SUPPLEMENTAL DIGITAL CONTENT

**SDC 1 (Figure).** MEDLINE search strategy

**SDC 2 (Table).** Quality assessment of studies included in the meta-analysis

**SDC 3 (Table).** Subgroup analyses of the SMD in FMD between young athletes (< 40 years) and control subjects in studies included in the meta-analysis

**SDC 4 (Table).** Subgroup analyses of the SMD in FMD between master athletes (> 50 years) and control subjects in studies included in the meta-analysis

**Figure SDC 1.** MEDLINE search strategy (*Filters activated: “Humans”)*

|  |
| --- |
| “athletes” [All Fields] OR “highly trained” [All fields] |
|  |
| AND |
|  |
| “endothelial function” [All Fields] OR (“flow mediated ” [All Fields] AND “dilation” [All Fields] OR “dilatation” [All Fields] OR “vasodilation” [All Fields]) OR “vasoreactivity” [All Fields] |
|  |

**Table SDC 2.** Quality assessment of studies included in the meta-analysis \*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study, year of publication | Athlete group  (0 to 4) | Control group  (0 to 4) | Quality of FMD measurement  (0 to 3) | Confounding variables  (0 to 3) | Data  (0 to 2) | Total quality  score |
| Agrotou et al ([1](#_ENREF_1)), 2013 | 1 | 4 | 1 | 2 | 2 | 10 |
| Welsch et al ([22](#_ENREF_22)), 2013 | 2 | 3 | 3 | 0 | 2 | 10 |
| Green et al ([6](#_ENREF_6)), 2013 | 3 | 3 | 3 | 3 | 2 | 14 |
| Rowley et al ([18](#_ENREF_18)), 2012 | 2 | 3 | 3 | 0 | 2 | 10 |
| Phillips et al ([13](#_ENREF_13)), 2011 | 3 | 4 | 3 | 3 | 2 | 15 |
| Nualnim et al ([12](#_ENREF_12)), 2011 | 2 | 4 | 2 | 3 | 2 | 13 |
| Florescu et al ([3](#_ENREF_3)), 2010 | 1 | 4 | 2 | 3 | 2 | 12 |
| Ballard et al ([2](#_ENREF_2)), 2008 | 2 | 3 | 2 | 3 | 2 | 12 |
| Walther et al ([21](#_ENREF_21)), 2008 | 3 | 4 | 3 | 3 | 2 | 15 |
| Rognmo et al ([16](#_ENREF_16)), 2008 | 3 | 4 | 2 | 2 | 2 | 13 |
| Galetta et al ([5](#_ENREF_5)), 2006 | 2 | 4 | 3 | 1 | 2 | 12 |
| Hagmar et al ([7](#_ENREF_7)), 2006 | 2 | 3 | 2 | 3 | 2 | 12 |
| Naylor et al ([11](#_ENREF_11)), 2006 | 2 | 3 | 3 | 3 | 2 | 13 |
| Tanriverdi et al ([20](#_ENREF_20)), 2005 | 3 | 4 | 1 | 3 | 2 | 13 |
| Moe et al ([10](#_ENREF_10)), 2005 | 3 | 4 | 2 | 3 | 2 | 14 |
| Franzoni et al ([4](#_ENREF_4)), 2005 | 3 | 4 | 3 | 3 | 2 | 15 |
| Rickenlund et al ([14](#_ENREF_14)), 2005 | 3 | 3 | 2 | 3 | 2 | 13 |
| Kasikcioglu et al ([9](#_ENREF_9)), 2005 | 1 | 3 | 2 | 3 | 2 | 11 |
| Rinder et al ([15](#_ENREF_15)), 2000 | 2 | 2 | 2 | 3 | 2 | 11 |
| Rywik et al ([19](#_ENREF_19)), 1999 | 2 | 4 | 1 | 2 | 2 | 11 |
| Jensen-Urstad et al ([8](#_ENREF_8)), 1999 | 1 | 3 | 2 | 3 | 2 | 11 |

\* Adapted from to the Systematic Appraisal of Quality for Observational Research (SAQOR)([17](#_ENREF_17))

**Table SDC 3.** Subgroup analyses of the SMD in FMD between young athletes (< 40 years) and control subjects in studies included in the meta-analysis

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Studies** |  | **FMD** | | | | |
| **Group** | **Number \*** |  | **SMD (95% CI)** | | ***I*2** | ***P*** | ***PDifference*** |
| *Clinical characteristics* |  |  |  | |  |  |  |
| *n* |  |  |  | |  |  |  |
| ≥ 19 | 11 |  | 0.50 (-0.03, 1.03) | | 85 | 0.07 | 0.43 |
| < 19 | 10 |  | 0.10 (-0.71, 0.92) | | 80 | 0.80 |  |
| Mean age |  |  |  | |  |  |  |
| ≥ 23.24 years | 11 |  | -0.16 (-0.55, 0.23) | | 51 | .41 | 0.01 |
| < 23.24 years | 10 |  | 0.88 (0.17, 1.58) | | 87 | 0.02 |  |
| Gender |  |  |  | |  |  |  |
| females | 2 |  | 0.24 (-0.83, 1.32) | | 69 | 0.66 | 0.96 |
| males | 17 |  | 0.21 (-0.34, 0.76) | | 84 | 0.45 |  |
| Difference in height |  |  |  | |  |  |  |
| ≥ 0.95 cm | 7 |  | 0.57 (-0.72, 1.85) | | 92 | 0.39 | 0.94 |
| < 0.95 cm | 7 |  | 0.62 (0.23, 1.01) | | 28 | 0.002 |  |
| Difference in weight |  |  |  | |  |  |  |
| ≥ -0.90 kg | 7 |  | 1.03 (-0.24, 2.30) | | 91 | 0.11 | 0.24 |
| < -0.90 kg | 7 |  | 0.23 (-0.20, 0.66) | | 46 | 0.30 |  |
| Difference in BMI |  |  |  | |  |  |  |
| ≥ -0.2 kg/m2 | 11 |  | 0.43 (-0.45, 1.32) | | 89 | 0.34 | 0.73 |
| < -0.2 kg/m2 | 10 |  | 0.26 (-0.16, 0.68) | | 67 | 0.22 |  |
| Difference in SBP |  |  |  | |  |  |  |
| ≥ -1 mmHg | 10 |  | -0.09 (-0.57, 0.39) | | 75 | 0.72 | 0.26 |
| < -1 mmHg | 9 |  | 0.46 (-0.38, 1.30) | | 88 | 0.28 |  |
| Difference in DBP |  |  |  | |  |  |  |
| ≥ -0.7 mmHg | 9 |  | -0.03 (-0.52, 0.45) | | 75 | 0.89 | 0.55 |
| < -0.7 mmHg | 9 |  | 0.28 (-0.61, 1.16) | | 88 | 0.54 |  |
| *Training characteristics* |  |  |  | |  |  |  |
| Type |  |  |  | |  |  |  |
| endurance | 16 |  | 0.44 (-0.09, 0.97) | | 85 | 0.10 | 0.63 |
| strength | 3 |  | 0.11 (-1.12, 1.34) | | 80 | 0.86 |  |
| Main trained limb |  |  |  | |  |  |  |
| upper | 3 |  | 0.99 (-1.15, 3.14) | | 89 | 0.36 | 0.59 |
| lower | 13 |  | 0.39 (-0.16, 0.95) | | 85 | 0.17 |  |
| Sport |  |  |  | |  |  |  |
| racket | 2 |  | -0.25 (-1.43, 0.92) | | 71 | 0.67 | 0.33 |
| other | 19 |  | 0.38 (-0.11, 0.87) | | 84 | 0.13 |  |
| Volume |  |  |  | |  |  |  |
| ≥ 12 hours/week | 6 |  | 0.01 (-0.66, 0.68) | | 68 | 0.98 | 0.14 |
| < 12 hours/week | 5 |  | 0.98 (-0.13, 2.09) | | 85 | 0.08 |  |
| *Vascular assessment* |  |  |  | |  |  |  |
| Cuff placement |  |  |  | |  |  |  |
| upper-arm | 3 |  | 0.08 (-0.41, 0.58) | | 4 | 0.74 | 0.47 |
| forearm | 18 |  | 0.35 (-0.17, 0.87) | | 85 | 0.19 |  |
| Occlusion time |  |  |  | |  |  |  |
| 5 min | 17 |  | 0.30 (-0.26, 0.87) | | 85 | 0.29 | 0.85 |
| < 5 min | 4 |  | 0.39(-0.37, 1.16) | | 81 | 0.31 |  |
| Difference in baseline brachial diameter | | | |
| ≥ 0.405 mm | 9 |  | 0.43 (-0.38, 1.25) | | 87 | 0.30 | 0.80 |
| < 0.405 mm | 9 |  | 0.29 (-0.50, 1.07) | | 84 | 0.47 |  |
| Assessment of peak brachial diameter | | | |
| ≥ continuous scan | 16 |  | 0.08 (-0.36, 0.52) | | 73 | 0.72 | 0.13 |
| < single point scan | 5 |  | 0.93 (-0.08, 1.94) | | 90 | 0.07 |  |
| Difference in hyperemic shear rate | | | |
| ≥ -0.21 SMD | 6 |  | -0.47 (-1.07, 0.13) | | 59 | 0.12 | 0.95 |
| < -0.21 SMD | 5 |  | -0.45 (-0.92, 0.02) | | 0 | 0.06 |  |
| Difference in NMD |  |  |  | |  |  |  |
| ≥ -0.21 SMD | 7 |  | 0.52 (-0.32, 1.37) | | 87 | 0.23 | 0.08 |
| < -0.21 SMD | 7 |  | -0.34 (-0.77, 0.09) | | 26 | 0.12 |  |
| *Methodological quality* |  |  |  | |  |  |  |
| ≥ 14 points | 11 |  | 0.00 (-0.64, 0.65) | | 76 | 0.99 | 0.18 |
| < 14 points | 10 |  | 0.61 (0.02, 1.20) | | 86 | 0.04 |  |
| *Year of publication* |  |  |  | |  |  |  |
| ≥ 2010 | 11 |  | -0.25 (-0.71, 0.21) | | 66 | 0.29 | 0.003 |
| < 2010 | 10 |  | 0.98 (0.30, 1.66) | | 85 | 0.005 |  |

Median values of continuous variables were used as cut-off values for grouping studies. Difference of each potential moderating factor was calculated as athlete group value minus control group value

\* Certain enrolled studies were not included because the value used for subgroup analysis was not reported

BMI, body mass index; DBP, diastolic blood pressure; FMD, flow-mediated dilation; NMD, nitrate-mediated dilation; SBP, systolic blood pressure; SMD, standardized mean difference

**Table SDC 4.** Subgroup analyses of the SMD in FMD between master athletes (> 50 years) and control subjects in studies included in the meta-analysis

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Studies** |  | **FMD** | | | | | |
| **Group** | **Number \*** |  | **SMD (95% CI)** | | | ***I*2** | ***P*** | ***PDifference*** |
| *Clinical characteristics* |  |  |  | | |  |  |  |
| *n* |  |  |  | | |  |  |  |
| ≥ 33.5 | 4 |  | 0.87 (-0.06, 1.80) | | | 86 | 0.07 | 0.63 |
| < 33.5 | 4 |  | 1.14 (0.54, 1.74) | | | 41 | 0.0002 |  |
| Mean age |  |  |  | | |  |  |  |
| ≥ 64.34 years | 4 |  | 1.21 (0.52, 1.91) | | | 67 | .0007 | 0.44 |
| < 64.34 years | 4 |  | 0.78 (-0.06, 1.62) | | | 78 | 0.07 |  |
| Gender |  |  |  | | |  |  |  |
| females | 1 |  | 0.73 (-0.23, 1.70) | | | N/A | 0.14 | N/A |
| males | 5 |  | 1.37 (0.76, 1.97) | | | 64 | <0.00001 |  |
| Difference in height |  |  |  | | |  |  |  |
| ≥ 3 cm | 4 |  | 0.53 (0.08, 0.99) | | | 33 | 0.02 | N/A |
| < 3 cm | 1 |  | 0.73 (-0.23, 1.70) | | | N/A | 0.14 |  |
| Difference in weight |  |  |  | | |  |  |  |
| ≥ -7 kg | 3 |  | 0.44 (-0.14, 1.02) | | | 43 | 0.14 | 0.39 |
| < -7 kg | 2 |  | 0.80 (0.22, 1.38) | | | 0 | 0.007 |  |
| Difference in BMI |  |  |  | | |  |  |  |
| ≥ -2.3 kg/m2 | 4 |  | 1.19 (0.07, 2.31) | | | 88 | 0.04 | 0.48 |
| < -2.3 kg/m2 | 3 |  | 0.76 (0.32, 1.20) | | | 0 | 0.0007 |  |
| Difference in SBP |  |  |  | | |  |  |  |
| ≥ 0 mmHg | 4 |  | 0.80 (0.02, 1.59) | | | 78 | <0.05 | 0.38 |
| < 0 mmHg | 3 |  | 1.34 (0.45, 2.23) | | | 71 | 0.003 |  |
| Difference in DBP |  |  |  | | |  |  |  |
| ≥ 1.25 mmHg | 3 |  | 0.95 (-0.43, 2.33) | | | 90 | 0.18 | 0.85 |
| < 1.25 mmHg | 3 |  | 1.10 (0.31, 1.89) | | | 70 | 0.007 |  |
| *Training characteristics* |  |  |  | | |  |  |  |
| Type |  |  |  | | |  |  |  |
| endurance | 8 |  | 0.99 (0.44, 1.55) | | | 75 | 0.0005 | N/A |
| strength | 0 |  | N/A | | | N/A | N/A |  |
| Main trained limb |  |  |  | | |  |  |  |
| upper | 1 |  | -0.08 (-0.76, 0.61) | | | N/A | 0.83 | N/A |
| lower | 7 |  | 1.16 (0.65, 1.67) | | | 64 | <0.00001 |  |
| *Vascular assessment* |  |  |  | | |  |  |  |
| Cuff placement |  |  |  | | |  |  |  |
| upper-arm | 2 |  | 0.82 (0.25, 1.39) | | | 0 | 0.005 | 0.63 |
| forearm | 6 |  | 1.05 (0.31, 1.79) | | | 82 | 0.006 |  |
| Occlusion time |  |  |  | | |  |  |  |
| 5 min | 5 |  | 1.08 (0.20, 1.95) | | | 85 | 0.02 | 0.65 |
| < 5 min | 3 |  | 0.84 (0.35, 1.34) | | | 0 | 0.0008 |  |
| Difference in baseline brachial diameter | | | |  |
| ≥ 0.09 mm | 4 |  | 0.88 (-0.03, 1.79) | | | 78 | 0.06 | 0.72 |
| < 0.09 mm | 4 |  | 1.10 (0.35, 1.84) | | | 76 | 0.004 |  |
| Assessment of peak brachial diameter | | | |  |
| ≥ continuous scan | 4 |  | 1.49 (0.81, 2.18) | | | 67 | <0.0001 | 0.13 |
| < single point scan | 2 |  | 0.76 (0.10, 1.43) | | | 0 | 0.02 |  |
| Difference in NMD |  |  |  | | |  |  |  |
| ≥ 0.33 SMD | 3 |  | 1.33 (0.47, 2.20) | | | 74 | 0.003 | 0.95 |
| < 0.33 SMD | 2 |  | 1.38 (0.15, 2.61) | | | 72 | 0.03 |  |
| *Methodological quality* |  |  |  | | |  |  |  |
| ≥ 12 points | 5 |  | 1.07 (0.19, 1.95) | | | 85 | 0.02 | 0.68 |
| < 12 points | 3 |  | 0.86 (0.37, 1.34) | | | 0 | 0.0006 |  |
| *Year of publication* |  |  |  | | |  |  |  |
| ≥ 2006 | 4 |  | 0.85 (-0.14, 1.84) | | | 86 | 0.09 | 0.61 |
| < 2006 | 4 |  | 1.14 (0.58, 1.70) | | | 41 | <0.0001 |  |

Median values of continuous variables were used as cut-off values for grouping studies. Difference of each potential moderating factor was calculated as athlete group value minus control group value

\* Certain enrolled studies were not included because the value used for subgroup analysis was not reported

BMI, body mass index; DBP, diastolic blood pressure; FMD, flow-mediated dilation; NMD, nitrate-mediated dilation; SBP, systolic blood pressure; SMD, standardized mean difference

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