Routledge
Taylor & Francis Group

Journal of Sports Sciences

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rjsp20

A Manifesto for exercise science – a vision for improving the health of the public and planet

Andy Smith, David Broom, Marie Murphy & Stuart Biddle

To cite this article: Andy Smith, David Broom, Marie Murphy & Stuart Biddle (2022) A Manifesto for exercise science – a vision for improving the health of the public and planet, Journal of Sports Sciences, 40:10, 1110-1115, DOI: 10.1080/02640414.2022.2049083

To link to this article: https://doi.org/10.1080/02640414.2022.2049083

Published online: 09 Mar 2022.

JOURNAL OF SPORTS SCIENCES
2022, VOL. 40, NO. 10, 1110–1115
https://doi.org/10.1080/02640414.2022.2049083

Routledge
Taylor & Francis Group

PHYSICAL ACTIVITY, HEALTH AND EXERCISE

A Manifesto for exercise science – a vision for improving the health of the public and planet

Andy Smith[a], David Broom[b], Marie Murphy[c] and Stuart Biddle[d]

[a]Independent, Unaffiliated Sport and Exercise Scientist, UK; [b]Centre for Sport Exercise and Life Sciences, Coventry University, Coventry, UK; [c]Doctoral College, Ulster University, Co. Antrim, Northern Ireland; [d]Centre for Health Research, University of Southern Queensland, Toowoomba, QL, Australia

ABSTRACT

In this manifesto, we make the case that Exercise Science can and must do more to improve the health of the public and the planet. Post pandemic, our vision for Exercise Science is one of a maturing scientific discipline reaching outwards from a base of strong empirical evidence to have a profound and sustained positive global impact on health. In each of the three main areas of the discipline – research, teaching, and professional practice – a new and distinctive approach is needed. We propose 12 points of action, in no particular order, for a). quality, rigour, and professional standing, and b). reach, relevance, and public engagement and make numerous suggestions for action and change. We encourage the teachers, researchers and practitioners of Exercise Science to consider and act on these recommendations. We hope that this manifesto can help create a shared sense of purpose amongst the global Exercise Science community and further the principles of equality, diversity and inclusion. To act on these principles, we need to cultivate a discipline that encourages more women, people who experience racism and other forms of discrimination, and people with a disability to become involved in the discipline.

ARTICLE HISTORY
Accepted 24 February 2022

KEYWORDS
Exercise science; manifesto; physical activity; sedentary behaviour

Introduction

The COVID-19 pandemic has caused many individuals and organisations to rethink their plans and strategies. Here, we make the case that Exercise Science (also referred to as "the discipline") can and must do more to improve the health of the public and the planet. In calling for, and writing, a manifesto for the discipline, our thinking was shaped by Henderson (2012) and his "Geek Manifesto" in which he articulates the benefits of scientists working together to ensure evidence-based approaches to a range of societal and political issues, including education, health and the environment.

Post pandemic, our vision for Exercise Science is one of a maturing scientific discipline reaching outwards from a base of strong empirical evidence to have a profound and sustained positive global impact on health. In each of the three main areas of the discipline – research, teaching, and professional practice – a new and distinctive approach is needed.

In writing this manifesto, our underpinning values are those of equality, diversity, and inclusion. This is seen both in the words we have used to describe people and in the issues that we address. For example, climate change (see Action Point 7) is likely to have the biggest impact on some of the poorest and most disadvantaged people on the planet.

None of the authors have experienced "physical activity insecurity" (Lambert et al., 2020) and share a common cultural perspective. Therefore, it is important for readers to note that whilst the authors believe this manifesto has international relevance, care needs to be taken by readers to interpret its content to ensure it fits their culture and communities. Indeed, we welcome further development and application of this manifesto across different social and cultural contexts.

We propose 12 points of action, in no particular order, for a). quality, rigour, and professional standing, and b). reach, relevance, and public engagement.

A manifesto for quality, rigour, and professional standing

Over the next five years, the authors suggest that the field, and the professionals involved, seek to improve the quality, rigour, and professional standing of Exercise Science by taking five actions.

Action 1 – Address the Replication "Crisis"

Ritchie (2020) provides compelling evidence that in a number of scientific disciplines not enough research is being replicated. He asserts that "hardly anyone runs replication studies … in economics, a miserable 0.1% of all articles published were attempted replications of prior results … " (page 34). To address this issue in Exercise Science, we suggest that the discipline i) identifies if, as in many other fields, it has a replication crisis, ii) recognises and supports the value of replication studies through its funding and publication mechanisms, and iii) that the training of early-career researchers includes guidance on the importance of and approaches to replication in research.

CONTACT David Broom ad5173@coventry.ac.uk Independent, Unaffiliated Sport and Exercise Scientist, Coventry, UK

Action 2 – Focus on Effect Size

Requirements of many journals have long stated the need for reporting effect sizes, but progress is still quite slow. For example, Orben (2020), in her discussion concerning the controversies of the use and effects of technology by young people, suggests that a much greater emphasis on size of effects is needed. Reporting effect sizes allows the reader to see the practical rather than merely the statistical significance of a finding. She suggests that researchers not only report effect sizes but also provide an interpretation of what the effect size means for stakeholders (e.g., is it practical or meaningful?).

Action 3 – Look for the "bad news"

Whilst physical activity has many benefits, it is also important to study the risks and limitations of active living (Smith & Noret, 2019). For Exercise Science to be true to the scientific method, it should also investigate and report potential negative outcomes. For example, unhealthy exercise levels (exercise dependence or addiction) have shown associations with muscle dysmorphia and eating disorders (Trott et al., 2021).

Action 4 – Planning Impact

It is important that Exercise Scientists conduct curiosity-led research. However, when conducting research, it is vital that we also pay attention to the potential impact of the work. This impact may, for example, be on improving public health or increasing gross domestic happiness. Recently, several tools have been developed to help researchers assess the impact of their work (Reed, 2018) which we encourage researchers to use. Equally, we recognise that impact can take a long time to be realised and this should not hold back excellent research ideas and practices. [Also see Action 6]

Action 5 – Enhance standards in learning, teaching and assessment

Undergraduate and post-graduate ("graduate") students are the future of the discipline and wider profession. Therefore, continuous attention needs to be given to improving how and what they are taught and how their knowledge, performance and competencies are assessed. Arguably more emphasis needs to be put on building bridges between the curriculum and our "industries" including more work/study placements in situ.

A manifesto for reach, relevance, and public engagement

Over the next five years, the authors suggest that the field improves the reach, relevance, and impact of Exercise Science by taking seven main actions.

Action 6 – Engaging the Public

Exercise Science is a collaborative endeavour within which there are many stakeholders (also see Action 4). Public engagement can take many forms, including open days, public lectures, and collaborative outreach work. Work in this field by UK universities is assessed through the new Knowledge Exchange Framework (KEF; Research England Knowledge exchange framework, 2021) which has helped to identify the different types of public engagement and to showcase examples of best practice.

Action 7 – Do more to tackle climate change

Like all disciplines, Exercise Science needs to contribute to tackling climate change and mitigating any negative impact it has on the planet. Just as Exercise Science responded to the threat of COVID-19 by conducting new research, offering advice to the public, and changing how it operates, so a more concerted effort is required to the substantial threat posed by climate change.

It is possible to identify two features of climate change, which underscore the responsibility that Exercise Science has to act. The first is that climate change will have a major impact on the health of the world's population (CDC, 2021). As a health-focused discipline, it would be hypocritical for Exercise Science to promote the health benefits of physical activity while behaving in a way that made climate change, and therefore the health of many, worse. Secondly, as the environment plays a part in motivating people to exercise, the discipline cannot ignore the destruction of that environment through global warming. Nature provides an important attractive space in which people can be active and as climate change damages this environment and leads, for example, to flooding and forest fires (Nestpick, 2021), some of the places in which communities are active, and could be encouraged to be more active in, will be destroyed.

Increasing physical activity for personal transport at the population level has the potential to contribute to the global sustainability agenda by reducing the use of fossil fuels, improving air quality, decreasing congestion, and increasing the safety of roads and public spaces. From a societal perspective, increasing physical activity has been shown to also increase community engagement, improve social cohesion, and decrease loneliness and isolation. Indeed, active living has the potential to address 13 of the 17 WHO 2030 Sustainable Development Goals as well as the UN goals on climate change (UN – THE 17 GOALS | Sustainable Development (un.org), 2021).

Our suggestions for how Exercise Science can do more to tackle climate change are:

- *"Green the Curriculum"*: Ensure that upon graduation all Exercise Scientists are aware of the scientific evidence related to climate change and its impact on health, physical activity, sport and the environment.
- *Promote Active Transport and Safe Mobility integrated with good Public Transport*: Design, deliver and evaluate the efficacy of active transport initiatives to improve health

and address climate change. The AI-controlled smart cities of the future need input from Exercise Science to ensure they promote active living.

- *Reduce the Carbon Footprint of Exercise Science*: This can be achieved by a combination of methods including i) on campus interventions regarding energy efficiency and ii) only flying to attend those conferences and meetings where the outcomes cannot be achieved online or where more environmentally friendly forms of travel, such as trains, are not viable. We acknowledge, however, that whilst tackling climate change is important, so too is promoting international understanding and scientific discussion through occasional face-to-face meetings.

Action 8 – Shape the 4th Industrial Revolution

Klaus Schwab coined the term the "4th industrial revolution" to describe the fast-paced development of the omnipresent internet, artificial intelligence, and machine learning. Over the next 5 years, new and emergent technologies are likely to have a profound impact on both how we do Exercise Science and the communities and individuals we work with. These impacts are already being felt as the discipline uses big data to conduct research and individuals use "devices" to, for example, count their steps and prompt them to be active. However, Schwab has argued that unprecedented change is on the near horizon as more jobs become automated, smart manufacturing grows, and the internet of things develops faster. As with any revolution, there will be winners and losers within our societies both in terms of wealth but, more importantly, health.

Rather than simply responding to the 4th industrial revolution, we challenge Exercise Science to shape events and suggest that:

- Academics exploit developments in technology to i) change the way they conduct learning, teaching and assessment; ii) conduct better research studies by, for example, using AI; iii) ensure that graduates in the discipline have the skills to be lifelong learners, adaptable and ready for change; and iv) enhance health behaviour adoption and maintenance by being early adopters of new health and educational enhancing technologies.
- Within professional practice, incorporate new and emerging technology to increase reach and connect with an increasingly diverse range of clients, and provide tailored support and messages.

Action 9 – Move from "should" to "want"

How can we package the physical activity message as a "want to" rather than as a "should"? How do we move away from a disease prevention focused message to one that people can better relate to and find more meaningful and engaging?

A cornerstone of Exercise Science has been the production of physical activity guidelines. These have been important statements and have driven policy and surveillance initiatives. However, the production of guidelines has been based primarily on associations between physical activity and health outcomes – the "disease prevention" approach. It is time for such guidance to be better aligned with behavioural science and include the array of benefits the target population wants from physical activity.

The emphasis on health-related (disease) outcomes may be disconnected from why most people engage in and maintain good levels of physical activity. While health-related reasons for physical activity may be a motive for starting or adopting some activity, this is often insufficient for maintaining involvement. Hence, the mismatch is between a message that says, "be active for your health" and the motives for sustaining involvement (usually feelings of well-being and enjoyment). This argument might support the view that the guidelines themselves are appropriate, but the messaging of them requires attention.

The wording of guidelines often centres on the word "should". For example, the 2020 WHO guidelines state that "Adults should do at least 150–300 min of moderate-intensity aerobic physical activity, or at least 75–150 min of vigorous-intensity aerobic physical activity, or an equivalent combination . . . throughout the week for substantial health benefits". At first glance, this may seem a reasonable approach. But psychologists who study motivation would argue that "should" creates a controlling form of motivation (Ryan & Deci, 2020). For example, thoughts of "have to" or "ought to" (i.e., "should"), may be linked to feelings of guilt if the behaviour is not undertaken. We need people to undertake physical activity for more intrinsic reasons. Therefore, future guidelines (or the messages associated with them) might be better aligned with what people want from physical activity in the short term and in ways that maximise enjoyment rather than just "health".

We challenge Exercise Science to move away from a disease prevention model to a wider biopsychosocial approach when promoting physical activity and suggest that:

- Academics explore the impact of changing the wording and messaging of guidelines to better align with behaviour change.
- Practitioners focus on the pleasure, enjoyment, and reinforcement value of physical activity as well as health enhancement and disease prevention.

Action 10 – Progress the understanding of sedentary behaviour alongside other intensities of physical activity

Exercise Science graduates across the globe are likely to have studied "Exercise Physiology". This discipline seeks to understand the acute and chronic effects of exercise on the muscular, cardiovascular, and neurohumoral systems that leads to changes in functional capacity. Exercise physiology also seeks to understand the effects of exercise on pathology and the mechanisms by which exercise affects the risk and treatment of non-communicable diseases. Its inclusion in most Sport and Exercise Science degrees is no surprise considering the maturity of Exercise Physiology. For example, Archibald Hill and Otto Meyerhof shared the 1922 Nobel Prize in Physiology or Medicine for their respective works in maximum oxygen uptake and muscle metabolism.

Sedentary behaviour has been defined as "any waking behavior characterized by an energy expenditure ≤1.5 metabolic equivalents (METs), while in a sitting, reclining or lying

posture" (Tremblay et al., 2017) and is distinct from simply having low levels of physical activity and exercise. Many early exercise physiology and physical activity epidemiology papers referred to people as being "sedentary" without measuring the specific behaviour. It is likely that it would have been more accurate to classify these people as "physically inactive" – having an insufficient level of physical activity to meet current recommendations.

In the last two decades, there has been an exponential growth in published studies examining sedentary behaviour and, whilst in its infancy as a discipline relative to exercise physiology, there is compelling evidence that "prolonged" and "excessive" sedentary behaviour is detrimental to health. Whilst many public health-related organisations and government departments have published guidelines on sedentary behaviour the key focus has been "reducing" sedentary behaviour. The COVID-19 pandemic and government-imposed lockdowns has probably increased sedentary behaviour (Meyer et al., 2020; although some groups may actually have increased their physical activity behaviour) so it is important to try to identify how long is "prolonged" or "excessive" and if specific patterns of sedentary behaviour need to be avoided.

Below are our suggestions for how Exercise Science can do more to progress the discipline and understanding of sedentary behaviour:

- Researchers are encouraged to maintain the momentum of sedentary behaviour research but focus efforts on achieving a better understanding of quantified guidance for amounts of sedentary behaviour, especially in the context of different levels of physical activity. Reference to 24-hour movement models and guidelines (Chastin et al., 2021; Dempsey et al., 2020); may be important for this. For example, whether sedentary behaviour should be seen independently of light and other intensities of physical activity is a moot point. Reductions in sedentary time need to be accounted for by increases in time allocation elsewhere, and much of this is likely to be into light intensity movement.
- Teachers need support to embed sedentary behaviour research content into their Exercise Science and related degree programmes in a way that engages students. The authors hope for a future where sub-fields, such as Sedentary Physiology and Sedentary Behaviour Change become mainstream disciplines.
- Practitioners would benefit their clients if they informed and educated them about the effects of excessive sedentary behaviour and developed, evaluated, and implemented efficacious and effective interventions to reduce it. Use of ableist language such as "stand up and move" is best avoided.

Action 11: Progress the active travel agenda

We have already set out in our manifesto that Exercise Science can play a role addressing the climate change emergency. Motorised travel has replaced many journeys formerly made by walking or cycling, as people travel longer distances more frequently. This has been a key factor in the decline in physical activity in recent decades.

"Active travel" (or active transportation or mobility) means walking or cycling for all or part of a journey as an alternative to motorised transport (e.g., cars, motorbikes) for the purpose of making everyday journeys. Active and sustainable travel is not only good for the environment but improves physical and mental health, quality of life and local productivity (Petrokofsky & Davis, 2016). Health-promoting transport systems support local economic prosperity due to being able to travel to work with less congestion, collisions, and pollution, and therefore support a healthier workforce.

The built and natural environment impacts on the choices people are able to make regarding physical activity so it is not surprising that there is an association observed such that countries with the highest levels of active travel generally have the lowest rates of obesity (Bassett et al., 2008).

We are not suggesting that motorised transport be abolished but we do propose that travel systems need rebalancing. The challenge is how we can develop more "active environments" which make active travel an easier and safer option so that they become the first and best choice for all members of the community.

Below are our suggestions for how the Exercise Science community can do more to progress the active travel agenda:

- Researchers can continue to conduct studies examining how green space influences physical activity throughout the whole of the life-course. There is a concern that interventions that promote and support active travel and public transport may increase health inequalities favouring more affluent groups. There is also growing evidence on the benefits of 20 mph (~30 kph) speed limits in built-up areas. Both areas need further work.
- Teachers are encouraged to embed active travel and environmental issues into curricula and promote walking and cycling as the norm for short journeys, or as part of a longer journey.
- Practitioners and researchers can support bids to government agencies for sustainable transport initiatives that create environments that promote physical activity as a normal part of everyday life. They will need to work with others to develop local healthy transport strategies and promote active travel and public transport for journeys of less than say 5 miles (~8 km).
- Pedestrians, cyclists, and users of other forms of transport that involve physical activity must be prioritised when developing or maintaining infrastructure. It is imperative to work with town and housing planners to design safe environments where movement is encouraged.

Action 12 – Develop a life-course approach to physical activity in public health

Evidence generated over the past half century or so has shown that regular physical activity reduces the risk of developing over 20 non-communicable diseases and contributes to good physical and mental health (Lee et al., 2012). Despite this evidence and widespread acceptance of such positive benefits, significant proportions of the population (irrespective of

geographical location, gender, age or socioeconomic status) are inactive or do insufficient activity to gain these benefits (Bull et al., 2020).

For an individual to be active throughout life physical activity needs to become a habit. As with any habit, it is best adopted early in life and then adapted as the individual develops and their circumstances change. This enhances the probability of it being maintained through the lifespan. An analogy is daily toothbrushing. This is something children are taught from an early age and a behaviour that is adhered to over a lifetime.

Multiple interventions to promote physical activity (in policy, practice and research) have been targeted at the individual encouraging them to become active by increasing awareness of the benefits and addressing the multiple barriers cited to regular participation. At best, these interventions have demonstrated short-term effects but for the most part population levels of activity remain stubbornly static.

For physical activity to have a sustained impact on public health at the national and supranational level, we suggest that Exercise Science needs to:

- Intervene at the multiple levels that influence behaviour. These levels are illustrated in Figure 1.
- By addressing all four levels, Exercise Science can help make the physically active option the easiest choice.
- By focusing less on changing the individual and more on environmental factors that create prompts and rewards, we are more likely to make physical activity a habit or a convenient choice. Such a habit-forming environment would focus less on the individual and would prioritise interventions that focus on social and environment context (e.g., infrastructure for walking and cycling), and urban design.

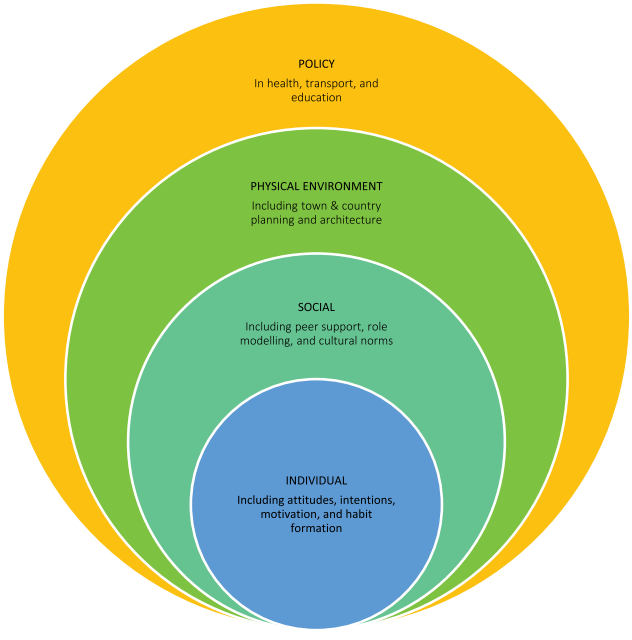

Figure 1. An ecological framework for the promotion of physical activity compiled based on the principles presented in. Sallis and Owen (2015)

Next steps

A key purpose of this manifesto is to stimulate discussion, change and action. The Exercise Science Community will ultimately decide amongst themselves how many of the suggestions made here will be acted upon and implemented. We recognise that any actions taken in response to this manifesto will need to reflect local circumstances, cultures and the health needs of local communities and, as such, may differ by context. Nonetheless, we hope that this manifesto can help create a shared sense of purpose amongst the global Exercise Science community and further the principles of equality, diversity and inclusion. To act on these principles, we need to cultivate a discipline that encourages more women, people who experience racism and other forms of discrimination, and people with a disability to become involved in the discipline. Researchers need to embrace these values by including these people as participants in exercise science studies.

Finally, we welcome open dialogue regarding this manifesto. Please address any thoughts, opinions, and further suggestions to the corresponding author.

Acknowledgments

The authors would like to acknowledge the efforts of the exercise science community and thank the community for their anticipated action to improve the health of the public and the planet.

Author contributions

AS and DB conceived the idea for the manifesto. All authors contributed to the writing and reviewing of the manifesto.

Declarations of Interest

The following declarations of interest are listed by the authors.
Professors Broom, Biddle and Murphy were members of Expert Working Groups responsible for developing the UK physical activity guidelines, 2018-19.
Professor Biddle was a member of guideline development groups for The Australian 2019 24-Hour Movement Guidelines for Children and Young People, and the World Health Organisation's 2020 guidelines on physical activity and sedentary behaviour.
Professor Murphy is SubPanel Chair for the research excellence framework unit of assessment 24 and Chair of WHO Europe HEPA Steering Committee.
Professor Broom is chair of the BASES Physical Activity for Health Division.
Professor Smith is chair of the BASES Public and External Affairs Advisory Panel and the BASES Climate Change Action Team.
Professor Smith is a member of the U.K. Science Council's Policy Advisory Committee.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

ORCID

Stuart Biddle http://orcid.org/0000-0002-7663-6895

References

Bassett, D., Pucher, J., Buehler, R., Thompson, D. L., & Crouter, S. E. (2008). Walking, cycling, and obesity rates in Europe, North America and Australia. *Journal of Physical Activity & Health*, *5*(6), 795–814. https://doi.org/10.1123/jpah.5.6.795

Bull, F. C., Al- Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J. -P., Chaput, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *British Journal of Sports Medicine*, *54*(24), 1451–1462. https://doi.org/10.1136/bjsports-2020-102955

CDC. *Climate change and public health - climate effects on health | CDC*. Accessed 24.September 2021. https://www.cdc.gov/climateandhealth/effects/default.htm

Chastin, S. F. M., McGregor, D. E., Biddle, S. J. H., Cardon, G., Chaput, J.-P., Dall, P. M., Dempsey, P. C., DiPietro, L., Ekelund, U., Katzmarzyk, P. T., Leitzmann, M., Stamatakis, E., & Van der Ploeg, H. P. (2021). Striking the right balance: Evidence to inform combined physical activity and sedentary behavior recommendations. *Journal of Physical Activity & Health*, *18*(6), 631–637. https://doi.org/10.1123/jpah.2020-0635

Dempsey, P. C., Biddle, S. J. H., Buman, M. P., Chastin, S., Ekelund, U., Friedenreich, C. M., Katzmarzyk, P. T., Leitzmann, M. F., Stamatakis, E., van der Ploeg, H. P., Willumsen, J., & Bull, F. (2020). New global guidelines on sedentary behaviour and health for adults: Broadening the behavioural targets. *International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), 151. https://doi.org/10.1186/s12966-020-01044-0

Henderson, M. (2012). The geek manifesto – why science matters. *Corgi Books*. https://geekmanifesto.wordpress.com/

Lambert, E. V., Kolbe-Alexander, T., Adlakha, D., Oyeyemi, A., Anokye, N. K., Goenka, S., Mogrovejo, P., & Salvo, D. (2020). Making the case for 'physical activity security': The 2020 WHO guidelines on physical activity and sedentary behaviour from a Global South perspective. *British Journal of Sports Medicine*, *54*(24), 1447–1448. https://doi.org/10.1136/bjsports-2020-103524

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

Meyer, J., McDowell, C., Lansing, J., Brower, C., Smith, L., Tully, M., & Herring, M. (2020). Changes in PA and sedentary behavior in response to COVID-19 and their associations with mental health in 3052 US Adults. *International Journal of Environmental Research and Public Health*, *17*(18), 6469. https://doi.org/10.3390/ijerph17186469

Nestpick. 2021. *Climate change city index | Nestpick*. accessed 24. September 2021. https://www.nestpick.com/2050-climate-change-city-index/

Orben, A. (2020). The Sisyphean cycle of technology panics. *Perspectives on Psychological Science*, *15*(5), 1143–1157. https://doi.org/10.1177/1745691620919372

Petrokofsky, C., & Davis, A. (2016). *Working together to promote active travel A briefing for local authorities*. Public Health England.

Reed, M. S. (2018). *The Research Impact Handbook, 2nd Edition*. Fast Track Impact.

Research England Knowledge exchange framework. (ukri.org). accessed 24. September 2021. https://re.ukri.org/knowledge-exchange/#:~:text=Knowledge%20exchange%201%20Funding%20support%20for%20knowledge%20exchange.,Knowledge%20Exchange%20Concordat.%20.%204%20In%20this%20section

Ritchie, S. (2020). *Science Fictions: Exposing fraud, bias, negligence and hype in science*. The Bodley Head.

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

Sallis, J. F., & Owen, N. (2015). Ecological models of health behavior. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior: Theory, research and practice (5th edn)* (pp. 43–64). Jossey-Bass.

Smith, A., & Noret, N. (2019). Studying the risks of exercise and its negative impacts. In S. Bird (Ed.), *Research methods in physical activity and health*. Routledge. pp.230–237.

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., Chastin, S. F. M., Altenburg, T. M., Chinapaw, M. J. M. (2017). Sedentary Behavior Research Network (SBRN) – terminology consensus project process and outcome. *Int J Behav Nutr and PA*, *14* (75). https://doi.org/10.1186/s12966-017-0525-8

Trott, M., Jackson, S. E., Firth, J., Jacob, L., Grabovac, I., Mistry, A., Stubbs, B., & Smith, L. (2021). A comparative meta-analysis of the prevalence of exercise addiction in adults with and without indicated eating disorders. *Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity*, *26*(1), 37–46. https://doi.org/10.1007/s40519-019-00842-1

UN - THE 17 GOALS | Sustainable Development (un.org). Accessed 24. September 2021. https://www.un.org/sustainabledevelopment/