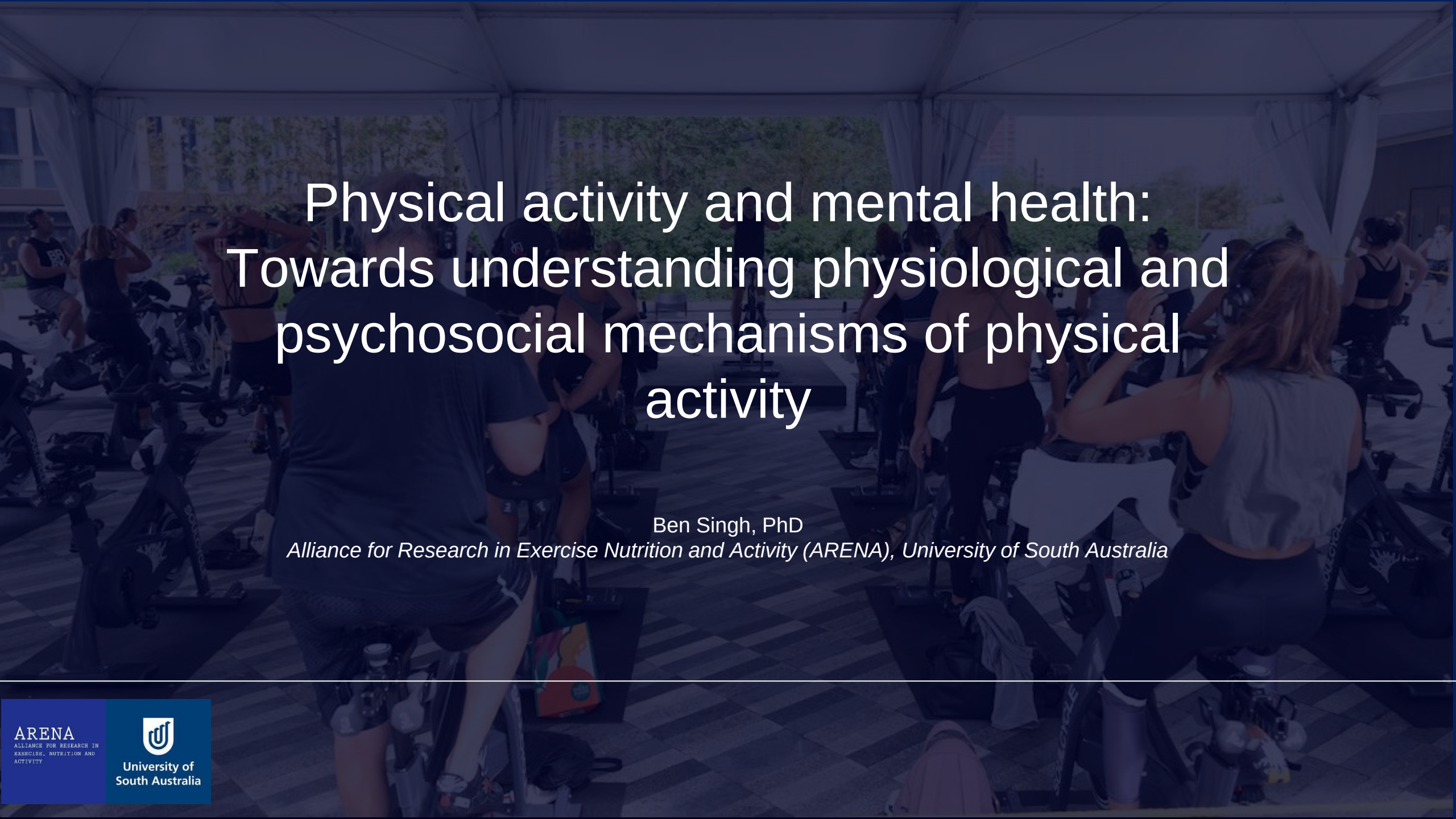
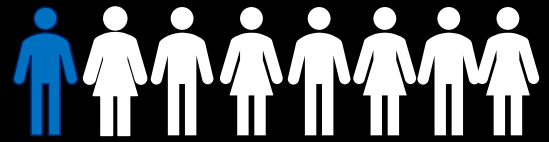


Physical activity and mental health: Towards understanding physiological and psychosocial mechanisms of physical activity

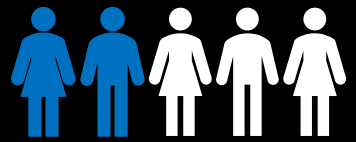
Ben Singh, PhD
Alliance for Research in Exercise Nutrition and Activity (ARENA), University of South Australia

ARENA
ALLIANCE FOR RESEARCH IN EXERCISE, NUTRITION AND ACTIVITY

University of South Australia



live with a mental disorder[1]



affected in their lifetime[1]

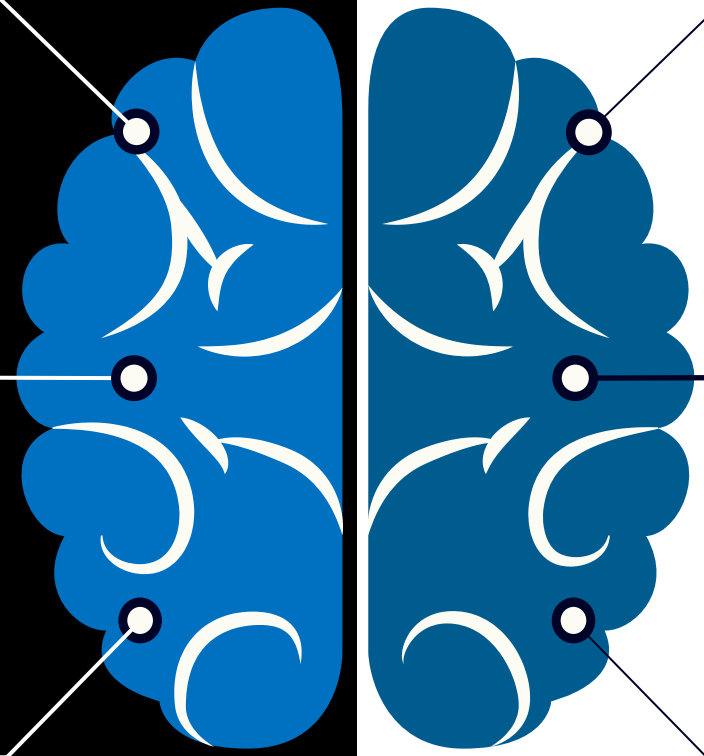
$2.5 trillion annual global cost → $6 trillion by 2030[2]

[1] WHO (2022). Mental disorders – key facts.
[2] Marquez et al. *Cerebrum*. 2016;10:16.

Low mood lasting weeks or months.

Loss of interest in daily activities.

Affects energy, sleep, and concentration.

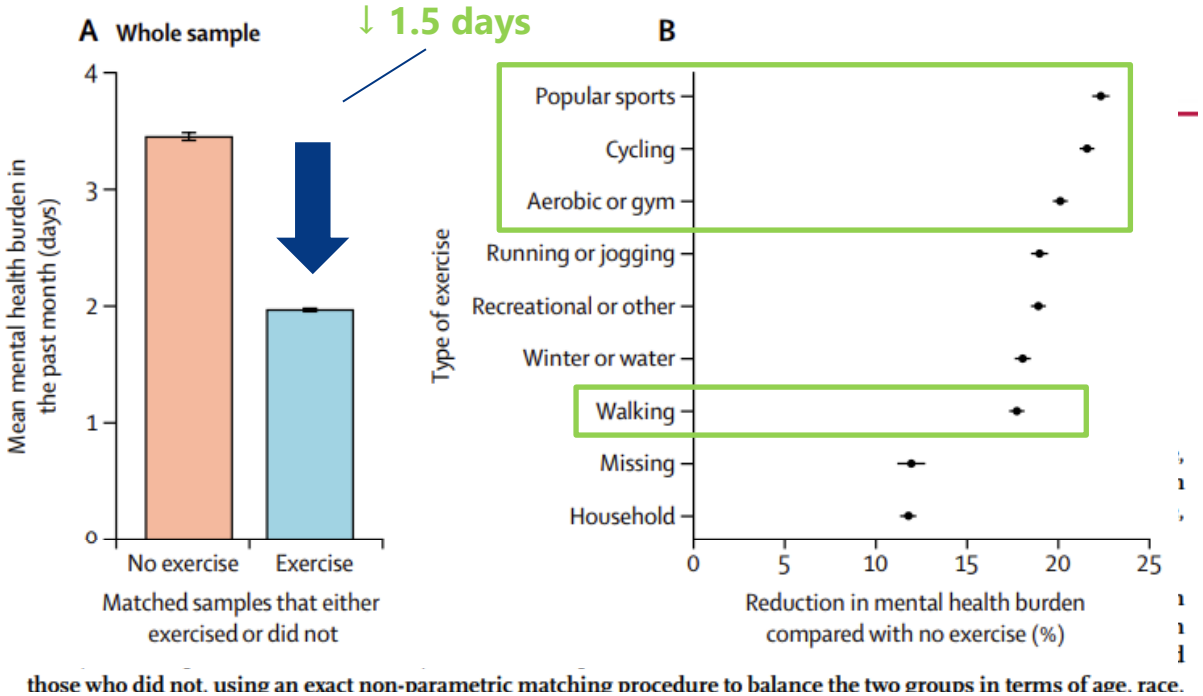


Excessive fear or worry about daily situations.

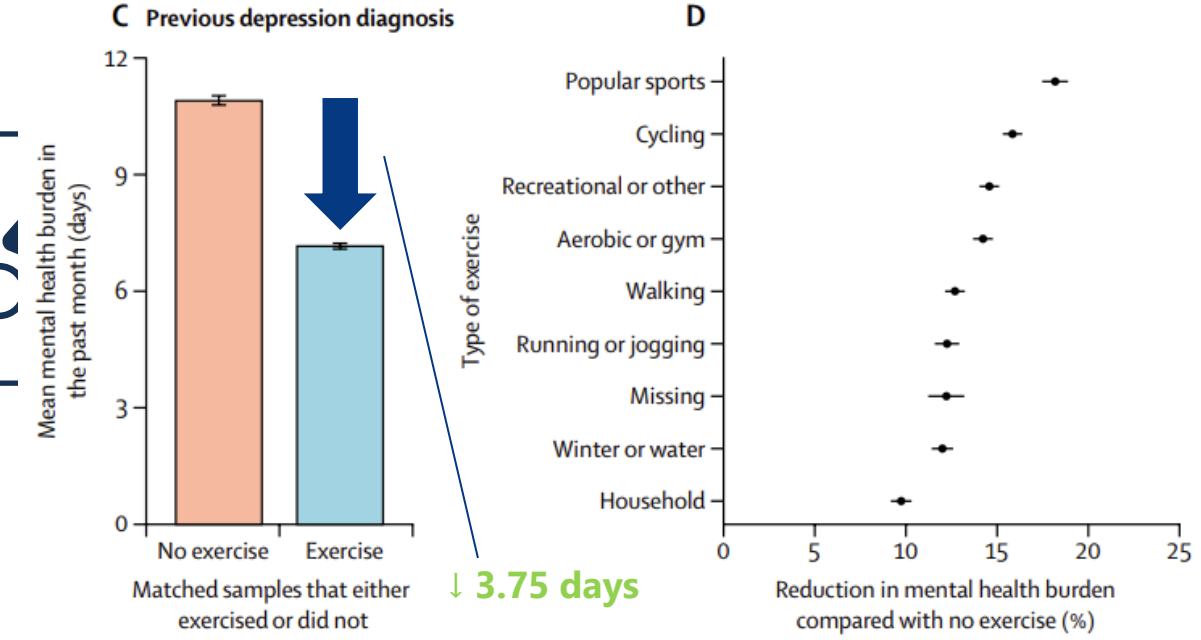
Can cause physical symptoms (e.g., nausea, dizziness).

Often linked to stress or trauma.

Exercise & mental health



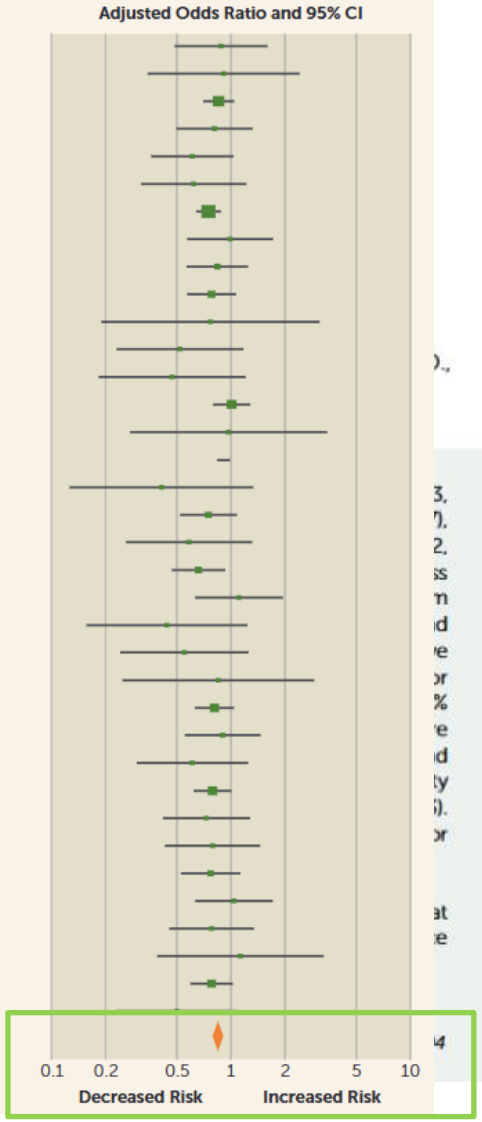
those who did not, using an exact non-parametric matching procedure to balance the two groups in terms of age, race,



k

Exercise & mental health

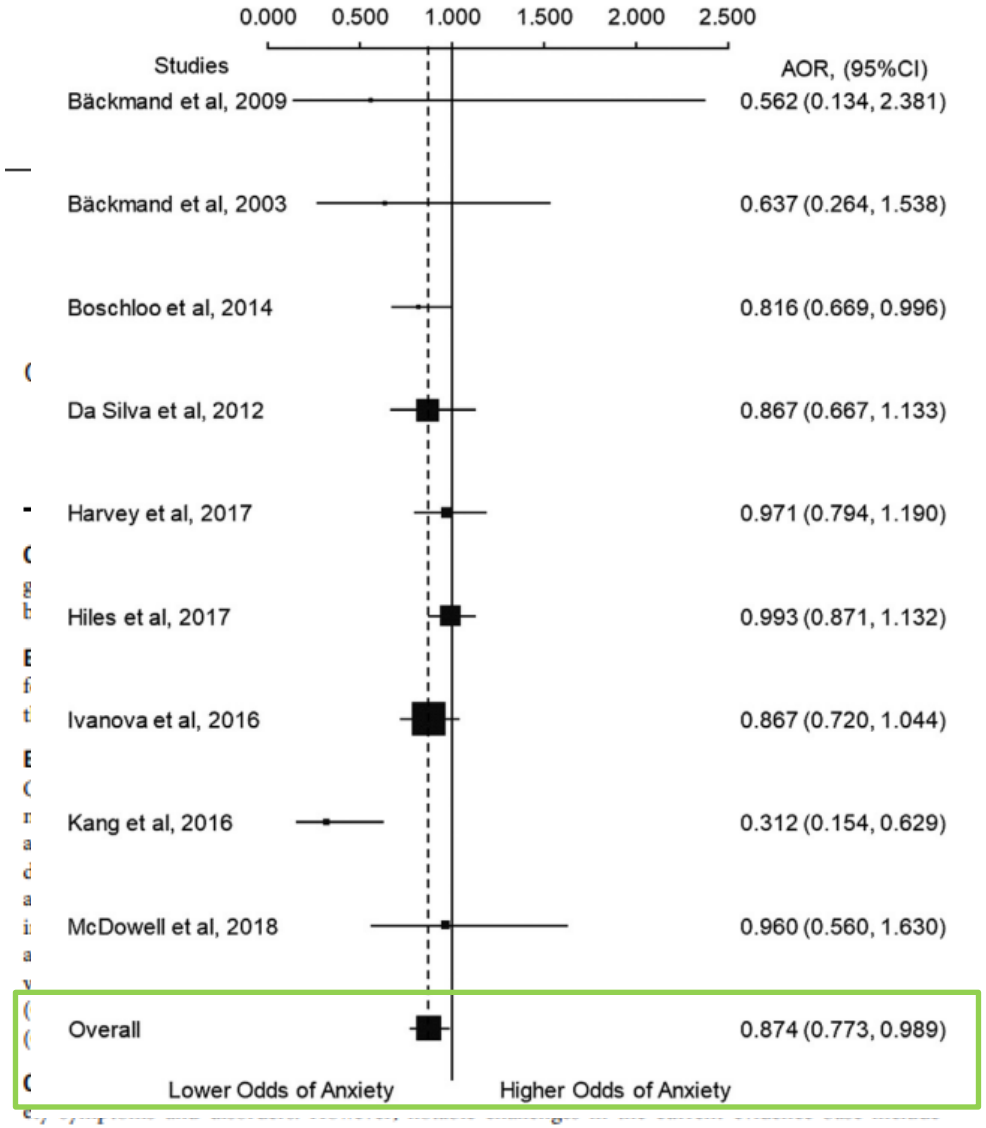
Study Authors, Year, Reference	Odds Ratio	Lower Limit	Upper Limit	p
Augestad et al., 2008 (30) (men)	0.880	0.484	1.599	0.675
Augestad et al., 2008 (30) (women)	0.910	0.343	2.415	0.850
Baumeister et al., 2017 (31)	0.854	0.699	1.044	0.124
Cabello et al., 2017 (34)	0.810	0.496	1.322	0.399
Chang et al., 2016 (36)	0.610	0.359	1.036	0.068
Chen and Millar, 1999 (37)	0.620	0.315	1.221	0.167
Choi et al., 2015 (38)	0.750	0.639	0.881	0.000
Clark et al., 2007 (39)	0.990	0.570	1.720	0.972
Da Silva et al., 2012 (42)	0.840	0.566	1.247	0.387
España-Romero et al., 2013 (43)	0.780	0.570	1.068	0.121
Farmer et al., 1988 (44) (men)	0.769	0.189	3.123	0.713
Farmer et al., 1988 (44) (women)	0.520	0.230	1.175	0.116
Gallegos-Carrillo et al., 2013 (45)	0.470	0.183	1.209	0.117
Garcia-Pena et al., 2013 (46)	1.010	0.795	1.283	0.935
Hiles et al., 2015 (49)	0.970	0.274	3.440	0.962
Jerstad et al., 2010 (50)	0.910	0.837	0.990	0.028
Joshi et al., 2016 (52)	0.410	0.126	1.335	0.139
Ku et al., 2009 (54)	0.750	0.521	1.080	0.122
Messier et al., 2013 (57) (remained active)	0.584	0.260	1.313	0.193
Mihrshahi et al., 2015 (58)	0.660	0.468	0.930	0.018
Mobily et al., 1996 (60)	1.110	0.631	1.951	0.717
Park et al., 2015 (61)	0.440	0.157	1.237	0.120
Pasco et al., 2011 (62)	0.550	0.241	1.254	0.155
Rius-Ottenheim et al., 2013 (63)	0.850	0.248	2.910	0.796
Roh et al., 2015 (64)	0.810	0.629	1.043	0.102
Sanchez-Villegas et al., 2008 (65)	0.900	0.553	1.466	0.672
Smith et al., 2010 (67)	0.610	0.298	1.249	0.176
Strawbridge et al., 2002 (68)	0.790	0.620	1.007	0.057
Strohle et al. 2007 (69)	0.730	0.417	1.278	0.271
Ten have et al., 2011 (70)	0.790	0.428	1.457	0.450
Tsai et al., 2013 (71)	0.770	0.525	1.129	0.181
Tsutsumimoto et al., 2017 (72)	1.040	0.632	1.713	0.878
Veronese et al., 2017 (73)	0.780	0.453	1.344	0.371
Wereyer, 1992 (75)	1.130	0.388	3.295	0.823
Wise et al., 2006 (76)	0.780	0.593	1.026	0.075
Yoshida et al., 2015 (77) (maintenance)	0.500	0.230	1.089	0.081
Summary effect size estimate	0.837	0.794	0.883	0.000



49 studies
n=266,939
Average 7.4 years

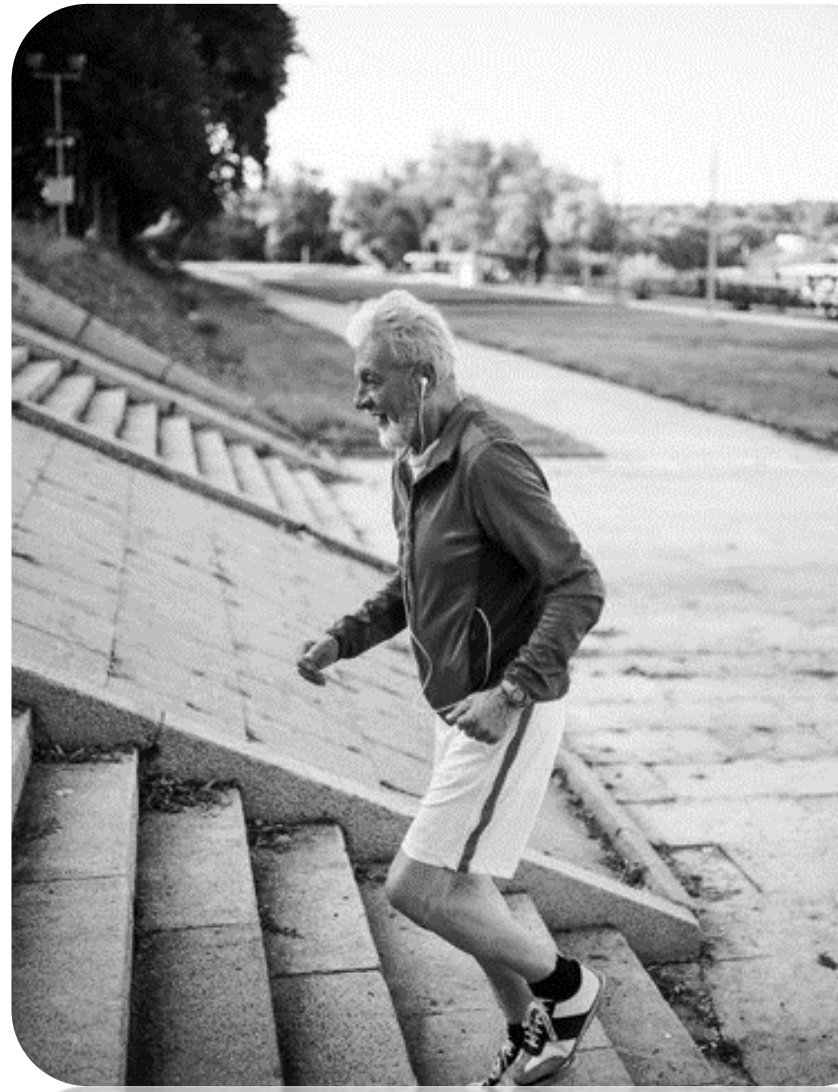
Adjusted OR: 0.83
17% ↓ risk of depression

Exercise & mental health



24 studies
n >80,000
Average 4.7 years

OR: 0.87
13% ↓ risk of anxiety



Exercise & mental health

97 meta-analyses
1,039 RCTs
n=128,119

Depression: -0.43*
Anxiety: -0.42*
Distress: -0.60*

Resistance exercise ↓ depression
Yoga ↓ anxiety

Higher intensity
Shorter durations

*Effect size interpretation:
-0.2 = Small effect
-0.5 = Medium Effect
-0.8 = Large effect

Systematic review

OPEN ACCESS

Effectiveness of physical activity interventions for improving depression, anxiety and distress: an overview of systematic reviews

Ben Singh ,[1] Timothy Olds,[1] Rachel Curtis,[1] Dorothea Dumuid ,[1] Rosa Virgara,[1] Amanda Watson,[1] Kimberley Szeto,[1] Edward O'Connor,[1] Ty Ferguson,[1] Emily Eglitis,[1] Aaron Miatke,[1] Catherine EM Simpson,[1] Carol Maher[2]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bjsports-2022-106195).

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ABSTRACT

Objective To synthesise the evidence on the effects of physical activity on symptoms of depression, anxiety and psychological distress in adult populations.

Design Umbrella review.

Data sources Twelve electronic databases were searched for eligible studies published from inception to 1 January 2022.

Eligibility criteria for selecting studies Systematic reviews with meta-analyses of randomised controlled trials designed to increase physical activity in an adult population and that assessed depression, anxiety or psychological distress were eligible. Study selection was undertaken in duplicate by two independent reviewers.

Results Ninety-seven reviews (1039 trials and 128 119 participants) were included. Populations included healthy adults, people with mental health disorders and people with various chronic diseases. Most reviews (n=77) had a critically low A MeaSurement Tool to Assess systematic Reviews score. Physical activity had medium effects on depression (median effect size=−0.43, IQR=−0.66 to −0.27), anxiety (median effect size=−0.42, IQR=−0.66 to −0.26) and psychological distress (effect size=−0.60, 95% CI −0.78 to −0.42), compared with usual care across all populations. The largest benefits were seen in people with depression, HIV and kidney disease, in pregnant and postpartum women, and in healthy individuals. Higher intensity physical activity was associated with greater improvements in symptoms. Effectiveness of physical activity interventions diminished with longer duration interventions.

Conclusion and relevance Physical activity is highly beneficial for improving symptoms of depression, anxiety and distress across a wide range of adult populations, including the general population, people with diagnosed mental health disorders and people with chronic disease. Physical activity should be a mainstay approach in the management of depression, anxiety and psychological distress.

PROSPERO registration number CRD42021292710.

which is projected to increase to $6 trillion (USD) by 2030.[5] Depression is the leading cause of mental health-related disease burden,[6] while anxiety is the most prevalent mental health disorder.[3] Additionally, the COVID-19 pandemic has been associated with increased rates of psychological distress, with prevalence ranging between 35% and 38% worldwide.[7–9]

The role of lifestyle management approaches, such as exercise, sleep hygiene and a healthy diet, varies between clinical practice guidelines in different countries. In US clinical guidelines,[10] psychotherapy or pharmacotherapy is recommended as the initial treatment approaches, with lifestyle approaches considered as 'complementary alternative treatments' where psychotherapy and pharmacotherapy are 'ineffective or unacceptable'. In other countries such as Australia, lifestyle management is recommended as the first-line treatment approach,[11 12] though in practice, pharmacotherapy is often provided first.

There have been hundreds of research trials examining the effects of physical activity (PA) on depression, anxiety and psychological distress, many of which suggest that PA may have similar effects to psychotherapy and pharmacotherapy (and with numerous advantages over psychotherapy and pharmacotherapy, in terms of cost, side-effects and ancillary health benefits).[13–18] Despite the evidence for the benefits of PA, it has not been widely adopted therapeutically. Patient resistance, the difficulty of prescribing and monitoring PA in clinical settings, as well as the huge volume of largely incommensurable studies, have probably impeded a wider take-up in practice.[13 14 17]

Meta-reviews are systematic reviews of systematic reviews, offering a way of synthesising a vast evidence base. While there have been several meta-reviews of PA for depression, anxiety and psychological distress,[17 19–24] they have focused on specific population subgroups, particular conditions (eg, depression only) or on particular forms of PA. We set out to undertake the most comprehensive synthesis to date

Exercise & mental health

Depression scores following randomization of depressed CAD patients to three treatment groups

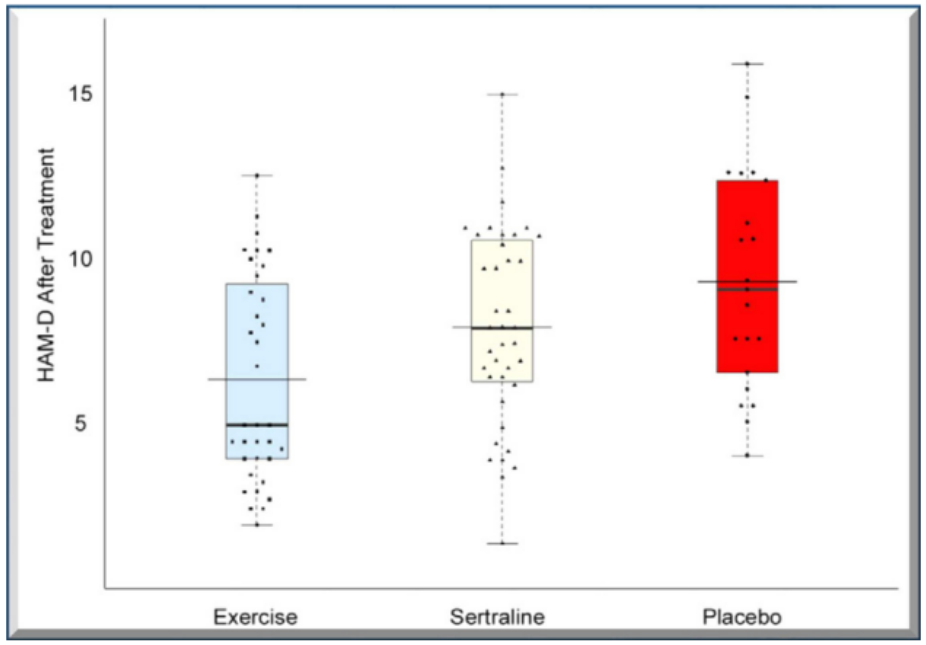

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Fig. 3. Hamilton-D (HAM—D) scores for depression among 101 cardiac patients with elevated depression symptoms, randomized to three groups, after completion of their randomized treatments. The exercise group had the lowest depression scores. (Reprinted with permission from Blumenthal et al.[26]).

James A. Blumenthal PhD *, Andrew Sherwood PhD *, Michael A. Babyak PhD *, Lana L. Watkins PhD *, Patrick J. Smith PhD *, Benson M. Hoffman PhD *, C. Virginia F. O'Hayer PhD P. Murali MD ‡

Aerobic exercise
3 times/week for
4 months

Sertraline: 36% ↓
Aerobic exercise: 67% ↓

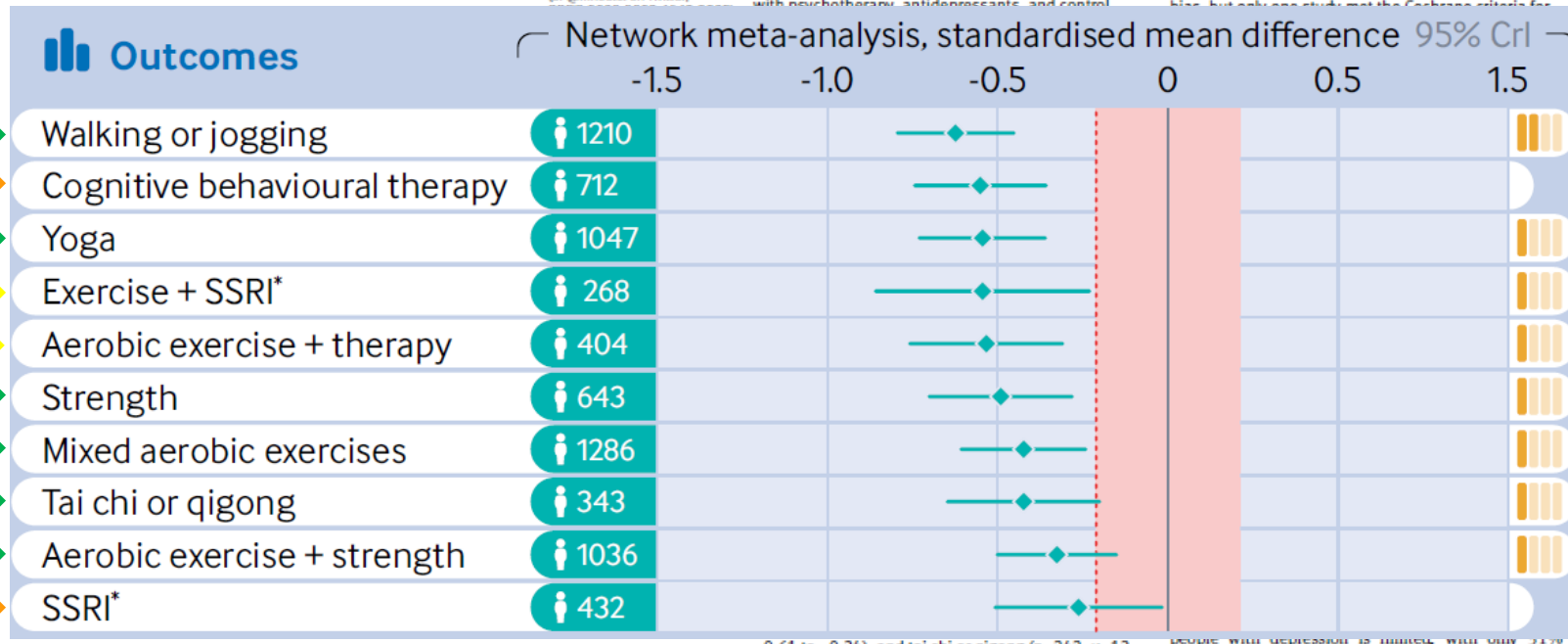
Exercise & mental health

218 studies
n=14,170

Walking/jogging: -0.62
Yoga: -0.55
Strength: -0.49
Mixed: -0.43

CBT: -0.55
SSRI: -0.26
Exercise+SSRI: -0.55
Aerobic+therapy: -0.54

Effect size interpretation:
-0.2 = Small effect;
-0.5 = Medium Effect
-0.8 = Large effect
CBT: Cognitive behavioral therapy
SSRI: Selective serotonin reuptake inhibitors



RESEARCH

OPEN ACCESS

Check for updates

Effect of exercise for depression: systematic review and network meta-analysis of randomised controlled trials

Michael Noetel,[1] Taren Sanders,[2] Daniel Gallardo-Gómez,[3] Paul Taylor,[4] Borja del Pozo Cruz,[5,6] Daniel van den Hoek,[7] Jordan J Smith,[8] John Mahoney,[9] Jemima Spathis,[9] Mark Moresi,[4] Rebecca Pagano,[10] Lisa Pagano,[11] Roberta Vasconcellos,[2] Hugh Arnott,[2] Benjamin Varley,[12] Philip Parker,[13] Stuart Biddle,[14,15] Chris Lonsdale[13]

For numbered affiliations see end of the article

Correspondence to: M Noetel m.noetel@uq.edu.au (or @mnoetel on Twitter;

ABSTRACT

OBJECTIVE

To identify the optimal dose and modality of exercise for treating major depressive disorder, compared

g −0.42, −0.65 to −0.21). The effects of exercise were proportional to the intensity prescribed. Strength training and yoga appeared to be the most acceptable modalities. Results appeared robust to publication

−0.61 to −0.24), and tai chi or qigong (n=343, k=12,

WHAT IS ALREADY KNOWN ON THIS TOPIC

Depression is a leading cause of disability, and exercise is often recommended alongside first line treatments such as pharmacotherapy and psychotherapy

Treatment guidelines and previous reviews disagree on how to prescribe exercise to best treat depression

WHAT THIS STUDY ADDS

Various exercise modalities are effective (walking, jogging, mixed aerobic exercise, strength training, yoga, tai chi, qigong) and well tolerated (especially strength training and yoga)

Effects appeared proportional to the intensity of exercise prescribed and were stronger for group exercise and interventions with clear prescriptions

Preliminary evidence suggests interactions between types of exercise and patients' personal characteristics

people with depression is limited, with only 51% treatment coverage for high income countries and 20% for low and lower-middle income countries.[9] More evidence based treatments are therefore needed.

Exercise may be an effective complement or alternative to drugs and psychotherapy.[10-14] In addition to mental health benefits, exercise also improves a range of physical and cognitive outcomes.[15-17] Clinical practice guidelines in the US, UK, and Australia recommend physical activity as part of treatment for depression.[18-21] But these guidelines do not provide clear, consistent recommendations about dose or exercise modality. British guidelines recommend group exercise programmes[20 21] and offer general recommendations to increase any form of physical activity,[21] the American Psychiatric Association recommends any dose of aerobic exercise or resistance training,[20] and Australian and New Zealand guidelines

Exercise & mental health

Exercise

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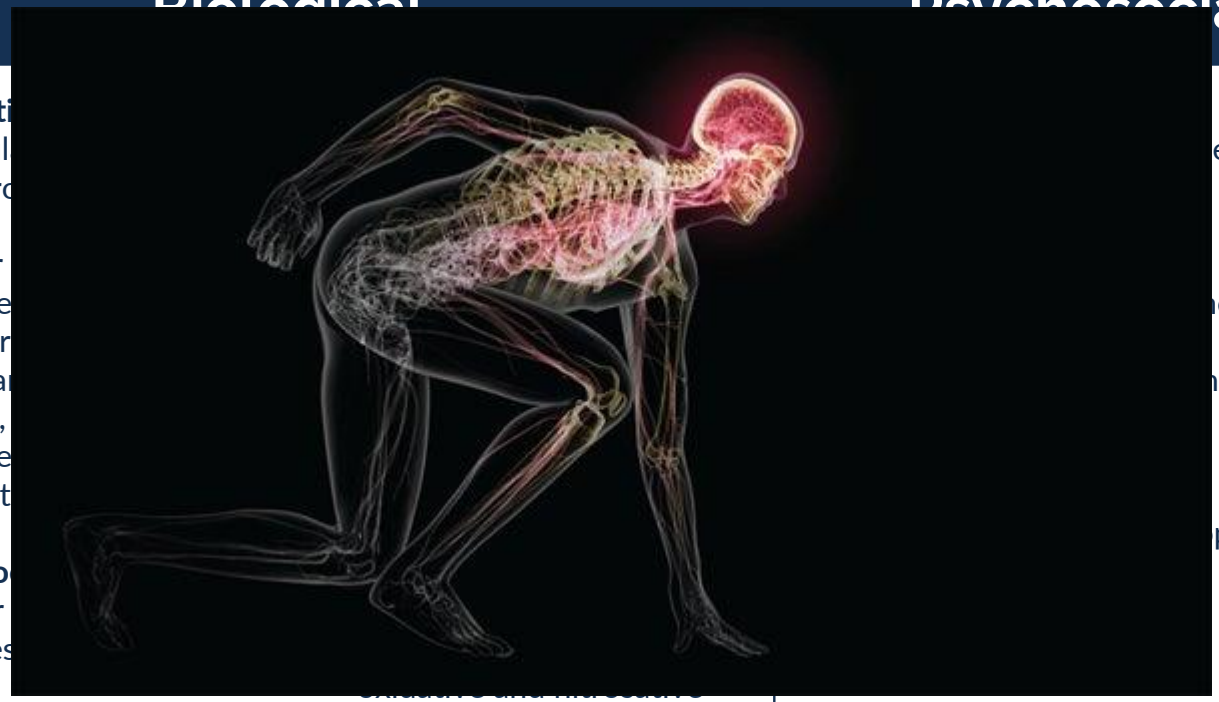
Changes



stress

Psychosocial

erceptions

notional

etworks

ping with

Mental health benefits

- Age
- Biological profile e.g. IL-6 or BDNF levels
- Symptoms
- Length/severity of depression/anxiety
- Psychosocial factors e.g. body image or barriers to exercise
- Fitness level
- Exercise factors (time, intensity, type)
- Context of exercise (individual or group exercise)
- Adherence to exercise
- Medication use

- Social deprivation
- Genetic factors e.g. polygenetic risk of depression
- Physical health status
- Stress
- Education
- Ethnicity
- Other psychiatric conditions
- Comorbid conditions e.g. diabetes
- Other health behaviours e.g. sleep
- Trauma

BDNF: Brain-derived neurotrophic factor
HPA: hypothalamic-pituitary-adrenal

Adapted from Kandola et al. *Neurosci Biobehav Rev*. (2019).

Exercise & mental health

LEISURE STUDIES
2024, VOL. 43, NO. 4, 545–561
https://doi.org/10.1080/02614367.2023.2243654

systematic review of the wellbeing benefits of being active through leisure and fitness centres

Leila Heckel[a], Rochelle Eime[b,c], Adam Karg[d], Heath McDonald[e], Carleigh Yeomans[d] and Ian O'Boyle[a]

[a]UniSa Business, University of South Australia, Adelaide, Australia; [b]School of Science Psychology and Sport, Federation University, Ballarat, Australia; [c]Institute for Health and Sport, Victoria University, Melbourne, Australia; [d]School of Business, Law and Entrepreneurship, Swinburne University of Technology, Melbourne, Australia; [e]School of Economics, Finance and Marketing, RMIT University, Melbourne, Australia

ABSTRACT

The aim of this systematic review was to provide an overview of the scientific evidence for psychosocial wellbeing benefits for individuals who are active through settings like leisure centres, gymnasiums or swimming pools. The level of physical activity required to achieve well-being outcomes through centre usage was a focal point. Nine electronic databases (AUSPORT, SPORTDiscus, EMBASE, MEDLINE, CINAHL complete, PsycINFO, Web of Science, PubMed, Scopus) were systematically searched to identify relevant literature, including all articles published in English from January 2011 to December 2021. A total of 1667 manuscripts were identified of which 31 articles were included in this review. Mental health was the most investigated psychological outcome, followed by stress reduction and relaxation; bonding with family/friends was the most frequently studied social outcome. Regular physical activity at leisure/fitness centres may be associated with increased social and psychological well-being. Participation in group programmes seems to be superior to individual activities in achieving health benefits due to its social nature. Findings from this review confirm that outcomes of being active through leisure/fitness centres go beyond physical benefits. However, scientific evidence is limited and more longitudinal studies with larger samples, and a focus on the dose–response relationship issue are recommended.

ARTICLE HISTORY
Received 30 November 2022
Accepted 25 July 2023

KEYWORDS
Aquatic recreation and leisure centres; gymnasium; swimming pools; social wellbeing; psychological wellbeing; mental health

- Systematic review of 31 studies.
- Physical activity at leisure/fitness centres associated with increased social & psychological well-being.

- Group programs seem to be superior to individual activities in achieving health benefits due to its social nature.

Exercise & mental health

Leisure and Fitness Centres
(multipurpose leisure centres + gymnasiums + swimming pools)

Social wellbeing benefits
- Bonding with family and friends
- Sense of belonging
- Connectedness
- Socialising with others
- Networking with others
- Sense of community

↑ Social Wellbeing benefits
- Women
- Youngest and oldest age groups
- Recreational swimmers, learn-to-swim participants
- Group activities
- Higher attendance
- Higher educated females
- Non-married individuals

↓ Social Wellbeing benefits
- Men
- Middle-aged individuals
- Lap swimmers, group fitness participants
- Individual activities
- Lower attendance
- Less educated females
- Married individuals

Psychological wellbeing benefits
- Positive mood, relaxation, stress reduction
- Fun, enjoyment, pleasure, happiness
- Self-discovery, self-esteem/-worth/-compassion
- QoL, life satisfaction
- Better mental health
- Better aging

↑ Psychological Wellbeing benefits
- Individuals aged < 30 years
- Lap and recreational swimmers
- Higher attendance
- Single women

↓ Psychological Wellbeing benefits
- Middle-aged and older individuals
- Learn-to-swim participants
- Lower attendance
- Married women

- Consider psychosocial benefits when designing exercise programs for diverse populations.
- Group-based activities enhance both physical and mental health.
- Social exercise supports holistic mental health, complementing traditional therapies.
- Group settings improve physical health, social connections, and self-esteem.

Heckel et al. *Leisure Studies* (2023)

Physical activity domains

AMERICAN JOURNAL OF
Preventive Medicine

REVIEW ARTICLE

Domain-Specific Physical Activity and Mental Health: A Meta-analysis

Rhiannon Lee White, PhD,[1] Mark J. Babic, BSc (Hons),[2] Philip D. Parker, PhD,[1] David R. Lubans, PhD,[2] Thomas Astell-Burt, PhD,[3,4,5] Chris Lonsdale, PhD[1]

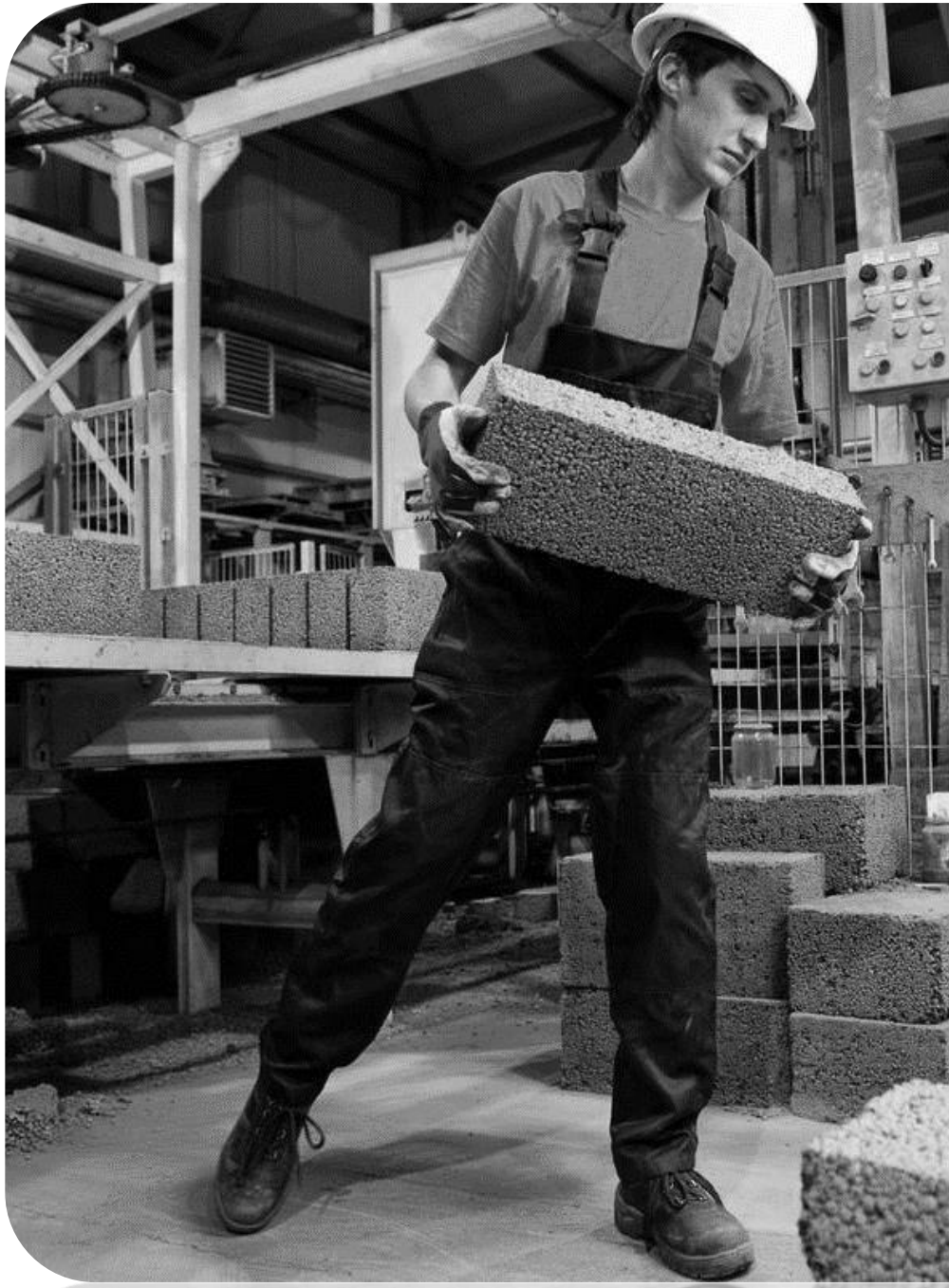
Context: The mental health benefits of physical activity are well established. However, less is known about whether the relationship between physical activity and mental health is consistent across different life domains. It is important to understand how context may influence the relationship between physical activity and mental health so that interventions and policy guidelines can be tailored to maximize positive effects.

Evidence acquisition: In 2015, systematic searches of four databases identified 13,435 records, of which 98 studies met the inclusion criteria.

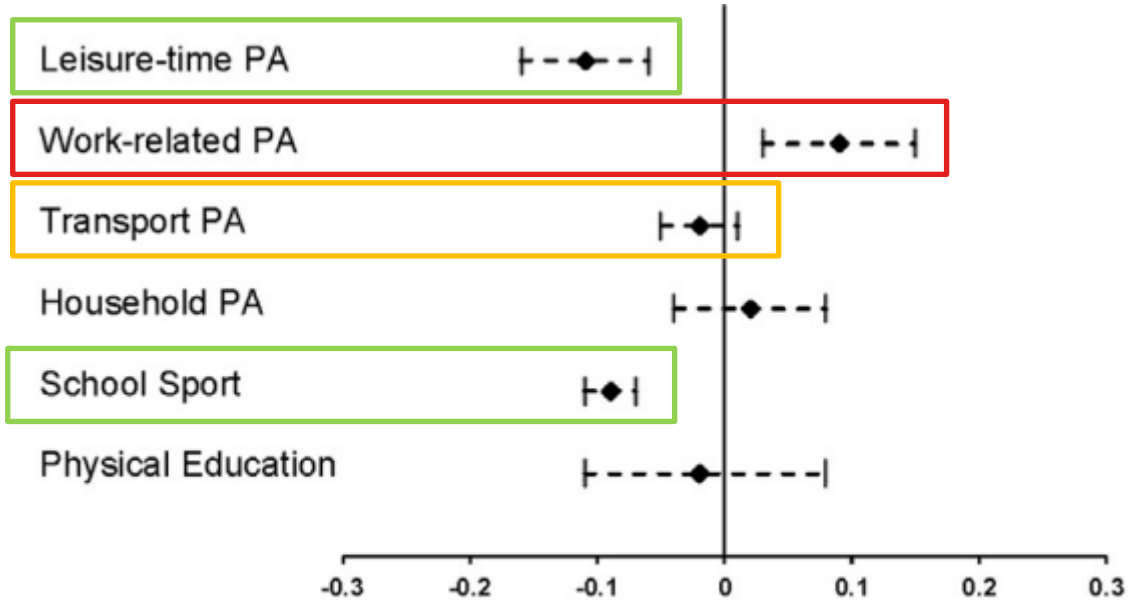
Evidence synthesis: Included studies were published between 1988 and 2015 and had a combined sample size of 648,726. Of the 98 included studies, 93 examined leisure-time physical activity, 14 examined work-related physical activity, 15 examined transport physical activity, 16 examined household physical activity, three examined school sport, and three examined physical education. Multi-level meta-analyses showed that leisure-time physical activity (r =0.13) and transport physical activity (r =0.13) both had a positive association with mental health. Leisure-time physical activity (r = −0.11) and school sport (r = −0.09) both had an inverse association with mental ill-health. However, physical activity was not consistently associated with lower mental ill-health across domains, as work-related physical activity was positively associated with mental ill-health (r =0.09). Household physical activity and participation in physical education had no relationship with mental health or mental ill-health.

Conclusions: The domain in which physical activity occurs influences the relationship between physical activity and mental health and should, therefore, be considered when developing interventions, treatment programs, and policy guidelines.

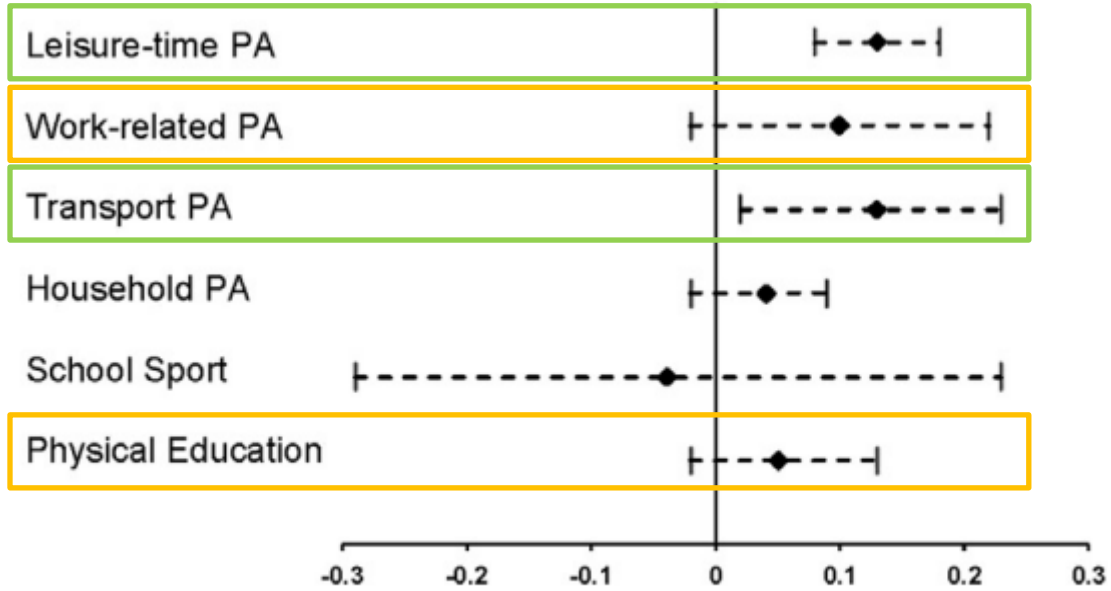
Am J Prev Med 2017;52(3):653–666.



Physical activity domains



a) Mental ill-health



b) Mental health

- ↑ LTPA & School sport = ↓ anxiety, depression & stress
- ↑ Work PA= ↑ anxiety, depression & stress

- ↑ LTPA & Transport PA = ↑ positive state of mental well-being

Physical activity domains

Is all activity equal? Associations between different domains of physical activity and depressive symptom severity among 261,121 European adults

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Abstract

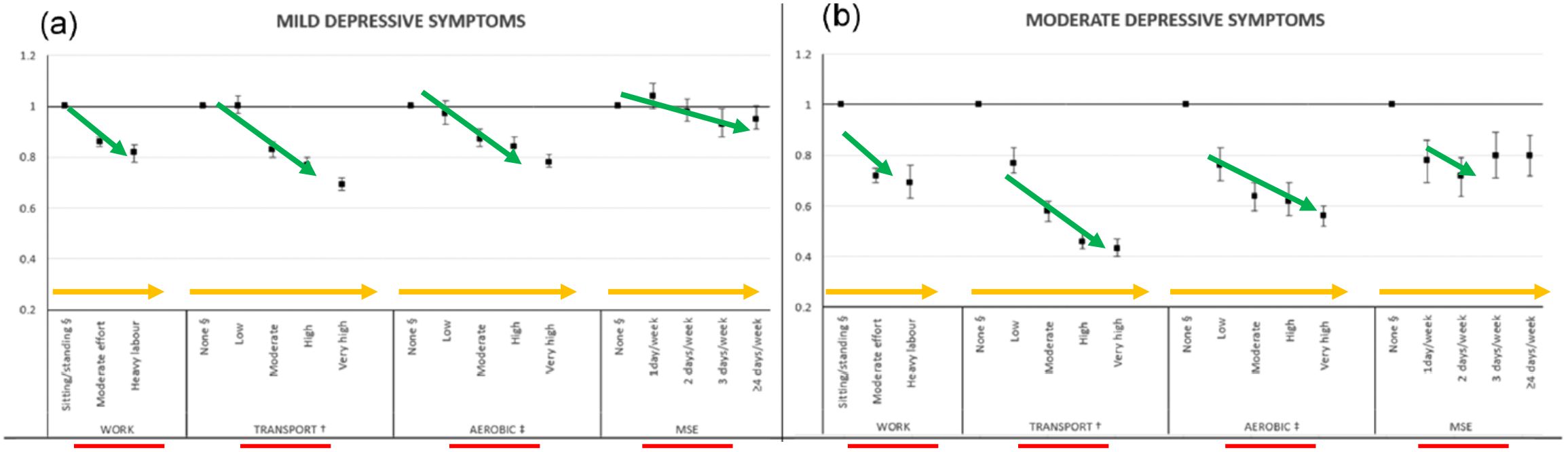
Background: Physical activity is often associated with better mental health. However, there is evidence that the domain of physical activity influences the strength and direction of this association. Therefore, this study aimed to examine the associations between different domains of physical activity and depression among a large sample of adults living in the European Union.

Methods: Cross-sectional analyses were conducted on 261,121 adults, recruited in the European Health Interview Survey (wave 2). Validated items were used to assess physical activity domains (i.e., work-related, transport-related, leisure-time aerobic, and muscle-strengthening) and depression symptom severity (8-item personal health questionnaire). Generalized linear models with Poisson regressions provided adjusted prevalence ratios (APR) of depressive symptom severity categories across the physical activity domains.

Results: Compared to doing no physical activity, any physical effort at work (APR: 0.82–0.86), moderate, high, and very high levels of transport-related (APR: 0.69–0.83) and aerobic leisure-time activity (APR: 0.78–0.87), and 3 days/week of muscle-strengthening (APR: 0.93) were associated with a lower prevalence of mild depressive symptom severity. Moreover, doing any level of physical activity in any domain was mostly associated with a lower prevalence of moderate (APR: 0.43–0.80), moderate–severe (APR: 0.34–0.82), and severe (APR: 0.26–0.56) depressive symptoms.

Conclusion: Favorable associations were seen between any domain (leisure-time, transport- and work-related) of physical activity and depressive symptom severity. The more severe the symptoms, the stronger the associations. Both modalities of leisure-time physical activity (aerobic and muscle-strengthening) demonstrated beneficial associations with depression, but slightly more so for aerobic physical activity.

Physical activity domains



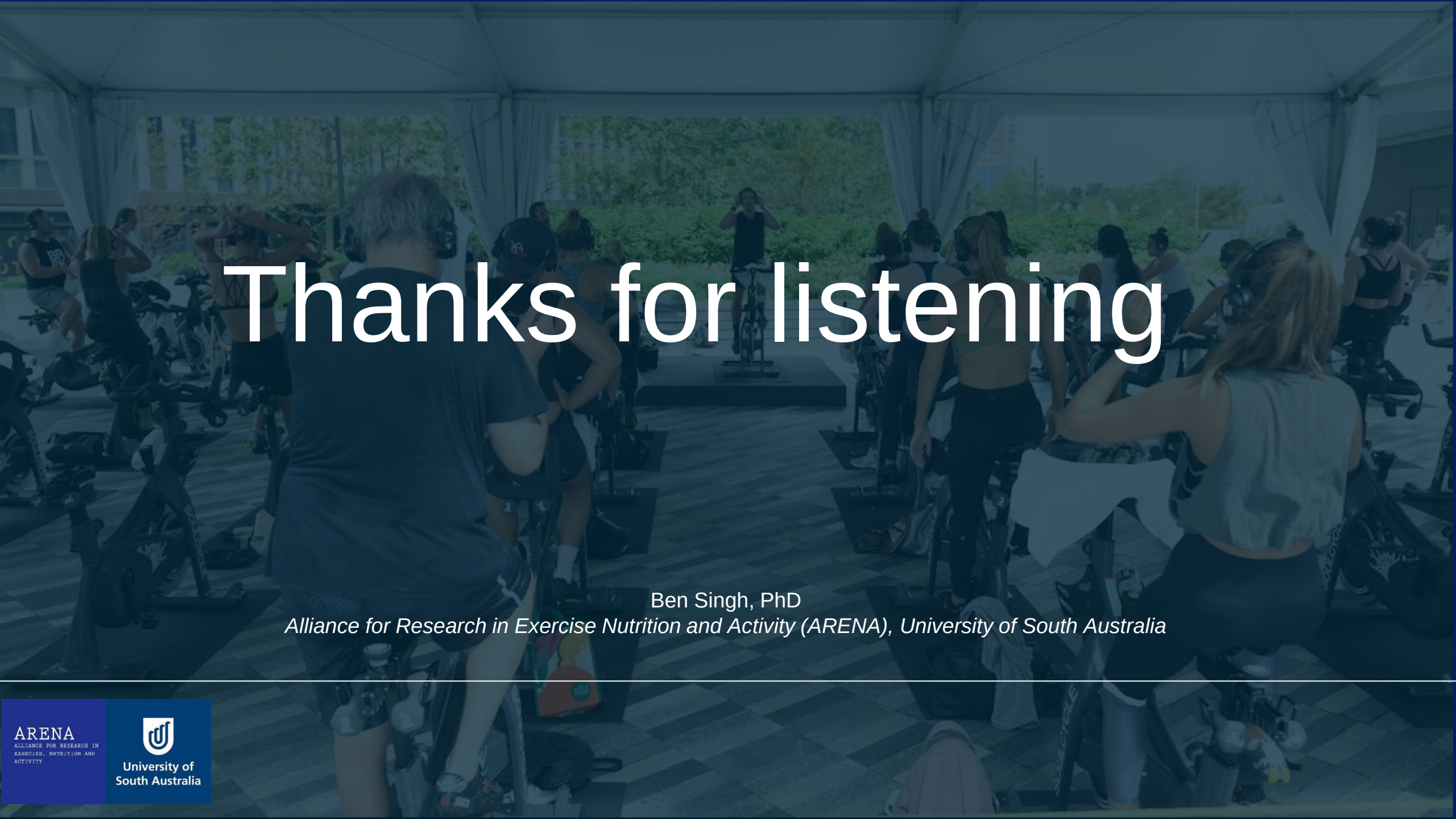
Promote active lifestyles

More is generally better

Incorporate PA into daily life

- **Exercise significantly improves mental health** - those who exercise experience 43.2% fewer days of poor mental health compared to non-exercisers
- Benefits occur through both **biological** mechanisms (e.g., increased BDNF, reduced inflammation) & **psychosocial** pathways (improved self-esteem, social interaction)

- **Any type of activity helps** - even simple walking reduces mental health burden by 18%, with optimal benefits seen at 45 minutes, 3-5 times weekly
- **Context matters** - leisure and transport-related PA show strongest mental health benefits, while work-related PA may increase stress



Thanks for listening

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