

Electronic supplementary material

Adherence to aerobic and muscle-strengthening activities guidelines: A systematic review and meta-analysis of 3.3 million participants across 32 countries

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Online supplemental eFigure 8. Doi plot for adolescents aged 12-17 years old.

Online supplemental emethod 1. Electronic search strategy.*PubMed*

#1 (((("aerobic"[All Fields] AND "aerobic"[All Fields]) OR OR "exercise"[MeSH Terms] OR "exercise"[All Fields] AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR ("physical"[All Fields] AND "activity"[All Fields]) OR "physical activity"[All Fields]) AND ("muscle-strengthening"[All Fields] AND ("activable"[All Fields] OR "activate"[All Fields] OR "activated"[All Fields] OR "activates"[All Fields] OR "activating"[All Fields] OR "activation"[All Fields] OR "activations"[All Fields] OR "activator"[All Fields] OR "activator s"[All Fields] OR "activators"[All Fields] OR "active"[All Fields] OR "activated"[All Fields] OR "actively"[All Fields] OR "actives"[All Fields] OR "activities"[All Fields] OR "activity s"[All Fields] OR "activitys"[All Fields] OR "motor activity"[MeSH Terms] OR ("motor"[All Fields] AND "activity"[All Fields]) OR "motor activity"[All Fields] OR "activity"[All Fields])) AND ("strengthen"[All Fields] OR "strengthened"[All Fields] OR "strengthening"[All Fields] OR "strengthens"[All Fields])) OR ("muscle-strengthening"[All Fields] AND ("exercise"[MeSH Terms] OR "exercise"[All Fields] OR "exercises"[All Fields] OR "exercise therapy"[MeSH Terms] OR ("exercise"[All Fields] AND "therapy"[All Fields]) OR "exercise therapy"[All Fields] OR "exercise s"[All Fields] OR "exercised"[All Fields] OR "exerciser"[All Fields] OR "exercisers"[All Fields] OR "exercising"[All Fields]))))

#2 ("adherence"[All Fields] OR "adhere"[All Fields] OR "adhered"[All Fields] OR "adherence"[All Fields] OR "adherences"[All Fields] OR "adherent"[All Fields] OR "adherents"[All Fields] OR "adherer"[All Fields] OR "adherers"[All Fields] OR "adheres"[All Fields] OR "adhering"[All Fields]) AND ("guideline"[Publication Type] OR "guidelines as topic"[MeSH Terms] OR "guidelines"[All Fields] OR "recommendation as topic"[MeSH Terms] OR "recommendation"[All Fields])

#3 #1 AND #2

Web of Science

#1 TOPIC: ("aerobic physical activity" OR "exercise")

#2 TOPIC: ("muscle-strengthening" OR “strengthening” OR “strengthen” OR “strengthened” OR “strengthens”)

#3 TOPIC: ("adherence" OR “adhering”)

#4 TOPIC: ("guideline" OR “guidelines” OR “recommendation”)

#5 #4 AND #3 AND #2 AND #1

SPORTDiscus

S1 (MH " aerobic physical activity") OR (MH "exercise")

S2 (MH " muscle-strengthening") OR 'strengthening' OR 'strengthen' OR 'strengthened' OR 'strengthens'

S3 ((MH "adherence") OR 'adhering')

S4 (MH "guideline") OR 'guideline' OR 'recommendation'

S5 S4 AND S3

EMBASE

((('adherence'/exp OR adherence OR adhering:ti,ab,kw) AND 'physical activity':ti,ab,kw OR exercise:ti,ab,kw) AND ('resistance training':ti,ab,kw OR 'strengthening exercise':ti,ab,kw) AND (guideline:ti,ab,kw OR recommendation:ti,ab,kw OR guidelines))

Scopus

((TITLE-ABS-KEY (adherence OR adhering) AND TITLE-ABS-KEY ("aerobic physical activity" OR exercise OR "physical activity") AND TITLE-ABS-KEY (strength OR strengthening OR muscle-strengthening OR strengthen OR strengthening) AND TITLE-ABS-KEY (guidelines OR guideline OR recommendations)))

Online supplemental emethod 2. Excluded studies and reasons for exclusion.

Ahn, H., Choi, H. Y., & Ki, M. (2010). The association between levels of physical activity and low handgrip strength: Korea National. *People*, 39(4), 412-23.

Reason for exclusion: Duplicated

Bennie, J. A., De Cocker, K., Teychenne, M. J., Brown, W. J., & Biddle, S. J. (2019). The epidemiology of aerobic physical activity and muscle-strengthening activity guideline adherence among 383,928 US adults. *International Journal of Behavioral Nutrition and Physical Activity*, 16(1), 1-11.

Reason for exclusion: Duplicated

Bennie, J. A., Teychenne, M. J., De Cocker, K., & Biddle, S. J. (2019). Associations between aerobic and muscle-strengthening exercise with depressive symptom severity among 17,839 US adults. *Preventive medicine*, 121, 121-127.

Reason for exclusion: Duplicated

Bennie, J. A., De Cocker, K., Biddle, S. J., & Teychenne, M. J. (2020). Joint and dose-dependent associations between aerobic and muscle-strengthening activity with depression: A cross-sectional study of 1.48 million adults between 2011 and 2017. *Depression and anxiety*, 37(2), 166-178.

Reason for exclusion: Duplicated

Bennie, J. A., De Cocker, K., & Duncan, M. J. (2021). Associations of muscle-strengthening and aerobic exercise with self-reported components of sleep health among a nationally representative sample of 47,564 US adults. *Sleep Health*, 7(2), 281-288.

Reason for exclusion: Duplicated

Bennie, J. A., Ding, D., & De Cocker, K. Dose-dependent associations of joint aerobic and muscle-strengthening exercise with obesity: A cross-sectional study of 280,605 adults. *Journal of sport and health science*, S2095-2546.

Reason for exclusion: Duplicated

Blackwell, D. L., & Clarke, T. C. (2016). Occupational Differences Among Employed Adults Who Met 2008 Federal Guidelines for Both Aerobic and Muscle-strengthening Activities: United States, 2008-2014. *National health statistics reports*, (94), 1-12.

Reason for exclusion: Duplicated

Blackwell, D. L., & Clarke, T. C. (2018). State variation in meeting the 2008 federal guidelines for both aerobic and muscle-strengthening activities through leisure-time physical activity among adults aged 18-64: United States, 2010-2015. *National health statistics reports*, (112), 1-22.

Reason for exclusion: Duplicated

Branscum, P., & Fairchild, G. (2019). Differences in determinants of aerobic and muscle strengthening physical activity among college students: a reasoned action approach. *Journal of Sports Sciences*, 37(1), 90-99.

Reason for exclusion: Non-representative sample

Buckner, S. L., Loenneke, J. P., & Loprinzi, P. D. (2017). Single and combined associations of accelerometer-assessed physical activity and muscle-strengthening activities on plasma homocysteine in a national sample. *Clinical physiology and functional imaging*, 37(6), 669-674.

Reason for exclusion: Duplicated

Carlson, S. A., Fulton, J. E., Schoenborn, C. A., & Loustalot, F. (2010). Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans. *American journal of preventive medicine*, 39(4), 305-313.

Reason for exclusion: Duplicated

Centers for Disease Control and Prevention (CDC. (2013). Suicide among adults aged 35-64 years--United States, 1999-2010. *MMWR. Morbidity and mortality weekly report*, 62(17), 321-325.

Reason for exclusion: Duplicated

Harris, C. D., Watson, K. B., Carlson, S. A., Fulton, J. E., Dorn, J. M., & Elam-Evans, L. (2013). Adult participation in aerobic and muscle-strengthening physical activities—United States, 2011. *Morbidity and Mortality Weekly Report*, 62(17), 326-330.

Reason for exclusion: Duplicated

Chen, S., Malete, L., & Ling, J. An examination of physical activity guidelines and health-related quality of life among US older adults. *Preventive medicine*, 156, 106986.

Reason for exclusion: Duplicated

Dankel, S. J., Loenneke, J. P., & Loprinzi, P. D. (2016). The individual, joint, and additive interaction associations of aerobic-based physical activity and muscle strengthening activities on metabolic syndrome. *International journal of behavioral medicine*, 23(6), 707-713.

Reason for exclusion: Duplicated

Desmond, R., Jackson, B. E., & Hunter, G. (2015). Utilization of 2013 BRFSS Physical Activity Data for State Cancer Control Plan Objectives: Alabama Data. *Southern Medical Journal*, 108(5), 290-297.

Reason for exclusion: Duplicated

Du, Y., Liu, B., Sun, Y., Snetselaar, L. G., Wallace, R. B., & Bao, W. (2019). Trends in adherence to the physical activity guidelines for Americans for aerobic activity and time spent on sedentary behavior among US adults, 2007 to 2016. *JAMA network open*, 2(7), e197597.

Reason for exclusion: Study design

Lange, C., & Manz, K. (2017). Health-enhancing physical activity during leisure time among adults in Germany. *Journal of Health Monitoring*, 2(2).

Reason for exclusion: Duplicated

Grøntved, A., Pan, A., Mekary, R. A., Stampfer, M., Willett, W. C., Manson, J. E., & Hu, F. B. (2014). Muscle-strengthening and conditioning activities and risk of type 2 diabetes: a prospective study in two cohorts of US women. *PLoS medicine*, 11(1), e1001587.

Reason for exclusion: Non-representative sample

Hyde, E. T., Whitfield, G. P., Omura, J. D., Fulton, J. E., & Carlson, S. A. (2021). Trends in meeting the Physical Activity Guidelines: muscle-strengthening alone and combined with aerobic activity, United States, 1998–2018. *Journal of Physical Activity and Health*, 18(S1), S37-S44.

Reason for exclusion: Duplicated

Hyde, E. T., Watson, K. B., Omura, J. D., Janz, K. F., Lee, S. M., Fulton, J. E., & Carlson, S. A. (2021). Surveillance of Meeting the Youth Physical Activity Guideline: Impact of Including Vigorous-Intensity and Bone-Strengthening Activities. *Research Quarterly for Exercise and Sport*, 1-6.

Reason for exclusion: Duplicated

Kim, J. (2017). Longitudinal trend of prevalence of meeting physical activity guidelines among Korean adults. *Exercise Medicine*, 1.

Reason for exclusion: Study design

Lim, J., Park, S., & Kim, J. S. (2021). Joint association of aerobic physical activity and muscle-strengthening activities with metabolic syndrome: the Korean National Health and Nutrition Examination Survey 2014-2015. *Epidemiology and health*, 43, e2021096.

Reason for exclusion: Duplicated

Mama, S. K., Bhuiyan, N., Foo, W., Segel, J. E., Bluethmann, S. M., Winkels, R. M., ... & Schmitz, K. H. (2020). Rural-urban differences in meeting physical activity recommendations and health status in cancer survivors in central Pennsylvania. *Supportive Care in Cancer*, 28(10), 5013-5022.

Reason for exclusion: Clinical population

Mekary, R. A., Grøntved, A., Despres, J. P., De Moura, L. P., Asgarzadeh, M., Willett, W. C., ... & Hu, F. B. (2015). Weight training, aerobic physical activities, and long-term waist circumference change in men. *Obesity*, 23(2), 461-467.

Reason for exclusion: Non-representative sample

Merlo, C. L., Jones, S. E., Michael, S. L., Chen, T. J., Sliwa, S. A., Lee, S. H., ... & Park, S. (2020). Dietary and Physical Activity Behaviors Among High School Students-Youth Risk Behavior Survey, United States, 2019. *MMWR supplements*, 69(1), 64-76.

Reason for exclusion: Duplicated

Mu, L., Cohen, A. J., & Mukamal, K. J. (2015). Prevalence and predictors of resistance and aerobic exercise among hypertensive adults in the United States. *Journal of human hypertension*, 29(6), 394-395.

Reason for exclusion: Duplicated

Murphy, L. B., Hootman, J. M., Boring, M. A., Carlson, S. A., Qin, J., Barbour, K. E., ... & Helmick, C. G. (2017). Leisure Time Physical Activity Among US Adults With Arthritis, 2008– 2015. *American Journal of Preventive Medicine*, 53(3), 345-354.

Reason for exclusion: Clinical population

Nie, J., Haberstroh, M., Acosta, T., Huang, W., Wang, Y., & Barengo, N. C. (2021). Independent and joint associations between leisure time physical activity and strength activities with mortality outcomes in older adults at least 65 years of age: a prospective cohort study. *The Journals of Gerontology: Series A*, 76(12), 2122-2131.

Reason for exclusion: Study design

Oftedal, S., Smith, J., Vandelanotte, C., Burton, N. W., & Duncan, M. J. (2019). Resistance training in addition to aerobic activity is associated with lower likelihood of depression and comorbid depression and anxiety symptoms: a cross sectional analysis of Australian women. *Preventive Medicine*, 126, 105773.

Reason for exclusion: Non-representative sample

Oftedal, S., Holliday, E. G., Reynolds, A. C., Bennie, J. A., Kline, C. E., & Duncan, M. J. (2022). Prevalence, Trends, and Correlates of Joint Patterns of Aerobic and Muscle-Strengthening Activity and Sleep Duration: A Pooled Analysis of 359,019 Adults in the National Health Interview Survey 2004–2018. *Journal of Physical Activity and Health*, 19(4), 246-255.

Reason for exclusion: Duplicated

Quinn, T. D., Wu, F., Mody, D., Bushover, B., Mendez, D. D., Schiff, M., & Fabio, A. (2019). Associations Between Neighborhood Social Cohesion and Physical Activity in the United States, National Health Interview Survey, 2017. *Preventing Chronic Disease*, 16, E163.

Reason for exclusion: Duplicated

Schoenborn, C. A., & Stommel, M. (2011). Adherence to the 2008 adult physical activity guidelines and mortality risk. *American journal of preventive medicine*, 40(5), 514-521.

Reason for exclusion: Duplicated

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.

Reason for exclusion: Duplicated

Song, M., Nam, S., Buss, J., & Lee, S. J. (2020). Assessing the prevalence of meeting physical activity recommendations among US healthcare workers: Data from the 2015 National Health Interview Survey. *Archives of Environmental & Occupational Health*, 75(7), 422-430.

Reason for exclusion: Duplicated

Strain, T., Fitzsimons, C., Kelly, P., & Mutrie, N. (2016). The forgotten guidelines: cross-sectional analysis of participation in muscle strengthening and balance & co-ordination activities by adults and older adults in Scotland. *BMC public health*, 16(1), 1-12.

Reason for exclusion: Study design

Sudeck, G., Geidl, W., Abu-Omar, K., Finger, J. D., Krauß, I., & Pfeifer, K. (2021). Do adults with non-communicable diseases meet the German physical activity recommendations?. *German Journal of Exercise and Sport Research*, 51(2), 183-193.

Reason for exclusion: Duplicated

Sung, J. H., Son, S. R., Baek, S. H., & Kim, B. J. (2021). Association of occupation with the daily physical activity and sedentary behaviour of middle-aged workers in Korea: a cross-sectional study based on data from the Korea National Health and Nutrition Examination Survey. *BMJ open*, 11(11), e055729.

Reason for exclusion: Study design

Tarasenko, Y., Chen, C., & Schoenberg, N. (2017). Self-reported physical activity levels of older cancer survivors: Results from the 2014 National Health Interview Survey. *Journal of the American Geriatrics Society*, 65(2), e39-e44.

Reason for exclusion: Duplicated

Tarasenko, Y. N., Linder, D. F., & Miller, E. A. (2018). Muscle-strengthening and aerobic activities and mortality among 3+ year cancer survivors in the US. *Cancer Causes & Control*, 29(4), 475-484.

Reason for exclusion: Duplicated

Tittlbach, S. A., Hoffmann, S. W., & Bennie, J. A. (2022). Association of meeting both muscle strengthening and aerobic exercise guidelines with prevalent overweight and obesity classes-results from a nationally representative sample of German adults. *European Journal of Sport Science*, 22(3), 436-446.

Reason for exclusion: Duplicated

Visaria, A., Nagaraj, B., Shah, M., Kethidi, N., Modak, A., Shahani, J., ... & Raghuvanshi, M. (2022). Low Amount and Intensity of Leisure-time Physical Activity in Asian Indian Adults. *American Journal of Health Promotion*, 36(3), 440-449.

Reason for exclusion: Duplicated

Walker, T. J., Tullar, J. M., Diamond, P. M., Kohl, H. W., & Amick, B. C. (2017). The relation of combined aerobic and muscle-strengthening physical activities with presenteeism. *Journal of Physical Activity and Health*, 14(11), 893-898.

Reason for exclusion: Non-representative sample

Watson, K. B., Whitfield, G., Chen, T. J., Hyde, E. T., & Omura, J. D. (2021). Trends in Aerobic and Muscle-Strengthening Physical Activity by Race/Ethnicity Across Income Levels Among US Adults, 1998–2018. *Journal of Physical Activity and Health*, 18(S1), S45-S52.

Reason for exclusion: Duplicated

Xin, F., Zhu, Z., Chen, S., Chen, H., Hu, X., Ma, X., ... & Tang, Y. (2022). Prevalence and correlates of meeting the muscle-strengthening exercise recommendations among Chinese children and adolescents: Results from 2019 Physical Activity and Fitness in China—The Youth Study. *Journal of Sport and Health Science*, 11(3), 358-366.

Reason for exclusion: Study design

Zhao, G., Li, C., Ford, E. S., Fulton, J. E., Carlson, S. A., Okoro, C. A., ... & Balluz, L. S. (2014). Leisure-time aerobic physical activity, muscle-strengthening activity and mortality risks among US adults: the NHANES linked mortality study. *British journal of sports medicine*, 48(3), 244-249.

Reason for exclusion: Duplicated

Online supplemental eTable 1. Characteristics of studies included in the meta-analysis.

Author, year	Country	Study design	Source of information	Study period	N (% females) / Age	Physical activity assessment and physical active definition	Overall prevalence
Bennie et al. 2016 [21]	Australia	Cross-sectional	National Nutrition and Physical Activity Survey (NNPAS)	2011-2012	9,284 (54.1) / 18-85 years	Active Australia Survey ≥150 MVPA min per week and ≥2 sessions per week of strength or toning activities	15%
Bennie et al. 2017 [22]	Finland	Cross-sectional	Regional Health and Well-being Study	2013-2014	69,032 (52.0) / ≥ 18 years	Self-reported Finnish recommendations: ≥150 moderate-intensity min per week or ≥75 vigorous-intensity min per week or an equivalent combination of both and reporting MVPA on ≥3 days per week and ≥2 times per week of MSA and/or balance training	10.8%
Bennie et al. 2020 A [23]	USA	Cross-sectional	US Behavioral Risk Factor Surveillance System (BRFSS) surveys	2011-2017	1,677,108 (51.6) / ≥ 18 years	Behavioural Risk Factor Surveillance System Meeting both 150 min per week of moderate-intensity aerobic physical activity, or 75 min per week of vigorous-intensity aerobic physical activity, or an equivalent combination of both and ≥ 2 sessions per week of MSA	20.2%

Bennie et al. 2020 B [24]	South Korea	Cross-sectional	Korea National Health and Nutritional Examination Survey (KNHANES)	2014-2015	9,120 (50.3) / 20-80 years	GPAQ Meeting both MVPA ≥ 150 minutes per week and muscle strengthening exercise ≥ 2 sessions per week	15.4%
Bennie et al. 2021 [25]	Germany	Cross-sectional	German Health Update survey	2014	24,016 (51.1) / ≥ 18 years	Interview Survey Physical Activity Questionnaire Meeting both MVPA ≥ 150 minutes per week and muscle strengthening exercise ≥ 2 sessions per week	22.6%
Bennie and Wiesner 2022 [26]	28 European countries	Cross-sectional	European Health Interview Survey	2013-2014	280,605 (52.1) / ≥ 18 years	European Health Interview Survey – Physical Activity Questionnaire (EHIS-PAQ) Aerobic physical activity ≥ 150 min/ per week and muscle strengthening exercise ≥ 2 sessions per week	15.0%
CDC 2011 [39]	USA	Cross-sectional	National Youth Physical Activity and Nutrition Study (NYPANS)	2010	9,701 (NR) / 14–18 years	NYPANS questions Aerobic physical activity and muscle-strengthening activity participation in ≥ 60 minutes of aerobic activity per day, 7 days per week and MSA on ≥ 3 days per week)	15.3%
Chen et al. 2021 [9]	USA	Cross-sectional	Youth Risk Behavior Survey (YRBS)	2011-2019	86,869 (49.3) / 14-18 years	YRBS questions Aerobic physical activity and muscle-strengthening activity	19.2%

						participation of ≥ 60 min of aerobic activity per day, 7 days per week and MSA on ≥ 3 days per week	
Churilla et al. 2022 [27]	USA	Cross-sectional	US Behavioral Risk Factor Surveillance System (BRFSS) surveys	2019	323,435 (49.6) / ≥ 18 years	Behavioural Risk Factor Surveillance System Aerobic physical activity ≥ 150 min per week and muscle strengthening exercise ≥ 2 sessions per week	23.5%
de Cocker et al. 2020 [28]	UK	Cross-sectional	Health Survey for England (HSE) study	2012-2016	14,050 (56.0%) / ≥ 16 years	Self-reported questionnaire ≥ 150 min of moderate activity or 75 min of vigorous activity per week or an equivalent combination of both; and undertaking MSA on at least two days per week	25.7%
Dankel et al. 2016 [29]	USA	Cross-sectional	National Health and Nutrition Examination Survey (NHANES)	2003-2006	4,587 (49.0) / ≥ 20 years	Accelerometry (ActiGraph 7164) and questionnaire Accelerometer-determined physical activity ≥ 150 min per week of MVPA and ≥ 8 days of MSA within the past 30 days	11.0%
Dorner et al. 2021 [30]	Austria	Cross-sectional	Austrian Health Interview Surveys	2014 and 2019	31,232 (51.2%) / ≥ 15 years	European Health Interview Survey – Physical Activity Questionnaire (EHIS-PAQ) Aerobic physical activity ≥ 150 min per week and muscle	23.8%

						strengthening exercise ≥ 2 sessions per week	
Duijvestijn et al. 2020 [31]	The Netherlands	Cross-sectional	Dutch Health Survey/Lifestyle Monitor by Statistics Netherlands	2018	226,083 (52.0%) / ≥ 12 years	<p>Short Questionnaire to Assess Health-enhancing physical activity (SQUASH)</p> <p>Adolescents: Aerobic physical activity and muscle-strengthening activity participation in ≥ 60 min of aerobic activity per day, 7 days per week and MSA on ≥ 3 days per week</p> <p>Adults: Aerobic physical activity ≥ 150 min per week and muscle strengthening exercise ≥ 2 sessions per week</p>	<p>33.9% (12-17 years old)</p> <p>43.5% (≥ 18 years old)</p>
Lackinger and Dorner, 2015 [32]	Austria	Cross-sectional	Austrian Health Interview Survey	2006-2007	467 (46.7%) / 20-29 years	<p>IPAQ</p> <p>Aerobic physical activity ≥ 150 min per week and muscle strengthening exercise ≥ 2 sessions per week</p>	39.4%
Lee et al. 2022 [33]	South Korea	Cross-sectional	National Health Insurance Service of South Korea	2018-2019	<p>Cohort A: 76,395 (51.2%) / ≥ 20 years</p> <p>Cohort B: 2,295 (53.5%) / ≥ 20 years</p>	<p>Self-reported questionnaire</p> <p>≥ 150 min of moderate activity or 75 min of vigorous activity per week or an equivalent combination of both; and undertaking MSA on at least two days per week</p>	<p>Cohort A: 14.5%</p> <p>Cohort B: 12.7%</p>
Sandercock et al. 2022 [34]	UK	Cross-sectional	Active Lives Survey	2015-2017	275,182 (48.9%) /	Active Lives dataset	26.5%

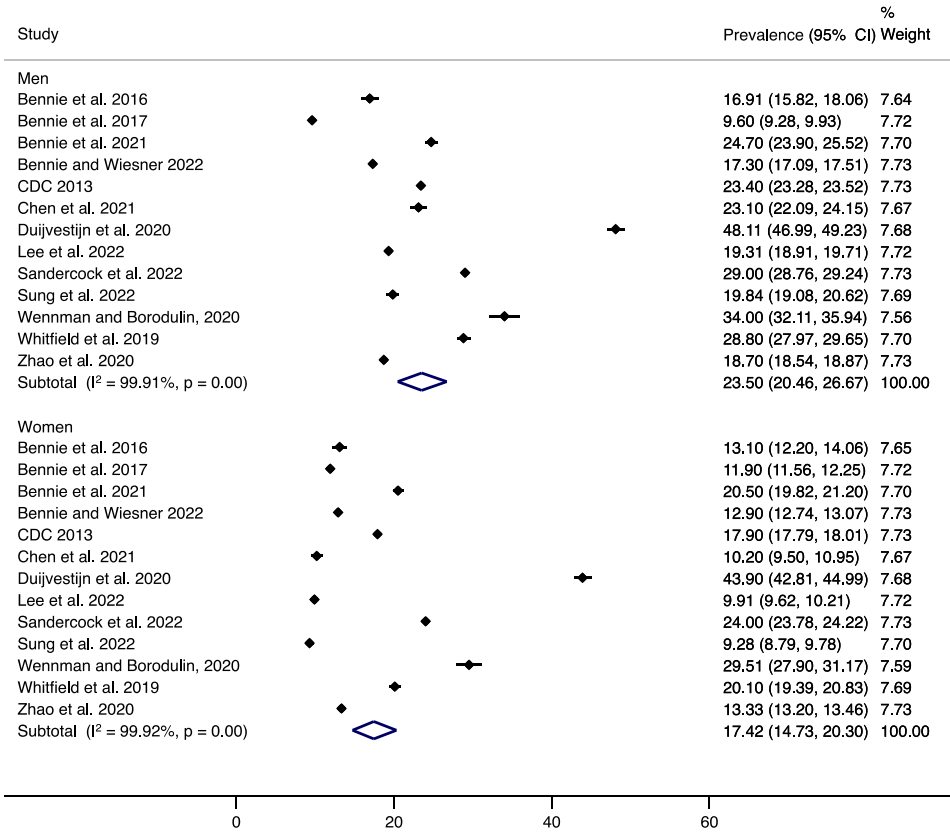
					18-95 years	150 min per week equivalent moderate physical activity including two sessions of strengthening activities	
Song et al. 2013 [35]	USA	Cross-sectional	National Health and Nutrition Examination Survey (NHANES)	1999-2006	6547 (48.9) / 12-17 years	Self-reported questionnaire Aerobic physical activity and MSA participation in ≥ 60 min of aerobic activity per day, 7 days per week and MSA on ≥ 3 days per week	16.3%
Sung et al. 2022 [36]	South Korea	Cross-sectional	Korea National Health and Nutritional Examination Survey (KNHANES)	2016-2019	23,505 (50.5) / ≥ 20 years	GPAQ Aerobic physical activity ≥ 150 min per week and muscle strengthening exercise ≥ 2 sessions per week	14.5%
Wennman and Borodulin, 2020 [37]	Finland	Cross-sectional	FinHealth 2017 Study	2017	5335 (56.0) / ≥ 18 years	FinHealth Health-Enhancing Physical Activity Questionnaire ≥ 150 min of moderate activity or 75 min of vigorous activity per week or an equivalent combination of both; and undertaking MSA on at least two days per week	34.2%
Whitfield et al. 2019 [38]	USA	Cross-sectional	National Health Interview Survey	2017	23,006 (51.8) / ≥ 18 years	Sample Adult Core questions 150–300 min of moderate-intensity, or 75–150 min of vigorous-intensity aerobic physical activity per week, or an equivalent combination of	24.3%

						moderate- and vigorous-intensity aerobic physical activity and MSA of at least moderate intensity that involve all major muscle groups on ≥ 2 days per week	
Zhao et al. 2020 [8]	USA	Prospective	National Health Interview Survey	1997-2014	479,856 (48.2) / ≥ 18 years	Sample Adult Core questions ≥ 150 min of moderate activity or 75 min of vigorous activity per week or an equivalent combination of both; and undertaking MSA on at least two days per week	15.9%
Abbreviations: GPAQ, Global Physical Activity Questionnaire; IPAQ, international physical activity questionnaire; MSA, Muscle-strengthening activities; MVPA, moderate-to-vigorous physical activity; NR, not reported.							

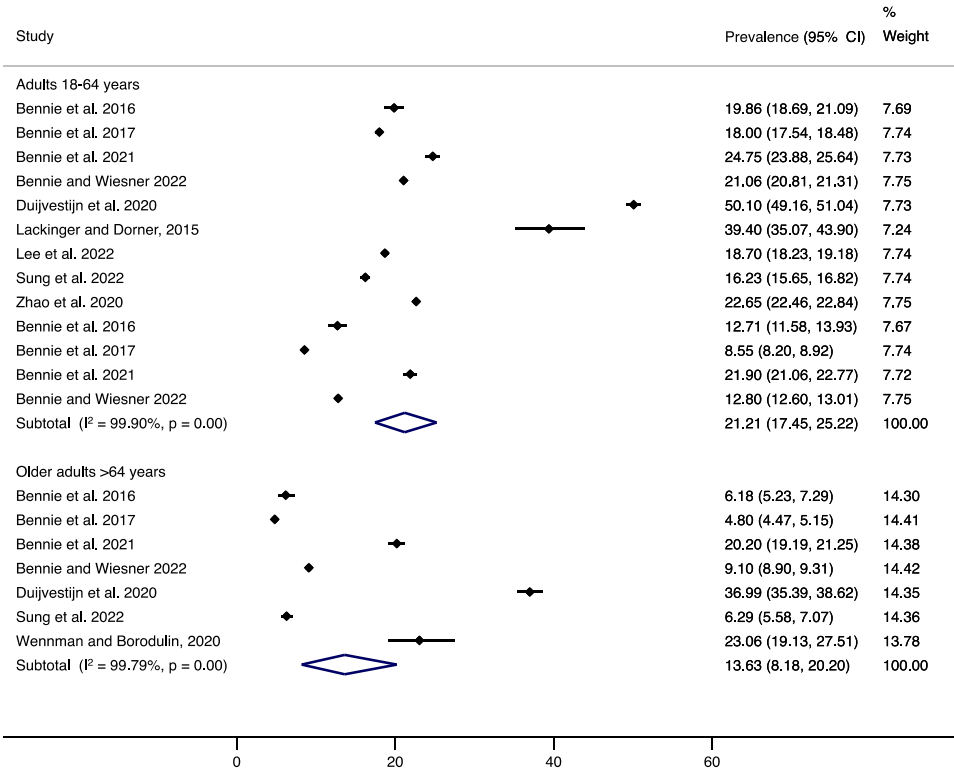
Online supplemental eTable 2. Results of the quality assessment checklist for prevalence studies.

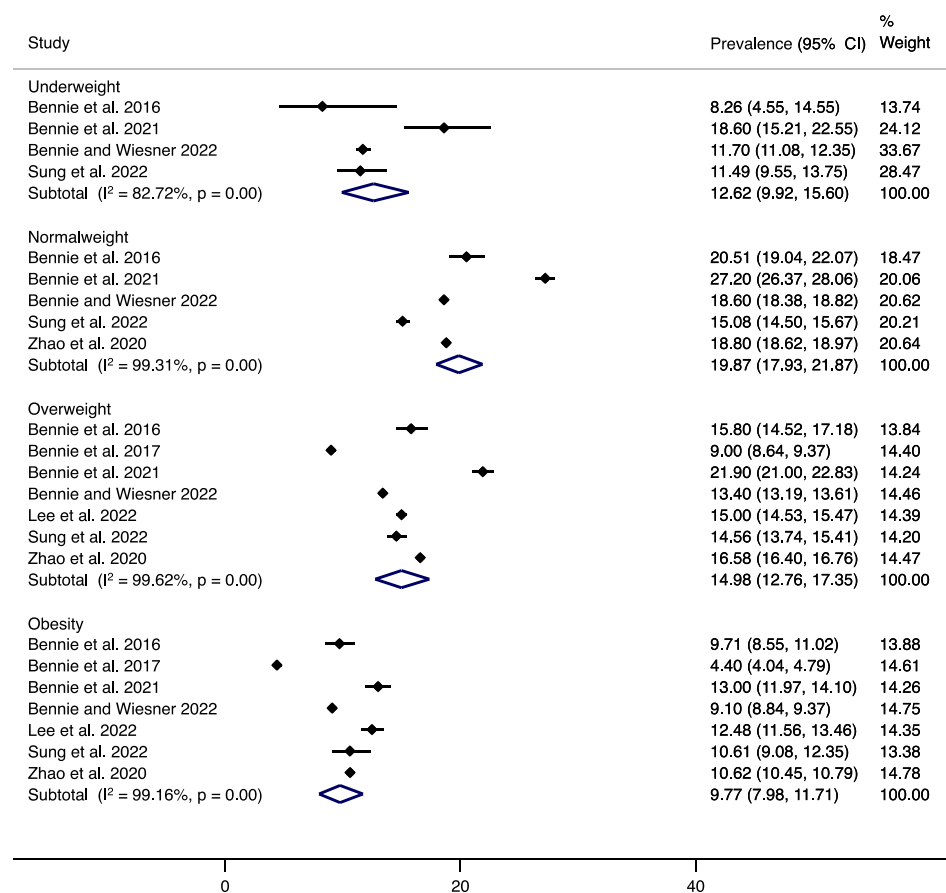
Study	1	2	3	4	5	6	7	8	9	Total score	Summary on the overall risk of study bias
Bennie et al. 2016	0	0	0	0	0	0	0	0	0	0	Low risk
Bennie et al. 2017	0	0	0	1	0	0	1	0	0	2	Low risk
Bennie et al. 2020 A	0	0	0	1	0	0	0	0	0	1	Low risk
Bennie et al. 2020 B	0	0	0	0	0	0	1	0	0	1	Low risk
Bennie et al. 2021	0	0	0	0	0	0	1	0	0	1	Low risk
Bennie & Wiesner 2022	0	0	0	0	0	0	1	0	0	1	Low risk
CDC 2011	0	0	0	0	0	0	1	0	0	1	Low risk
Chen et al. 2021	0	0	0	0	0	0	0	0	0	0	Low risk
Churilla et al. 2022	0	0	0	0	0	0	0	0	0	0	Low risk
De Cocker et al. 2020	0	0	0	1	0	0	1	0	0	2	Low risk
Dankel et al. 2016	0	0	0	0	0	0	0	0	0	0	Low risk
Dorner et al. 2021	0	0	0	0	0	0	1	0	0	1	Low risk
Duijvestijn et al. 2020	0	0	0	0	0	0	0	0	0	0	Low risk
Lackinger & Dorner, 2015	0	0	0	0	0	0	0	0	0	0	Low risk
Lee et al. 2022	0	0	0	1	0	0	0	0	0	0	Low risk
Sandercock et al. 2022	0	0	0	0	0	0	1	0	0	1	Low risk
Song et al. 2013	0	0	0	1	0	0	0	0	0	1	Low risk
Sung et al. 2022	0	0	0	0	0	0	0	0	0	0	Low risk
Wennman & Borodulin, 2020	0	0	0	0	0	0	1	0	0	1	Low risk
Whitfield et al. 2019	0	0	0	0	0	0	1	0	0	1	Low risk
Zhao et al. 2020	0	0	0	0	0	0	0	0	0	0	Low risk

Online supplemental eFigure 1. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by sex.

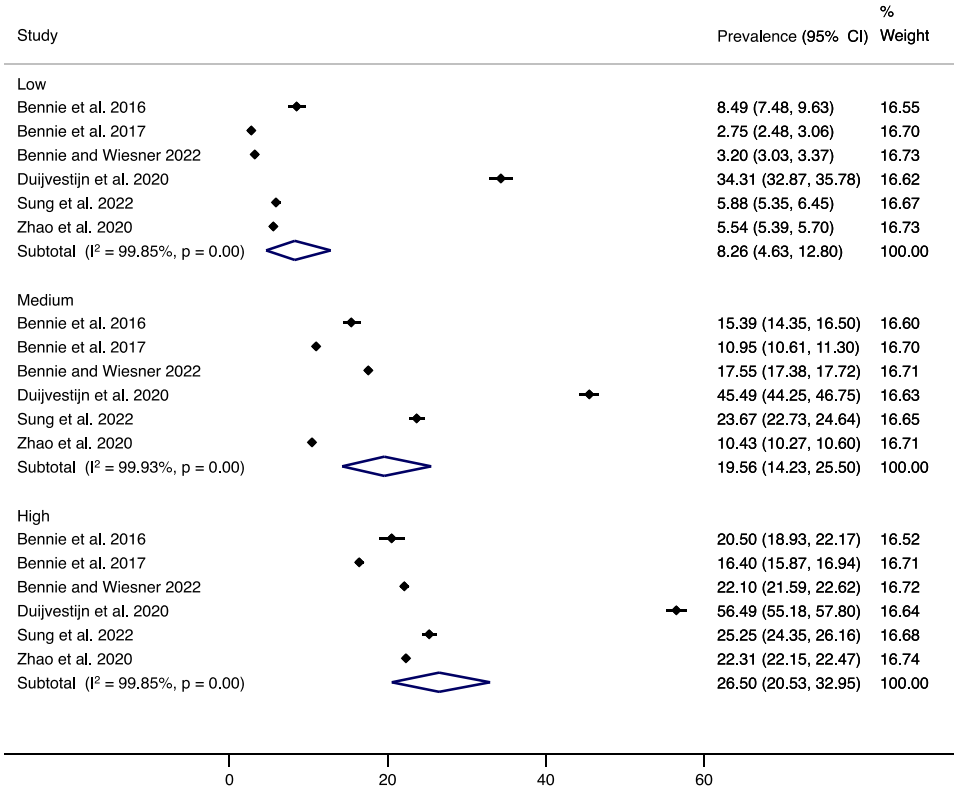


Online supplemental eFigure 2. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by age.

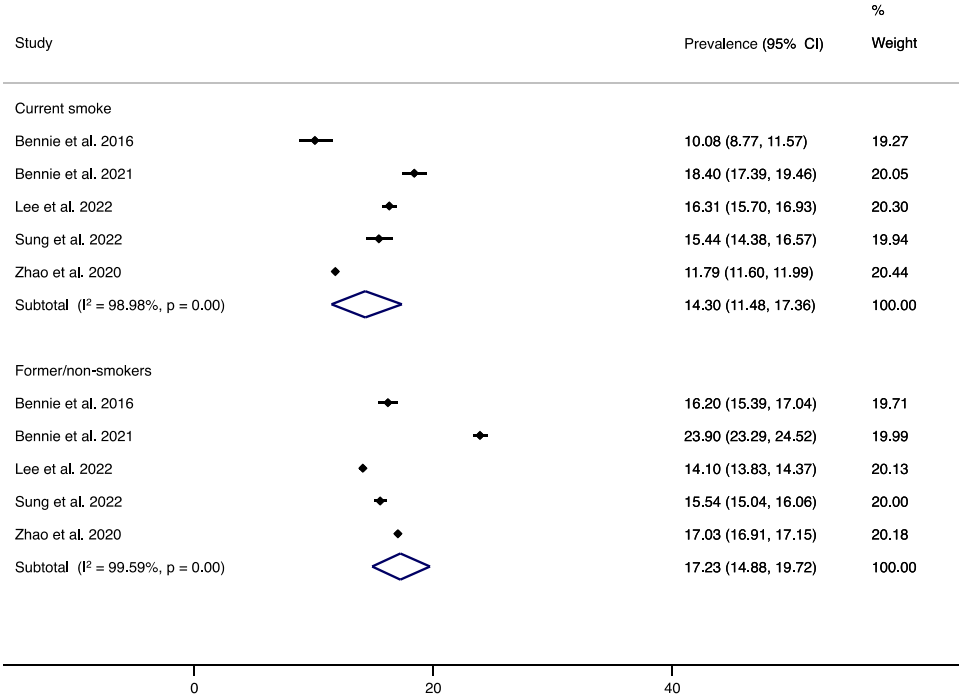


Online supplemental eFigure 3. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by weight status.

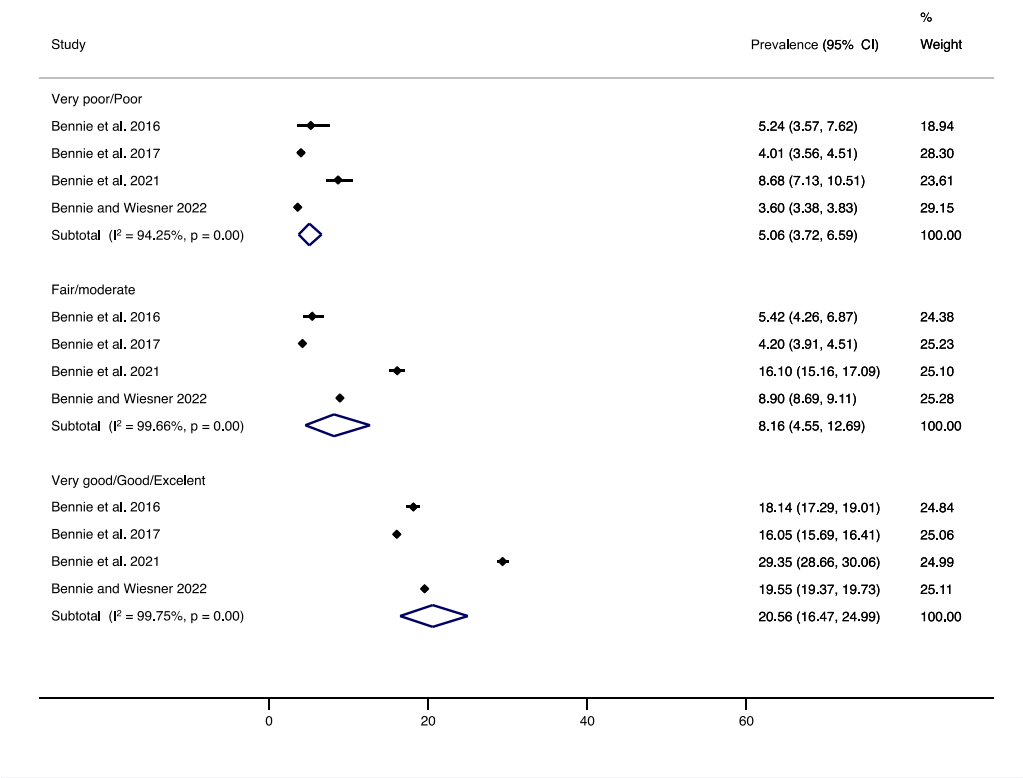
Online supplemental eFigure 4. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by education level.



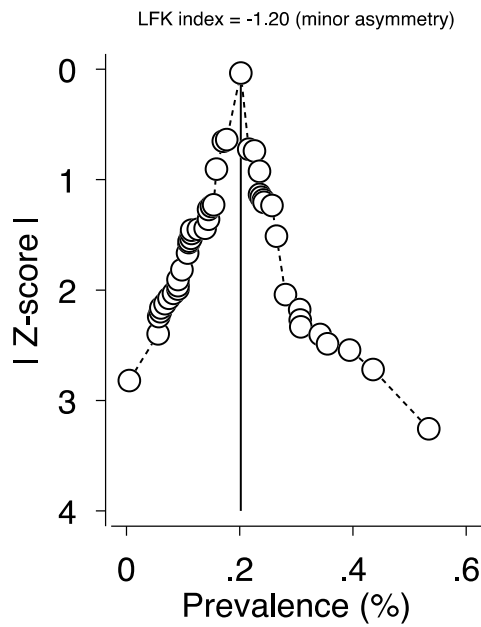
Online supplemental eFigure 5. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by smoking status.



Online supplemental eFigure 6. Forest plot of adherence to aerobic and muscle-strengthening activities guidelines by self-rated health status.



Online supplemental eFigure 7. Doi plot for adults ≥ 18 years old.



Online supplemental eFigure 8. Doi plot for adolescents aged 12-17 years old.

