

REVIEW ARTICLE

Somatic, psychological and economic benefits of regular physical activity beginning in childhood

Samuel A Fitzgerald,¹ Hugh T Fitzgerald,² Nicholas M Fitzgerald,³ Timothy R Fitzgerald⁴ and Dominic A Fitzgerald⁵

¹Student, Faculties of Law and Science, Macquarie University, ²Student, Exercise Physiology, Faculty of Medicine, University of NSW, ³Heart Centre for Children, ⁴Department of Respiratory Medicine, The Children's Hospital at Westmead and ⁵Asia Pacific Strategy and Transactions, Ernst & Young, Sydney, New South Wales, Australia

Physical activity is a natural part of a healthy life-style, which should be nurtured from early childhood. Regular physical activity mitigates against the global problems of overweight and obesity, hypertension, anxiety and depression. It lowers the morbidity and mortality from cardiovascular disease and provides hope for sustainable economics to support an ageing population into their retirement. This is preventative health economics that can be achieved with integrated support from families, communities, health-care professionals and governments at all levels. At present, children lack the support of those responsible for them at a societal level to adequately protect them from the physical and emotional consequences of reduced physical activity.

Key words: mental wellbeing; morbidity; mortality; obesity; physical activity.

While pre-schoolers are active, the desire to engage in regular physical activity often wanes through childhood and adolescence as reflected by declining participation in organised sport, increasing levels of overweight and obesity.¹ In the school years, the desire to participate reflects complex behaviours that encompass physical ability, opportunity, peer and adult support, individual motivation, perception of benefit and the competing distractions of electronic media.^{2–4} Physical activity practices are amenable to

change and sustainable if the behaviours are valued and the benefits perceived as important by individuals and their families.^{4,5} In 2020, the World Health Organization (WHO) published recommendations surrounding levels of physical activity and exercise to promote an active life-style and reduce the risk of developing preventable adverse health conditions.⁶ The WHO recommends that children and adolescents from the ages of 5 to 17 years should undertake a regular physical activity daily that is of a moderate to vigorous intensity. This exercise should predominantly be of an aerobic nature but include some form of resistance exercise 3 days per week that will serve to enhance bone and muscle strength. Arguably, these lifelong individual and societal benefits begin with sustained encouragement of physical activity in childhood.

Overweight, Obesity and Exercise

The WHO estimated that in 2016 over 1.9 billion adults were classified as being overweight, with approximately 650 million of these people being classified as obese (<https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>). Structured and repetitive exercise with a clear intent has numerous benefits to all body systems, resulting in lowering the likelihood of mortality and morbidity as you age.⁷ A lack of exercise and compromised psychological well-being are linked.^{1,8} Childhood obesity poses the risk of cementing negative behaviours resulting in poorer health with age.⁸ Physical activity and exercise should be maintained and encouraged from a young age to optimise motor skill development through infancy, childhood and adolescence. Mastery of the basic fine and gross motor skills can directly impact future adherence with general physical activity and uptake of recreational activities.⁹ Recurring, structured exercise

Key Points

- 1 Structured and repetitive exercise has numerous benefits to all body systems, resulting in lowering the likelihood of mortality and morbidity with increasing age.
- 2 Physical activity can be considered as an inexpensive, easily implemented and safe preventative and therapeutic intervention for clinically and non-clinically apparent mental health concerns on a community level.
- 3 Implementing the World Health Organization's 150 min of moderate intensity activity per week across the age range could equate to an increase in global gross domestic product of approximately 0.2% or around US\$400 billion per year.

Correspondence: Professor Dominic A Fitzgerald, Department of Respiratory Medicine, The Children's Hospital at Westmead, Locked Bag 4001, Westmead, Sydney, NSW 2145, Australia. Fax: +61 29845 3396; email: dominic.fitzgerald@health.nsw.gov.au

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has many cardiovascular benefits including but not limited to lowering resting blood pressure and heart rate, and increased aerobic capacity.¹⁰ However, exercise should be paired with an age appropriate, balanced and nutritious diet to achieve optimal results.¹¹ Purposeful exercise with a clear intent can increase skeletal muscle mass and reduce body fat mass percentage.¹²

Education around healthy life-style practises is provided in public health campaigns (e.g. 'Life be in it' in Australia in 1970s) and schools around the world to promote living a healthy life-style, emphasising national physical activity guidelines and teaching children to recognise what is included in a well-balanced diet.¹³ It is difficult to quantify the effectiveness of these measures with the challenges of the rising costs of fresh foods over processed food, the broad availability and relatively inexpensive cost of carbonated sugar-sweetened drinks, the rise of sedentary activities such as gaming with handheld devices and inter-generational consequences of social disadvantage.^{14,15} A frame-shift in prioritisation of preventative health measures in school curricula, financial incentives including government rebates to make participating in supervised organised sport for all children more affordable and public health campaigns limiting social screen time to a maximum of 2 h per day for school-aged children are needed.^{16,17}

Physical Activity, Mental Health and Cognition

There is a bidirectional relationship between physical activity and adolescent mental health.¹⁸ Mental health concerns in children are common, especially anxiety and depression. A mental health disorder was described in 14% of children aged 4–17 years in the 2013–2014 second National Survey of the Mental Health and Wellbeing of Australian Children.¹⁹ In 2016, parents of children in Australia aged 4–17 years accessed mental health services for their children commonly, 12% utilised health services, 1.2% school services and 0.6% telephone services.²⁰ Depression has been reported to affect 6.7% of young people aged 12–17 years.²¹ Exercise has been shown to be of benefit to children and adults with depression.^{22,23} Studies show physiological and biochemical changes with physical activity are associated with improved stress levels, feelings of anxiety, self-esteem and mood state.²⁴ Suggested benefits of physical activity include physiological (endorphins, mitochondrial metabolism, neurotransmitters), psychological (self-efficacy, distraction) and immune-mediated mechanisms (cytokines, brown vs. white adipocyte metabolism, toll-like receptors, vagal tone).²⁴

The impact of physical activity on mental health in children can be considered in terms of depression, anxiety, self-esteem and cognitive function.²⁵ A 2019 update of their 2011 systematic review of the benefits of physical activity for depression in young people found similar results to adults with the benefits ranging from no benefit to modest benefits.²⁶ The studies had small numbers, were mainly cross-sectional rather than longitudinal, of short duration (typically 3 months) and often studied young people with mild mental health problems or healthy subjects. Some anxiety reduction effects resulted from physical activity, including a small but statistically significant effect for yoga in two studies, to a moderate effect for young people with attention deficit

hyperactivity disorder and moderate to large effects for healthy young people.²⁵

The impact of physical activity on self-esteem is harder to characterise given the inherent ambiguity in its definition, but broadly includes aspects of physical and social self-perceptions.²⁵ The definition of physical activity included leisure-time physical activity, yoga, recreational dance and muscle strengthening exercise. It was unclear whether aspects of self-esteem were influenced by physical activity, reinforcing the view that young people with positive self-perceptions may choose to be more physically active.²⁵ However, one systematic review found a strong positive association for self-esteem with resistance training and weight training activities.²⁷

Cognitive outcomes with activity levels were assessed in a meta-analysis of children from pre-school age to late adolescence using the domains of cognitive functioning, academic achievement and brain structure and function.²⁵ The most comprehensive systematic review demonstrated that children aged 5–13 years with higher fitness showed better cognitive performance across longitudinal as well as cross-sectional studies.²⁸ However, the results were inconsistent; further study is needed to better describe the optimal type, amount, frequency and timing of physical activity. The findings for academic achievement were less certain and the effect sizes were smaller than for cognitive function tests. Animal studies have demonstrated that bouts of exercise bring about neurological changes through energy metabolism and synaptic plasticity in the hippocampus that have been linked to memory consolidation and skilled actions.²⁹ In the 2016 review by Donnelly *et al.*,²⁸ brain structure (neuronal architecture) and brain function through functional magnetic resonance imaging were assessed in relation to physical activity and aerobic fitness. Benefits were seen for brain structures that support executive functioning and memory and these were biologically plausible, raising the prospect of more, rather than less, physical activity being integrated into classroom learning time for primary school-aged children.

Physical activity can be considered as an inexpensive, easily implemented and safe preventative and therapeutic intervention for clinically and non-clinically apparent mental health concerns on a community level. On an individual level, physical activity may serve as an adjunct to cognitive behavioural therapy and pharmacotherapy in the management of more severe mental health problems in children.³⁰

Benefits of Physical Activity Throughout Life

Cardiovascular diseases (CVD), mediated through atherosclerosis, are the leading cause of global mortality.³¹ Atherosclerosis begins in childhood with reversible endothelial dysfunction.³² Time spent performing moderate to vigorous physical activity in young people is inversely associated with the risk of future CVD.³³ The consequences of overweight and obesity on the risk of later CVD, other morbidities including diabetes, arthritis, asthma, obstructive sleep apnoea and osteoporosis and reduced life expectancy are evident.³⁴ Being overweight or obese in childhood and adolescence contributes to premature mortality and physical morbidity in adulthood.³⁵

The optimal levels of activity during childhood and adolescence to minimise adult CVD are not clear.³³ Reductions in CVD rates through previous gains made in reducing smoking rates, more aggressive targets for controlling hypertension and physical activity in adulthood are being undermined by societal changes contributing to obesity beginning in childhood.^{36,37} Importantly, higher aerobic fitness is predictive of improved survival in otherwise healthy people.^{36,37} Increased physical activity can potentially alter the evolution of CVD, being associated with reduced systolic blood pressure and reduced early markers of atherosclerosis in obese pre-pubertal children.³⁸ Modifiable risk factors were reported in approximately 90% of people with their first myocardial infarction aged between 18 and 59 years in an American study.³⁹ Most common modifiable risk factors included hypertension, dyslipidaemia and smoking but, for women, obesity was also a modifiable risk factor. Hypertension is strongly linked to obesity. Total blood volume increases with increasing fat mass through central (renin-angiotensin and sympathetic systems) and peripheral (e.g. baroreceptors and autonomic dysregulation) mechanisms. This leads to a higher stroke volume, raised cardiac output, greater systemic vascular resistance, hypertension, increased left ventricular mass and left ventricular concentric hypertrophy.⁴⁰

Avoiding a sedentary life-style during adulthood prevents CVD independently of other risk factors, increases the total life expectancy and raises the CVD-free life expectancy for men and women.^{41,42} This effect is already seen at moderate levels of physical activity, and the benefits are doubled at higher activity levels.⁴¹ Patterns are established early in life such that a high level of physical activity at ages 9–18 years, especially when continuous, is predictive of a high level of adult physical activity. Thus, on a practical level, school-age physical activity appears to influence adult physical activity and through it the public health of the general population.⁴³

The Costs of Physical Inactivity

In high-income countries, the proportion of physically inactive members of the population has increased from 31.6 to 36.8% in the 15 years between 2001 and 2016.⁴⁴ Considering the global economic benefits of the WHO's 150 min of moderate intensity activity per week across the age range,⁶ it was estimated that this would equate to an increase in global gross domestic product (GDP) of approximately 0.2%, or around US\$400 billion per year, through a reduction in working age mortality and morbidity and increased productivity associated with less presenteeism and reduced absenteeism.⁴⁵

In Australia, 7% of health-care costs have been attributed to physical inactivity.⁴⁶ For enhanced physical activity throughout childhood to be successfully implemented as a national health policy to reduce disease, improve quality of life and prolong survival, regular exercise must be feasible, age-appropriate and safely supervised. Additionally, legislated physical activity recommendations need to be time-efficient, streamlined and cost-effective with limited financial resources. An Australian study from 2011 highlighted that feasible reductions in physical inactivity could provide cost savings of around AU\$258 million, with 37% of savings achieved in health.⁴⁶

Reducing physical inactivity enhances the economy across three tiers; Governments, businesses and individuals.⁴⁶ Improved physical activity expands the size and contribution of the workforce through lower mortality rates and increases individuals' productivity levels via reduced absenteeism related to sickness.⁴⁵ Internationally, the WHO estimates physical inactivity is costing \$54 billion (international dollars) in direct health-care costs, with an incremental \$14 billion ascribed to lost productivity.⁴⁷ It is estimated that 1–3% of health-care costs are directly attributed to physical inactivity.⁴⁷ As a proportion of GDP, Australia's spending on health has increased from 8.3% (AU\$91 billion) in 2000–2001 to 10% (AU\$185 billion) in 2017–2018 (<https://www.aihw.gov.au/reports/australias-health/health-expenditure>). Accounting for population growth, and adjusting for inflation, this translated to a cost of \$7485 per person in 2017–2018. At 2% of health-care expenditure, this would equate to an opportunity cost saving of AU\$3.7 billion annually. In 2017–2018, 40% was spent on hospitals and 34% of the total AU\$185 billion expenditure was incurred in primary health care (c.AU\$63 billion). In 2017, Australia ranked eighth among 38 OECD (Organisation for Economic Co-operation and Development) countries on health care spending to GDP ratio. By way of comparison, the USA spent 16.2% of GDP on health care, with the OECD median being 8.1%. Governments profit from increased savings in the form of reduced health-care costs, increased taxation from a resilient labour force and reduced need for welfare payments. Approximately two-thirds of health-care spending is funded by governments through tax receipts. Businesses are aided by reduced absenteeism and lower recruitment, training and on-boarding costs from happier and healthier employees. Individuals benefit from an enhanced quality of life and greater earning potential from the ability to sustain a longer working career. From increasing activity across each tier of the economy, significant economic benefits can be achieved at a headline GDP level; it is estimated that incremental global GDP growth of 0.15–0.24% year on year could be achieved over a 30-year period (2020–2050) with a more physically active population.⁴⁵

Legislator collaboration across sectors has the potential to generate meaningful returns by implementing policies supporting physical activity, aiding individuals' health, the local economy, community wellbeing and environmental sustainability.⁴⁴ Further thought into the cost savings from legislative collaboration must be considered when implementing educational campaigns and disease prevention initiatives.⁴⁶ Policymakers must be encouraged to promote policies at the population level, targeted at achieving not just better health outcomes but improved economic benefits from the related and resulting productivity and prosperity gains.⁴⁵ Initiatives can be more effective when health agencies partner with other organisations, construct public communication with simple messaging and integrate intergeneration benefits through urban planning and supportive infrastructure (e.g. cycle paths, green space for play and exercise).^{48,49} The cost of implementing national school-oriented programmes was modelled in the USA with a six-pronged approach that incorporated active physical education, active recess, active school day, healthy afterschool, new afterschool programmes and staff training programmes which were estimated to cost US\$54 per child per year.⁵ The most cost-effective part of the programme was the new afterschool programme involving 2 h of supervised sessions

daily, physical activity (80 min), academic enrichment, homework assistance and a nutritious snack at no cost to the families. This alone was projected to prevent more than 109 000 cases of obesity in the USA over 10 years and be cost saving at US\$4.6 billion (range –US\$5.6 to –US\$1.5 billion), largely through more efficient use of labour (greater child to caregiver ratios) in the afterschool setting.

Ultimately, the importance with an ageing population is to maintain physical wellbeing for as long as possible to prolong effective employment to benefit the individual and delay the need for pensions until an increasingly older retirement age.⁵⁰ This strategy must include optimising physical activity from childhood.

Conclusion

The importance of encouraging physical activity in all children should be a priority of all people responsible for the care and wellbeing of children and young people including parents, school teachers, clinicians, health-care officials and governments. Physical inactivity is the health equivalent of global warming on the environment: so just get on and do something more meaningful about it now.

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Altogether by Class 2P, Glendore Public School (age 7) from Operation Art 2021