomes addressed: Chronic diseases, musculoskeletal diseases</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Perez-Lopez F.R., Martinez-Dominguez S.J., Lajusticia H., Chedraui P.Effects of programmed exercise on depressive symptoms in midlife and older women: A meta-analysis of randomized controlled trials. Maturitas. 2017; 106; 38–47.</td></tr>
<tr><td>Purpose: To determine the effect of programmed exercise, for at least 6 weeks, as compared to no intervention over mild to moderate depressive symptoms in midaged and older women (> 40 years).</td><td rowspan="5">Abstract:<br><br>Objective: To perform a systematic review and meta-analysis to clarify the effect of programmed exercise on depressive symptoms (DSs) in midlife and older women.<br><br>Methods: We carried out a structured search of PubMed-Medline, Web of Science, Scopus, Embase, Cochrane Library and Scielo, from database inception through June 29, 2017, without language restriction. The search included the following terms: depression", "depressive symptoms", "exercise", "physical activity", "menopause", and "randomized controlled trial" (RCTs) in midlife and older women. The US, UK and Australian Clinical Trials databases were also searched. We assessed randomized controlled trials (RCTs) that compared the effect of exercise for at least 6 weeks versus no intervention on DSs as the outcome (as defined by trial authors). Exercise was classified according to duration as "mid-term exercise intervention" (MTEI; lasting for 12 weeks to 4 months), and "long-term exercise intervention" (LTEI; lasting for 6-12 months). Mean changes (+/-standard deviations) in DSs, as assessed with different questionnaires, were extracted to calculate Hedges' g and then used as the effect size for meta-analysis. Standardized mean differences (SMDs) of DSs after intervention were pooled using a random-effects model.<br><br>Results: Eleven publications were included for analysis related to 1943 midlife and older women (age range 44-55 years minimum to 65.5+/-4.0 maximum), none of whom was using a hormone therapy. Seven MTEIs were associated with a significant reduction in DSs (SMD=-0.44; 95% CI -0.69, -0.18; p=0.0008) compared with controls. The reduction in DSs was also significant in six LTEIs (SMD=- 0.29; 95% CI -0.49; -0.09; p=0.005). Heterogeneity of effects among studies was moderate to high. Less perceived stress and insomnia (after exercise) were also found as secondary outcomes.<br><br>Conclusion: Exercise of low to moderate intensity reduces depressive symptoms in midlife and older women.</td></tr>
<tr><td>Timeframe: From inception through June 29, 2017,</td></tr>
<tr><td>Total # studies included: 11</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc): RCTs in otherwise healthy women (>40 yrs); no significant differences regarding rate of anxiety or severity at baseline between intervention and control groups; program of exercise for at least 6 weeks; controls defined as women who did not participate in the exercise program.</td></tr>
<tr><td>Outcomes addressed: Depression measured with any of the following surveys: Beck Depression Inventory, Patient Health Questionnaire, Women's Health Questionnaire, Brief Symptom Inventory, Geriatric Depressed Scale.</td></tr>
<tr><td>Population analysed: Otherwise healthy women aged 40 or more</td><td>Author-Stated Funding Source: No funding was received.</td></tr>
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| **Meta-analysis**<br>**Citation:** Rathore A, Lom B. The effects of chronic and acute physical activity on working memory performance in healthy participants: A systematic review with meta-analysis of randomized controlled trials. Syst Rev. 2017;6(1):1–16. | |
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| **Purpose:** to evaluate and synthesize randomized controlled trial studies that investigated the effects of both chronic and acute PA on working memory performance (WMP) in physically and cognitively healthy individuals.<br>**Timeframe:** August 2009 – December 2016<br>**Total # studies included:** 8<br>**Author-stated inclusion criteria:**<br>1- Population: the sample population was identified as cognitively and physically healthy via validated diagnostic tools.<br>2- Intervention: PA defined as “any bodily movement produced by skeletal muscles that result in energy expenditure” [40]. Acute PA interventions were identified as those with a single PA session while chronic PA interventions were defined as those with more than one PA session. Furthermore, PA was the purposefully selected term as it incorporates a broader spectrum of interventions that otherwise could be excluded under the term “exercise.” Thus, “physical activity” was expected to capture conventional forms of activity, such as cardiovascular exercise and resistance training, but also less conventional forms, such as yoga. Finally, no limitations were imposed based upon modality, dose, intensity, or supervision, but dual-task interventions or self-reported interven- tions were excluded due to confounding factors noted in previous research [33].<br>3- Comparator: any kind of control group was eligible, including no treatment, waitlist, health education, sham exercise, or sedentary treatment.<br>4- Outcome: validated WMP cognitive assessment tools, according to a specific categorization described below.<br>5- Study design: randomized controlled trials, including cluster-RCTs, crossover-RCTs that are full-length studies published in peer-reviewed, English language journals.<br>**Outcomes addressed:**<br>Working memory performance | **Abstract:**<br>BACKGROUND: Understanding how physical activity (PA) influences cognitive function in populations with cognitive impairments, such as dementia, is an increasingly studied topic yielding numerous published systematic reviews. In contrast, however, there appears to be less interest in examining associations between PA and cognition in cognitively healthy individuals. Therefore, the objective of this review was to evaluate and synthesize randomized controlled trial (RCT) studies that investigated the effects of both chronic and acute PA on working memory performance (WMP) in physically and cognitively healthy individuals.<br>METHODS: Following the preferred reporting items for systematic review and meta-analysis (PRISMA) guidelines, a systematic review of studies published between August 2009 and December 2016 was performed on RCTs investigating the effects of chronic and acute PA on WMP with healthy participants as the sample populations. Searches were conducted in Annual Reviews, ProQuest, PsycARTICLES, PsycINFO, PubMed, and Web of Science. Main inclusion criteria stipulated (1) healthy sample populations, (2) PA interventions, (3) WMP as an outcome, and (4) RCT designs. Descriptive statistics included cohort and intervention characteristics and a risk of bias assessment. Analytical statistics included meta-analyses and moderation analyses.<br>RESULTS: From 7345 non-duplicates, 15 studies (eight chronic PA and seven acute PA studies) met the inclusion criteria and were evaluated. Overall, there was noticeable variance between both cohort and intervention characteristics. Sample populations ranged from primary school children to retirement community members with PA ranging from cycling to yoga. The majority of studies were characterized by "low" or "unclear" risk of selection, performance, detection, attrition, reporting, or other biases. Meta-analysis of chronic PA revealed a significant, small effect size while analysis of acute PA revealed a non-significant, trivial result. Age and intensity were significant moderators while allocation concealment, blinding, and intervention length were not.<br>CONCLUSIONS: Chronic PA can significantly improve WMP while acute PA cannot. The limiting factors for acute PA studies point to the diversity of working memory instruments utilized, unequal sample sizes between studies, and the sample age groups. Large-scale, high-quality RCTs are needed in order to provide generalizable and more powerful analysis between PA and WMP in a systematic approach. |
| **Populations analysed:** Healthy adults | **Author-stated funding source:** This work was not supported by specific funding. |

| **SR/MA**<br>**Citation:** Robbins R, Jackson CL, Underwood P, Vieira D, Jean-Louis G, Buxton OM. Employee Sleep and Workplace Health Promotion: A Systematic Review. American Journal of Health Promotion. 2019 Apr 7:0890117119841407. https://doi-org.ezproxy1.library.usyd.edu.au/10.1177/0890117119841407 |
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<td>Purpose: to examine workplace-based employee health interventions that measure sleep duration as an outcome.</td>
<td rowspan="5">Abstract:<br>Objective:<br>Workplace-based employee health promotion programs often target weight loss or physical activity, yet there is growing attention to sleep as it affects employee health and performance. The goal of this review is to systematically examine workplace-based employee health interventions that measure sleep duration as an outcome.<br>Data Source:<br>We conducted systematic searches in PubMed, Web of Knowledge, EMBASE, Scopus, and PsycINFO (n = 6177 records).<br>Study Inclusion and Exclusion Criteria:<br>To be included in this systematic review, studies must include (1) individuals aged >18 years, (2) a worker health-related intervention, (3) an employee population, and (4) sleep duration as a primary or secondary outcome.<br>Results:<br>Twenty studies met criteria. Mean health promotion program duration was 2.0 months (standard deviation [SD] = 1.3), and mean follow-up was 5.6 months (SD = 6.5). The mean sample size of 395 employees (SD = 700.8) had a mean age of 41.5 years (SD = 5.2). Measures of sleep duration included self-report from a general questionnaire (n = 12, 66.6%), self-report based on Pittsburgh Sleep Quality Index (n = 4, 22.2%), and self-report and actigraphy combined (n = 5, 27.7%). Studies most commonly included sleep hygiene (35.0%), yoga (25.0%), physical activity (10.0%), and cognitive–behavioral therapy for insomnia (10.0%) interventions. Across the interventions, 9 different behavior change techniques (BCTs) were utilized; the majority of interventions used 3 or fewer BCTs, while 1 intervention utilized 4 BCTs. Study quality, on average, was 68.9% (SD = 11.1). Half of the studies found workplace-based health promotion program exposure was associated with a desired increase in mean nightly sleep duration (n = 10, 50.0%).<br>Conclusions:<br>Our study findings suggest health promotion programs may be helpful for increasing employee sleep duration and subsequent daytime performance.</td>
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<tr><td>Timeframe: inception to 1 Sep 2018</td></tr>
<tr><td>Total # studies included: 20</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) any intervention studies, adult employees</td></tr>
<tr><td>Outcomes addressed: sleep duration, PSQI</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Schuch F.B., Vancampfort D., Firth J., Rosenbaum S., Ward P.B., Silva E.S., Hallgren M., Ponce De Leon A., Dunn A.L., Deslandes A.C., Fleck M.P., Carvalho A.F., Stubbs B. Physical Activity and Incident Depression: A Meta-Analysis of Prospective Cohort Studies. Am J Psychiatry, 2018; 175:631–648.</td></tr>
<tr><td>Purpose: To determine the prospective relationship between physical activity and incident depression and explored potential moderators</td><td rowspan="5">Abstract:<br><br>Objective: The authors examined the prospective relationship between physical activity and incident depression and explored potential moderators.<br><br>Method: Prospective cohort studies evaluating incident depression were searched from database inception through Oct. 18, 2017, on PubMed, PsycINFO, Embase, and SPORTDiscus. Demographic and clinical data, data on physical activity and depression assessments, and odds ratios, relative risks, and hazard ratios with 95% confidence intervals were extracted. Random-effects meta-analyses were conducted, and the potential sources of heterogeneity were explored. Methodological quality was assessed using the Newcastle-Ottawa Scale.<br><br>Results: A total of 49 unique prospective studies (N=266,939; median proportion of males across studies, 47%) were followed up for 1,837,794 person-years. Compared with people with low levels of physical activity, those with high levels had lower odds of developing depression (adjusted odds ratio=0.83, 95% CI=0.79, 0.88; I(2)=0.00). Furthermore, physical activity had a protective effect against the emergence of depression in youths (adjusted odds ratio=0.90, 95% CI=0.83, 0.98), in adults (adjusted odds ratio=0.78, 95% CI=0.70, 0.87), and in elderly persons (adjusted odds ratio=0.79, 95% CI=0.72, 0.86). Protective effects against depression were found across geographical regions, with adjusted odds ratios ranging from 0.65 to 0.84 in Asia, Europe, North America, and Oceania, and against increased incidence of positive screen for depressive symptoms (adjusted odds ratio=0.84, 95% CI=0.79, 0.89) or major depression diagnosis (adjusted odds ratio=0.86, 95% CI=0.75, 0.98). No moderators were identified. Results were consistent for unadjusted odds ratios and for adjusted and unadjusted relative risks/hazard ratios. Overall study quality was moderate to high (Newcastle-Ottawa Scale score, 6.3). Although significant publication bias was found, adjusting for this did not change the magnitude of the associations.<br><br>Conclusions: Available evidence supports the notion that physical activity can confer protection against the emergence of depression regardless of age and geographical region.</td></tr>
<tr><td>Timeframe: From inception through Oct. 18, 2017,</td></tr>
<tr><td>Total # studies included: 49</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc):<br>Prospective design with at least 1 year of follow-up; physical activity was measured with a self-report questionnaire, such as the International Physical Activity Questionnaire (IPAQ) or objective physical activity measures (e.g., accelerometers). Physical activity was defined as any bodily movement produced by skeletal muscles and requiring energy expenditure</td></tr>
<tr><td>Outcomes addressed: Depression measured with standardised instruments or through diagnostic interview or physician diagnosis</td></tr>
<tr><td>Population analysed: Adults any age who were free of depression or depressive symptoms at baseline</td><td>Author-Stated Funding Source: None reported.</td></tr>
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<table>
<tr><td colspan="2">Meta-analysis<br>Citation: Schuch F.B., Stubbs B., Meyer J., Heissel A., Zech P., Vancampfort D., Rosenbaum S., Deenik J., Firth J., Ward P.B., Carvalho A.F., Hiles S.A., Physical activity protects from incident anxiety: A meta-analysis of prospective cohort studies. Depress Anxiety. 2019;1-13.</td></tr>
<tr><td>Purpose: To examine the prospective relationship between PA and incident anxiety and explore potential moderators.</td><td rowspan="5">Abstract:<br><br>Background: Prospective cohorts have suggested that physical activity (PA) can decrease the risk of incident anxiety. However, no meta-analysis has been conducted. AIMS: To examine the prospective relationship between PA and incident anxiety and explore potential moderators.<br><br>Methods: Searches were conducted on major databases from inception to October 10, 2018 for prospective studies (at least 1 year of follow-up) that calculated the odds ratio (OR) of incident anxiety in people with high PA against people with low PA. Methodological quality was assessed using the Newcastle-Ottawa Scale (NOS). A random-effects meta-analysis was conducted and heterogeneity was explored using subgroup and meta-regression analysis.<br><br>Results: Across 14 cohorts of 13 unique prospective studies (N = 75,831, median males = 50.1%) followed for 357,424 person-years, people with high self-reported PA (versus low PA) were at reduced odds of developing anxiety (adjusted odds ratio [AOR] = 0.74; 95% confidence level [95% CI] = 0.62, 0.88; crude OR = 0.80; 95% CI = 0.69, 0.92). High self-reported PA was protective against the emergence of agoraphobia (AOR = 0.42; 95% CI = 0.18, 0.98) and posttraumatic stress disorder (AOR = 0.57; 95% CI = 0.39, 0.85). The protective effects for anxiety were evident in Asia (AOR = 0.31; 95% CI = 0.10, 0.96) and Europe (AOR = 0.82; 95% CI = 0.69, 0.97); for children/adolescents (AOR = 0.52; 95% CI = 0.29, 0.90) and adults (AOR = 0.81; 95% CI = 0.69, 0.95). Results remained robust when adjusting for confounding factors. Overall study quality was moderate to high (mean NOS = 6.7 out of 9).<br><br>Conclusion: Evidence supports the notion that self-reported PA can confer protection against the emergence of anxiety regardless of demographic factors. In particular, higher PA levels protects from agoraphobia and posttraumatic disorder.</td></tr>
<tr><td>Timeframe: From inception to October 10, 2018</td></tr>
<tr><td>Total # studies included: 13</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc):<br>Measured PA with a self-report questionnaire such as the IPAQ or any objective PA measures (e.g., pedometers and accelerometers). Only evaluations of high versus low PA, using any criterion, were eligible; used a prospective cohort study design with a follow-up period of 1 year or longer.</td></tr>
<tr><td>Outcomes addressed: Incident (new cases from baseline to follow-up) anxiety as the outcome, namely increased anxiety symptoms identified via established anxiety screening instruments (e.g., Hospital Anxiety and Depression Scale and Beck Anxiety Scale; Beck, Ward or anxiety disorders, diagnosed using structured or semi-structured diagnostic interviews (e.g. instruments using Diagnostic and Statistical Manual (DSM) for Mental Disorders or International Classification of Disease criteria, including PTSD).</td></tr>
<tr><td>Population analysed: Participants of any age, free from anxiety at baseline</td><td>Author-Stated Funding Source: Health Education England and the National Institute for Health Research HEE NIHR ICA Program Clinical Lectureship, Grant/Award Number: ICA-CL-2017-03-001; Maudsley Charity; the National Institute for Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care South London at King's College Hospital NHS Foundation Trust; AstraZeneca grant; Blackmores Institute Fellowship</td></tr>
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<tr><td colspan="2">SR/MA<br>Citation: Siahpush, M., Levan, T. D., Nguyen, M. N., Grimm, B. L., Ramos, A. K., Michaud, T. L., & Johansson, P. L. (2019). The Association of Physical Activity and Mortality Risk Reduction Among Smokers: Results From 1998–2009 National Health Interview Surveys–National Death Index Linkage. Journal of Physical Activity and Health, 16(10), 865-871.</td></tr>
<tr><td>Purpose: to investigate this association in relation to all-cause, cardiovascular disease, cancer, and respiratory disease mortality in the United States using data from the 1998–2009 National Health Interview Survey (NHIS), which have been linked to the National Death Index (NDI).</td><td rowspan="5">Abstract:<br>Background: The mortality benefits of meeting the US federal guidelines for physical activity, which includes recommendations for both aerobic and muscle-strengthening activities, have never been examined among smokers. Our aim was to investigate the association between reporting to meet the guidelines and all-cause, cancer, cardiovascular disease, and respiratory disease mortality among smokers. Methods: We pooled data from the 1998–2009 National Health Interview Survey, which were linked to records in the National Death Index (n = 68,706). Hazard ratios (HR) were computed to estimate the effect of meeting the physical activity guidelines on mortality. Results: Smokers who reported meeting the guidelines for physical activity had 29% lower risk of all-cause mortality (HR: 0.71; 95% confidence interval [CI], 0.62–0.81), 46% lower risk of mortality from cardiovascular disease (HR: 0.54; 95% CI, 0.39–0.76), and 26% lower risk of mortality from cancer (HR: 0.74; 95% CI, 0.59–0.93), compared with those who reported meeting neither the aerobic nor the muscle-strengthening recommendations of the guidelines. Meeting the aerobic recommendation of the guidelines was associated with a 42% decline in that risk (HR: 0.58; 95% CI, 0.44–0.77). Conclusion: Smokers who adhere to physical activity guidelines show a significant reduction in mortality</td></tr>
<tr><td>Timeframe: 1998–2009</td></tr>
<tr><td>Total # studies included: 12</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) the length of time of moderate or vigorous aerobic physical activity in minutes per week</td></tr>
<tr><td>Outcomes addressed: ACM, CVD mortality, ca mortality, respiratory diseases mortality</td></tr>
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<tr><td colspan="2">SR/MA<br>Citation: Stamatakis, E., Lee, I. M., Bennie, J., Freeston, J., Hamer, M., O'Donovan, G., ... & Mavros, Y. (2017). Does strength-promoting exercise confer unique health benefits? A pooled analysis of data on 11 population cohorts with all-cause, cancer, and cardiovascular mortality endpoints. American journal of epidemiology, 187(5), 1102-1112.</td></tr>
<tr><td>Purpose: to examine the associations between SPE and all-cause, CVD, and cancer mortality and to compare the SPE and aerobic activity guidelines in terms of their associations with mortality outcomes.</td><td rowspan="5">Abstract:<br>Public health guidance includes recommendations to engage in strength-promoting exercise (SPE), but there is little evidence on its links with mortality. Using data from the Health Survey for England and the Scottish Health Survey from 1994–2008, we examined the associations between SPE (gym-based and own-body-weight strength activities) and all-cause, cancer, and cardiovascular disease mortality. Multivariable-adjusted Cox regression was used to examine the associations between SPE (any, low-/high-volume, and adherence to the SPE guideline (≥2 sessions/ week)) and mortality. The core sample comprised 80,306 adults aged ≥30 years, corresponding to 5,763 any-cause deaths (736,463 person-years). Following exclusions for prevalent disease/events occurring in the first 24 months, participation in any SPE was favorably associated with all-cause (hazard ratio (HR) = 0.77, 95% confidence interval (CI): 0.69, 0.87) and cancer (HR = 0.69, 95% CI: 0.56, 0.86) mortality. Adhering only to the SPE guideline was associated with all-cause (HR = 0.79, 95% CI: 0.66, 0.94) and cancer (HR = 0.66, 95% CI: 0.48, 0.92) mortality; adhering only to the aerobic activity guideline (equivalent to 150 minutes/week of moderate-intensity activity) was associated with all-cause (HR = 0.84, 95% CI: 0.78, 0.90) and cardiovascular disease (HR = 0.78, 95% CI: 0.68, 0.90) mortality. Adherence to both guidelines was associated with all-cause (HR = 0.71, 95% CI: 0.57, 0.87) and cancer (HR = 0.70, 95% CI: 0.50, 0.98) mortality. Our results support promoting adherence to the strength exercise guidelines over and above the generic physical activity targets.</td></tr>
<tr><td>Timeframe: -</td></tr>
<tr><td>Total # studies included: The Health Survey for England and the Scottish Health Survey</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc) Physical activity was assessed using a questionnaire that inquired about participation in sports and exercises during the 4 weeks prior to the interview. Participants were shown a card (see the Web with 10 exercise groupings, including working out at a gym/weight training/exercise biking, which we labeled "gym-based" SPE, and exercises such as press-ups and sit-ups, which we labeled "own-body-weight" SPE.</td></tr>
<tr><td>Outcomes addressed: all-cause mortality, cardiovascular disease mortality, and cancer mortality</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Stanmore E, Stubbs B, Vancampfort D, de Bruin ED, Firth J. The effect of active video games on cognitive functioning in clinical and non-clinical populations: A meta-analysis of randomized controlled trials. Neurosci Biobehav Rev [Internet]. 2017;78(March):34–43.</td></tr>
<tr><td>Purpose: to establish effects of exergames on overall cognition and specific cognitive domains in clinical and non-clinical populations.</td><td rowspan="5">Abstract:<br>Physically-active video games ('exergames') have recently gained popularity for leisure and entertainment purposes. Using exergames to combine physical activity and cognitively-demanding tasks may offer a novel strategy to improve cognitive functioning. Therefore, this systematic review and meta-analysis was performed to establish effects of exergames on overall cognition and specific cognitive domains in clinical and non-clinical populations. We identified 17 eligible RCTs with cognitive outcome data for 926 participants. Random-effects meta-analyses found exergames significantly improved global cognition (g=0.436, 95% CI=0.18-0.69, p=0.001). Significant effects still existed when excluding waitlist-only controlled studies, and when comparing to physical activity interventions. Furthermore, benefits of exergames where observed for both healthy older adults and clinical populations with conditions associated with neurocognitive impairments (all p<0.05). Domain-specific analyses found exergames improved executive functions, attentional processing and visuospatial skills. The findings present the first meta-analytic evidence for effects of exergames on cognition. Future research must establish which patient/treatment factors influence efficacy of exergames, and explore neurobiological mechanisms of action.</td></tr>
<tr><td>Timeframe: Inception – January 2017</td></tr>
<tr><td>Total # studies included: 17</td></tr>
<tr><td>Author-stated inclusion criteria:<br>Only English-language research articles published in peer-reviewed<br>journals were included. No restrictions were placed on populations studied or sample type. Eligible studies were randomized controlled trials (RCTs) which compared the effects of exergame interventions to non-exergame control conditions on performance in untrained cognitive tasks (i.e. performance in cognitive tasks which varied from those directly practiced within the exergame itself). This includes clinically-validated measures of global cognition, or specific tests of individual domains of cognitive functioning. Studies which combined exergaming with other therapeutic aspects were also eligible for inclusion, provided that (a) the exergame was identified as a primary component of a multi-modal intervention, and (b) the intervention dedicated as much/more time to the exergame component as any other aspect of the intervention. Single-session studies which examined acute effects of exergames on cognitive functioning were excluded from this review.<br>Author-stated exergame definition:<br>exergames were defined as any video game for which required upper- or lower-body physical activity for user interaction.</td></tr>
<tr><td>Outcomes addressed:<br>Cognitive functioning</td></tr>
<tr><td>Populations analysed: No criteria on populations (clinical and non-clinical).</td><td>Author-stated funding source: No funding source stated.</td></tr>
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<table>
<tr><td colspan="2">SR/MA<br>Citation: Stutz J, Eiholzer R, Spengler CM. Effects of evening exercise on sleep in healthy participants: A systematic review and meta-analysis. Sports Medicine. 2019 Feb 14;49(2):269-87. https://doi-org.ezproxy1.library.usyd.edu.au/10.1007/s40279-018-1015-0</td></tr>
<tr><td>Purpose: to investigate the extent to which evening exercise affects sleep and whether variables such as exercise intensity or duration modify the response.<br><br>Timeframe: inception to 8 Aug 2018<br><br>Total # studies included: 23<br><br>Other details (e.g. definitions used, exclusions etc) any language, healthy adult, any study with non-exercise control group.<br><br>Outcomes addressed: sleep onset latency, rem latency, total sleep time, sleep efficiency, time awake after sleep onset, awakenings, stage 1–4 sleep, slow-wave sleep, rem sleep, fragmentation index, subjective score of sleep quality</td><td>Abstract:<br>Background<br>Current recommendations advise against exercising in the evening because of potential adverse effects on sleep.<br>Objectives<br>The aim of this systematic review was to investigate the extent to which evening exercise affects sleep and whether variables such as exercise intensity or duration modify the response.<br>Methods<br>A systematic search was performed in PubMed, Cochrane, EMBASE, PsycINFO, and CINAHL databases. Studies evaluating sleep after a single session of evening physical exercise compared to a no-exercise control in healthy adults were included. All analyses are based on random effect models.<br>Results<br>The search yielded 11,717 references, of which 23 were included. Compared to control, evening exercise significantly increased rapid eye movement latency (+ 7.7 min; p = 0.032) and slow-wave sleep (+ 1.3 percentage points [pp]; p = 0.041), while it decreased stage 1 sleep (− 0.9 pp; p = 0.001). Moderator analyses revealed that a higher temperature at bedtime was associated with lower sleep efficiency (SE) (b = − 11.6 pp; p = 0.020) and more wake after sleep onset (WASO; b = + 37.6 min; p = 0.0495). A higher level of physical stress (exercise intensity relative to baseline physical activity) was associated with lower SE (− 3.2 pp; p = 0.036) and more WASO (+ 21.9 min; p = 0.044). Compared to cycling, running was associated with less WASO (− 12.7 min; p = 0.037). All significant moderating effects disappeared after removal of one study.<br>Conclusion<br>Overall, the studies reviewed here do not support the hypothesis that evening exercise negatively affects sleep, in fact rather the opposite. However, sleep-onset latency, total sleep time, and SE might be impaired after vigorous exercise ending ≤ 1 h before bedtime.</td></tr>
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<tr><td colspan="2">Meta-analysis<br>Citation: Sultana RN, Sabag A, Keating SE, Johnson NA. The Effect of Low-Volume High-Intensity Interval Training (HIIT) on Body Composition and Cardiorespiratory Fitness: A Systematic Review and Meta-Analysis. Sports Med. 2019 Nov;49(11):1687-1721.</td></tr>
<tr><td>Purpose: to examine the effect of low-volume HIIT versus a non-exercising control & mod intensity continuous training (MICT) on body composition and cardio-respiratory fitness in normal weight, overweight and obese adults</td><td rowspan="4">Abstract:<br><br>Background: Evidence for the efficacy of low-volume high-intensity interval training (HIIT) for the modulation of body composition is unclear. Objectives: We examined the effect of low-volume HIIT versus a non-exercising control and moderate-intensity continuous training (MICT) on body composition and cardiorespiratory fitness in normal weight, overweight and obese adults. We evaluated the impact of low-volume HIIT (HIIT interventions where the total amount of exercise performed during training was ≤ 500 metabolic equivalent minutes per week [MET-min/week]) compared to a non-exercising control and MICT. Methods: A database search was conducted in PubMed (MEDLINE), EMBASE, CINAHL, Web of Science, SPORTDiscus and Scopus from the earliest record to June 2019 for studies (randomised controlled trials and non-randomised controlled trials) with exercise training interventions with a minimum 4-week duration. Meta-analyses were conducted for between-group (low-volume HIIT vs. non-exercising control and low-volume HIIT vs. MICT) comparisons for change in total body fat mass (kg),body fat percentage (%), lean body mass (kg) and cardiorespiratory fitness. Results: From 11,485 relevant records, 47 studies were included. No difference was found between low-volume HIIT and a non-exercising control on total body fat mass (kg) (effect size [ES]: - 0.129, 95% confidence interval [CI] - 0.468 to 0.210; p = 0.455), body fat (%) (ES: - 0.063, 95% CI - 0.383 to 0.257; p = 0.700) and lean body mass (kg) (ES: 0.050, 95% CI - 0.250 to 0.351; p = 0.744), or between low-volume HIIT and MICT on total body fat mass (kg) (ES: - 0.021, 95% CI- 0.272 to 0.231; p = 0.872), body fat (%) (ES: 0.005, 95% CI - 0.294 to 0.304;p = 0.974) and lean body mass (kg) (ES: 0.030, 95% CI - 0.167 to 0.266;p = 0.768). However, low-volume HIIT significantly improved cardiorespiratory fitness compared with a non-exercising control (p < 0.001) and MICT (p = 0.017). Conclusion: These data suggest that low-volume HIIT is inefficient for the modulation of total body fat mass or total body fat percentage in comparison with a non-exercise control and MICT. A novel finding of our meta-analysis was that there appears to be no significant effect of low-volume HIIT on lean body mass when compared with a non-exercising control, and while most studies tended to favour improvement in lean body mass with low-volume HIIT versus MICT, this was not significant. However, despite its lower training volume, low-volume HIIT induces greater improvements in cardiorespiratory fitness than a non-exercising control and MICT in normal weight, overweight and obese adults. Low-volume HIIT, therefore, appears to be a time-efficient treatment for increasing fitness, but not for the improvement of body composition.</td></tr>
<tr><td>Timeframe: from inception to June 2019</td></tr>
<tr><td>Total # studies included: 47</td></tr>
<tr><td>Other details (e.g. definitions used, exclusions etc): Regular exercise training intervention (≥ 4 weeks), a minimum of 2 days/week. Training needed to involve a low-volume HIIT or SIT protocol and a non-exercising control, or MICT intervention<br>Outcomes addressed: change in adiposity as fat mass (kg) or body fat (%), change in lean body mass (kg) or cardiorespiratory fitness measured as maximal or peak oxygen uptake (L/min or mL/kg/min). Only studies that used DXA, BIA or ADP to measure compositon were included.</td></tr>
<tr><td>Population analysed: Normal-weight, overweight and/or obese adult participants (18 years or older), who were physically active and inactive, and of any health status</td><td>Author-Stated Funding Source: No funding source</td></tr>
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| **Meta-analysis**<br>**Citation:** Wang Y., Shan W., Li Q., Yang N., Shan W. Tai Chi Exercise for the Quality of Life in a Perimenopausal Women Organization: A Systematic Review. *Worldviews on Evidence-Based Nursing*, 2017; 14:4, 294–305. |

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| **Purpose: T**his systematic review and meta-analysis aimed to summarize and analyze the effectiveness of NW interventions on the physical fitness, the body composition, and the quality of life in the elderly population. | **Abstract:**<br><br>**Background:** Improvement of the quality of life in perimenopausal women has recently become an important global health issue. Extensive research reports provide evidence of Tai Chi for the quality of life, but no systematic review has individually investigated Tai Chi as a main intervention on the quality of life in perimenopausal women.<br><br>**Objective:** To assess clinical evidence of Tai Chi for the quality of life in perimenopausal women.<br><br>**Methods:** Studies related to the effect of Tai Chi on the quality of life in perimenopausal women in the databases of China and abroad were searched. RevMan version 5.2 software was used, and the Medical Outcomes Study 36-item short form health survey (SF-36) and bone mineral density (BMD) were selected as evaluation indices.<br><br>**Results:** Five trials were included. The results of this study showed that Tai Chi **had a significant effect on bodily pain, general health, vitality, mental health of SF-36,** and the spine dimension of BMD, as supported by the following data: bodily pain (Standard Mean Difference [SMD] =–3.63; 95% confidence interval [CI] [–6.62, –0.64]; p = .02); general health (SMD=−5.08; 95% CI [−7.60, –2.56]; p < .0001); vitality (SMD=−5.67; 95% CI [–8.54, –2.81], p = .0001); **mental health (SMD = −2.51; 95% CI [–4.82, –0.20], p = .03)**; and spine dimension of BMD (SMD = −0.06; 95% CI [–0.10, –0.01]; p = .01). However, Tai Chi had no effect on physical function, emotional health, social function, role–physical of SF-36, and the hip dimension of BMD, as supported by the following data: physical function (SMD = –1.79; 95% CI [–5.15, 1.57]; p = .30); emotional health (SMD=−2.90; 95% CI [–7.23, 1.43], p = .19]; social function (SMD=−2.23, 95% CI [–5.08, 0.61], p = 0.12; role–physical (SMD = − 1.18; 95% CI [–4.84, 2.47], p = .53; and hip dimension of BMD (SMD = −0.01; 95% CI [–0.03, 0.01]; p = .31).<br><br>**Linking Evidence to Action:** This systematic review found significant evidence for Tai Chi improving bodily pain, general health, vitality, **mental health of SF–36**, and the spine dimension of BMD in patients with perimenopausal syndrome. Findings suggest that Tai Chi might be recommended as effective and safe adjuvant treatment for patients with perimenopausal syndrome. More high-quality randomized controlled trials are urgently needed to confirm these results. |
| **Timeframe:** from inception to before January 4, 2015 | |
| **Total # studies included:** 5 | |
| **Other details (e.g. definitions used, exclusions etc)**<br>RCTs in English or Chinese comparing Tai Chi with controls were included, whether they entailed allocation concealment or blinding or not. | |
| **Outcomes addressed:** Medical Outcomes Study 36-item short form health survey (SF-36) was used to assess overall health-related quality of life. It consists of eight dimensions of health: physical function, bodily pain, general health, vitality, mental health, social function, role-physical, and emotional health | |
| **Population analysed:** Women meeting diagnostic criteria of perimenopausal syndrome who (a) did not have any uncontrolled medical conditions or physical conditions that would preclude them from participating in an exercise program and (b) had not received HRT in the previous 3 months. | **Author-Stated Funding Source:** None stated. |

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