

Online resource 3 Key characteristics of studies examining the association between muscular fitness and cognition and academic outcomes

Author (year) Country	Study design	Sample size	Age (mean)	Measure of MF	Test of MF	Measure of cognition	Test of cognition	Adjusted for CRF
Aberg (2009) Sweden	Cross-sectional	N = 1221727 (m)	18 years	Combined	Isometric elbow flexion, knee extension, HG strength test	Cognition Fluid intelligence	Four cognitive tests: Performance on all 4 tests were combined to obtain a global intelligence score	NO
Adelantado-Renau (2018) Spain	Cross-sectional	n = 138 (m) n = 125 (f) N = 263 (m/f)	13.9 years	Upper body Lower body	HG strength test SLJ test	Cognition Fluid intelligence Academic achievement Combined	Questionnaire GPA	NO
Aguilar (2015) Chile	Cross-sectional	n = 196 (m) n = 196 (f) N = 395 (m/f)	12.1 years	Lower body	SLJ test	Academic achievement Combined Maths Languages	GPA School grades for mathematics and language	NO
Amenya (2021) Ghana	Cross-sectional	n = 266 (m) n = 325 (f) N = 591 (m/f)	8 to 13 years	Upper body Lower body Core	HG strength test SLJ test SU test	Cognition Fluid intelligence	Raven Coloured Progressive Matrices	NO
Bass (2013) USA	Cross-sectional	n = 395 (m) n = 443 (f) N = 838 (m/f)	13.1 years	Upper body Core	Push Up test, SU test	Academic achievement Combined Maths Languages	Illinois Standardized Achievement Test (ISAT) Maths and reading separated	NO
Cadenas-Sanchez (2017) Europe	Cross-sectional	n = 211 (m) n = 233 (f) N = 444 (m/f)	14.5 years	Upper body Lower body	HG strength test SLJ test	Cognition Attention	d2 test	YES
Cadenas-Sanchez (2020) Spain	Cross-sectional	n = 61 (m) n = 45 (f) N = 106 (m/f)	10 years	Upper body Lower body	HG strength test, SLJ test, 1 RM in lab	Cognition Fluid intelligence Academic achievement Combined	Woodcock-Muñoz test battery GPA	YES
Cancela (2019) Spain	Cross-sectional	n = 336 (m) n = 374 (f) N = 713 (m/f)	14.2 years	Lower body	SLJ test, 30 sec chair stand test	Cognition Inhibitory control Working memory Cognitive flexibility Academic achievement Combined	Stroop Visual Memory-Wechsler Memory Scale TMT School grades	NO
Chen (2013) Taiwan	Longitudinal	n = 352(m) n = 317 (f) N = 669 (m/f)	14.6 years	Core	SU test	Academic achievement Combined	School grades	NO

Coe (2013) USA	Cross-sectional	n = NA (m) n = NA (f) N = 1701 (m/f) Third Grade (N=291) Sixth Grade (N=706) Ninth Grade (N=704)	Not reported	Upper body Core	Push Up test SU test	Academic achievement Maths Languages	Standardized test scores	NO
Contreras- Osorio (2022) Chile	Cross-sectional	n = 46 (m) n = 44 (f) N = 90 (m/f)	11.45 years	Upper body Lower body	HG strength test, SLJ test	Cognition Cognitive flexibility Planning Inhibitory control	The ENFEN Battery Verbal fluency test, modified trail making test Modified Hanoi towers Modified Stroop	NO
De Castro (2016) Brazil	Cross-sectional	n = 183 (m) n = 143 (f) N = 326 (m/f)	17.1 years	Core	SU test	Academic achievement Combined	School grades	NO
de Greeff (2014) Netherlands	Cross-sectional	n = 286 (m) n = 258 (f) N = 544 (m/f)	8.0 years	Combined	SLJ test, SU test, HG strength test	Academic achievement Maths Languages	Standardized test scores	NO
Dubuc (2020) Canada	Longitudinal	n = 70 (m) n = 115 (f) N = 185 (m/f)	13.1 years	Upper body Core	Push Up test SU test	Cognition Inhibitory control Academic achievement Combined Maths Languages	Flanker School grades	NO
Esteban- Cornejo (2014) Spain	Cross-sectional	n = 1049 (m) n = 989 (f) N = 2038 (m/f)	10.2 years	Combined	SLJ test, HG strength test	Academic achievement Combined Maths Languages	School grades	YES
Eveland- Sayers (2009) USA	Cross-sectional	n = 61 (m) n = 73 (f) N = 134 (m/f)	9.7 years	Core	SU test	Academic achievement Maths Languages	Standardized test scores	NO
Fochesatto (2022) Brazil	Cross-sectional	n = 165 (m) n = 152 (f) N = 317 (m/f)	8 to 13 years	Upper body Lower body Core	SLJ test 2kg Med ball throw SU test	Cognition Fluid intelligence	Raven's coloured progressive matrix test	NO
García- Hermoso (2017) Chile	Cross-sectional	n = 19,827 (m) n = 17,043 (f) N = 36,870 (m/f)	13.8 years	Lower body	SLJ test	Academic achievement Maths Languages	Standardized test scores	YES

Garcia-Hermoso (2020) Chile	Cross-sectional	n = 69 (m) n = 132 (f) N = 201 (m/f)	12.1 years	Combined	SLJ test, HG strength test	Cognition Attention	d2 test	NO
Gil-Espinosa (2019) Spain	Longitudinal	n = 112 (m) n = 82 (f) N = 194 (m/f)	14.15 years	Lower body	SLJ test	Academic achievement Combined Maths Languages	School grades	NO
Gil-Espinosa (2020) Spain	Cross-sectional	n = 216 (m) n = 187 (f) N = 403 (m/f)	13.7 years	Lower body	SLJ test	Cognition Fluid intelligence Academic achievement Combined Maths Languages	D48 and Raven's Progressive Matrices. School grades	NO
Haapala (2015) Finland	Cross-sectional	n = 202 (m) n = 201 (f) N = 403 (m/f)	7.6 years	Upper body Core	HG strength test SU test	Cognition Fluid intelligence	Raven Coloured Progressive Matrices	NO
Hermassi (2021) Qatar	Cross-sectional	n = 36 (m) n = 0 (f) N = 36 (m/f)	9.0 years	Lower body Upper body Lower body	SLJ test Med ball throw Squat jump and counter-movement jumps	Academic achievement Maths	School grades	NO
Haverkamp (2021) Netherlands	Cross-sectional	n = 199 (m) n = 224 (f) N = 423 (m/f)	13.5 years	Combined	SLJ and SU test combined	Cognition Working memory Inhibition Attention Academic achievement Maths Languages	Grid test, Digit Span Task Modified Attention Network test Adapted standardized tests	NO
Hsieh (2018) Taiwan	Longitudinal	n = 198,774 (m) n = 183,485 (f) N = 382,259 (m/f)	Yr1 12.8 years Yr3 14.8 years	Core Lower body	SU test SLJ test	Academic achievement Combined	Standardized test scores	NO
Kalantari (2016) Japan	Cross-sectional	n = 580 (m) n = 0 (f) N = 580 (m/f)	15.7 years	Upper body	Push Up test and HG strength test	Academic achievement Combined	School grades	NO
Kao (2017) USA	Cross-sectional	n = 44 (m) n = 35(f) N = 79 (m/f)	10.1 years	Combined	Full body battery of assessments	Cognition Working memory Academic achievement Maths Languages	Serial n-back task Adapted standardized tests	YES
Mora-Gonzalez (2019a) Spain	Cross-sectional	n = 58 (m) n = 42 (f) N = 100 (m/f)	10.1 years	Combined	SLJ test, and HG strength test	Cognition Inhibitory control Planning Cognitive flexibility	Stroop test Zoo Map Test Design Fluency Test and Trail Making Test	NO

Mora-Gonzalez (2019b) Spain	Cross-sectional	n = 44 (m) n = 35 (f) N = 79 (m/f)	10.2 years	Upper body Lower body	HG strength test SLJ test	Cognition Working memory	Modified delayed non-matched-to-sample Task (DNMS)	NO
Mora-Gonzalez (2020) Spain	Cross-sectional	n = 47 (m) n = 37 (f) N = 84 (m/f)	10.1 years	Upper body Lower body	HG strength test SLJ test	Cognition Inhibitory control	Flanker task	NO
Moradi (2019) Iran	Cross-sectional	n = 206 (m) n = 0 (f) N = 206 (m/f)	11.0 years	Combined	SU test, and HG strength test	Cognition Inhibitory control Attention	Simon-task Simple and 4-choice reaction time	NO
Muntaner-Mas (2018) Spain	Cross-sectional	n = NA (m) n = NA (f) N = 234 (m/f)	10.98 years	Combined	SLJ test, and HG strength test	Academic achievement Combined Maths Languages	School grades	YES
Muntaner-Mas (2021) Spain	Longitudinal	n = 212 (m) n = 210 (f) N = 422 (m/f)	13.35 years	Combined	SLJ test, and HG strength test	Cognition Working memory Inhibition	Serial n-back task Go/ no-go task	NO
Padulo (2019) Italy	Cross-sectional	n = 34 (m) n = 46 (f) N = 80 (m/f)	11.0 years	Upper body Lower body	Med ball throw SLJ test	Academic achievement Maths Languages	School grades	NO
Ruiz (2010) Spain	Cross-sectional	n = 868 (m) n = 958 (f) N = 1820 (m/f)	13.0 to 18 years	Lower body	SLJ test	Academic achievement Maths	Standardized test	NO
Ruiz-Hermosa, (2020) Spain	Cross-sectional	n = 304 (m) n = 326 (f) N = 630 (m/f)	5.8 years	Lower body	SLJ test	Academic achievement Maths Languages Cognition Fluid intelligence	Battery of General and Differential Aptitudes (BADyG E1)	NO
Ryu (2021) South Korea	Cross-sectional	n = 60 (m) n = 50 (f) N = 110 (m/f)	9.0 years	Upper body Lower body Core	HG strength test SLJ test SU test	Academic achievement Maths Languages Combined	School grades	NO
Sember (2022) Slovenia	Longitudinal	n = 120 (m) n = 111 (f) N = 231(m/f)	Yr1, 11.3 years Yr3, 14.3 years	Upper body Lower body Core	HG strength test SLJ test SU test	Academic achievement Maths	School grades	
Shigeta (2021) Australia	Cross-sectional	n = 306 (m) n = 235 (f) N = 541 (m/f)	16.5 years	Combined	Push Up test, and SLJ test	Cognition Working memory Inhibitory control	Serial n-back task modified flanker task	YES

Solis-Urra (2021) Chile	Cross-sectional	n = 591 (m) n = 580 (f) N = 1171 (m/f)	12.23 years	Combined	SLJ test, and HG strength test	Cognition Cognitive flexibility Working memory Inhibitory control Fluid intelligence	Trail making tests Digit symbol coding Forward memory span Reverse memory span Go/ no-go task Balance scale Progressive matrices	NO
Syväoja (2019) Finland	Longitudinal	n = 458 (m) n = 496 (f) N = 954 (m/f)	12.5 years	Combined	Push Up test, and SU test	Academic achievement Combined	School grades	NO
Syväoja (2021) Finland	Cross-sectional	n = 127 (m) n = 184 (f) N = 311 (m/f)	14.0 years	Combined	Push Up test, and SU test	Cognition Inhibitory control Working memory Attention Academic achievement Maths	Flanker Spatial Working Memory test, Digit span Rapid Visual Information Processing Basic arithmetic test, School grades	NO
Torrijos- Nino, (2014) Spain	Cross-sectional	n = 183 (m) n = 215 (f) N = 398 (m/f)	9.49 years	Combined	SLJ test, and HG strength test	Academic achievement Combined	School grades	NO
Tsai (2016) Taiwan	Cross-sectional	n = NA (m) n = NA (f) N = 80 (m/f)	8-12 years	Core Lower body	SU test SLJ test	Cognition Inhibitory control	Flanker test	NO
Van Dunsen (2011) USA	Cross-sectional	n = 130684 (m) n = 124059 (f) N = 254743 (m/f)	Grades 3- 11	Upper body Core	Push Up test SU test	Academic achievement Languages Maths	Standardized test	NO
Abbreviations: MF = Muscular fitness, CRF = Cardiovascular fitness, HG = Hand grip, SLJ = Standing long jump, SU = Sit up * = Not included in meta-analysis								