Institution: University of Strathclyde		
Unit of Assessment: A3 Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: Global and national guidelines for prevention of obesity through early-life physical activity		
Period when the underpinning research was undertaken: 2013 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
John Reilly	Professor	05/01/2011 – present
Xanne Janssen	Senior Lecturer	20/01/2014 – present
Adrienne Hughes	Lecturer	01/12/2012 – present
Period when the claimed impact occurred: 2014 – December 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Since 2014, Strathclyde's research and expertise around physical activity in early life has directly informed the development of new guidelines and implementation plans globally (WHO) and nationally (Canada, Australia, South Africa, USA, UK). By providing clear and accessible guidance to enable health professionals and primary caregivers to reduce screen time and increase physical activity in the under 5s, the research has strengthened campaigns to lower child obesity rates in order to improve cognitive development and academic attainment as well as prevent associated diseases in later life. Ensuring a new emphasis on the cognitive and educational benefits of obesity prevention and physical activity promotion for young children, this work has shifted public health messaging globally and laid the foundations for transformative behavioural change.

2. Underpinning research

Conservative global estimates from UNICEF/WHO/World Bank in 2019 put the prevalence of obesity in the under 5s at 6%, equivalent to more than 38,000,000 children globally, with around 88% in Low-and-Middle-Income-Countries (LMICs); more than 124,000,000 school-age children and adolescents were obese globally in 2016. Moreover, more than 250,000,000 pre-school children in LMICs were failing to meet their cognitive potential in 2017.

Seeking to advance understanding of the connections between physical activity levels, obesity rates, and cognitive/educational attainment, from 2013 Strathclyde researchers led a series of studies examining physical activity changes through the course of life. With previous studies being highly inconclusive, particular attention was paid to the non-health effects of obesity and physical activity in order to:

- Identify when physical activity declines, to test the widespread assumption amongst researchers, policymakers and practitioners that things 'go wrong' at adolescence, not before;
- Determine the amounts of physical activity/sedentary behaviour which should be recommended for optimal health and development;
- Determine whether low physical activity causes obesity and if intensity alters risk - though seemingly obvious this was not well established; and
- Assess the extent to which low physical activity and/or obesity impair non-health outcomes in childhood, specifically educational attainment.

The researchers' approach was to conduct studies within the Avon Longitudinal Study of Parents and Children (ALSPAC; in collaboration with the University of Bristol and many other institutions including the University of Georgia) [**R1**, **R2**] and the Gateshead Millennium Study, in collaboration

with the University of Newcastle [R3, R4]. These studies afforded the unique strengths of longitudinal design; high-quality, objective measures of physical activity; large and broadly representative samples; measurement of confounders; and testing whether changes in physical activity with age altered health outcomes (obesity) and non-health outcomes (educational attainment, cognition).

These longitudinal studies were supplemented by meta-analyses (including the effects of screen time and physical activity on sleep, and timing of the decline in physical activity). The key findings, which ultimately led the team into guideline development work, were:

- Physical activity declines steadily across childhood and adolescence [R3, R5] and impairs sleep, which increases obesity risk and reduces educational attainment [R6];
- Low childhood physical activity (specifically moderate–vigorous intensity physical activity) [R4] is a major driver of the obesity pandemic; and
- Low physical activity (specifically low moderate-to-vigorous intensity physical activity) [R1] and obesity [R2] impair educational attainment substantially.

3. References to the research (Strathclyde-affiliated authors in **bold**; FWCI at 02/02/21)

R1 **J.N. Booth**, S.D. Leary, C. Joinson, A.R. Ness, P.D. Tomporowski, **J.M. Boyle**, **J.J. Reilly,** (2014) Associations between objectively measured physical activity and academic attainment in adolescents from a UK cohort: Avon Longitudinal Study of Parents and Children (ALSPAC), *British Journal of Sports Medicine*, 48: 265–270 http://dx.doi.org/10.1136/bjsports-2013-092334 [FWCI: 5.56; REF2]

R2 J.N. Booth, P.D. Tomporowski, J.M.E. Boyle, A.R. Ness, C. Joinson, S.D. Leary, **J.J. Reilly** (2014), Obesity impairs academic attainment in adolescence: findings from ALSPAC, a UK cohort, *International Journal of Obesity*, 38: 1335–1342. https://dx.doi.org/10.1038%2Fijo.2014.40 [FWCI: 1.5; REF2]

R3 **M.A. Farooq**, K.N. Parkinson, A.J. Adamson, M.S. Pearce, J.K. Reilly, **A.R. Hughes**, **X. Janssen**, L. Basterfield, **J.J. Reilly** (2018), Timing of the decline in physical activity in childhood and adolescence: Gateshead Millennium Cohort Study, *British Journal of Sports Medicine*, 52(15): 1002–1006 https://doi.org/10.1136/bjsports-2016-096933 [FWCI: 20.6; REF2]

R4 **X. Janssen**, L. Basterfield, K.N. Parkinson, M.S. Pearce, J.K. Reilly, A.J. Adamson, **J.J. Reilly** (2019), Non-linear associations between moderate-to-vigorous physical activity and adiposity across the adiposity distribution during childhood and adolescence: Gateshead Millennium Study, *International Journal of Obesity*, 43(4): 744–750. https://dx.doi.org/10.1038%2Fs41366-018-0188-9 [FWCI: 1.32]

R5 M.A. Farooq, A, Martin**, X. Janssen**, M.G. Wilson, A.M. Gibson, **A.R. Hughes, J.J. Reilly** (2020) Longitudinal changes in moderate-to-vigorous intensity physical activity in children and adolescents: a systematic review and meta-analysis, *Obesity Reviews*, 21(1): e12953. https://doi.org/10.1111/obr.12953 [FWCI: 9.43; REF2]

R6 **X. Janssen**, A. Martin**, A.R. Hughes**, C.M. Hill, G. Kotronoulas, K.R. Hesketh (2020), Associations of screen time, sedentary time and physical activity with sleep in the under 5s: systematic review and meta-analysis*, Sleep Medicine Reviews*, 49: 101226 https://doi.org/10.1016/j.smrv.2019.101226 [FWCI: 4.23; REF2]

Notes on the quality of research: All outputs are published in peer-reviewed journals and are highly cited articles. The research was supported with 6 competitively awarded UK and international grants totalling approximately GBP447,000. Key funders are: the World Health Organisation (WHO) (e.g. Reilly et al., *Review of infant and young child feeding practices to prevent overweight and obesity and other risk factors for NCDs in children and adolescents*, 2014–2016, GBP19,250); Canadian Institutes for Health Research; BUPA Foundation (Reilly et al.,

Paradigm shift in use of physical activity in treatment and prevention of disease: associations between objectively measured physical activity and cognition in 11–13 year olds in ALSPAC, 01/09/2011-30/11/2012, GBP78,150); and the Scottish Government Chief Scientist Office (Reilly et al., *Excessive sitting, in prolonged bouts, in children and adolescents: developing a sound evidence base for future interventions*, 01/01/2014–30/09/2015, GBP220,992).

4. Details of the impact

Strathclyde's research and expertise, channelled through numerous guideline and strategy development groups, has reshaped national and global guidelines on obesity and physical activity to include early childhood. Placing a new emphasis on the cognitive and educational benefits of obesity prevention and physical activity promotion for young children, this has shifted public health messaging globally and laid the foundations for transformative behavioural change. As well as influencing World Health Organisation (WHO) strategy and guidance between 2014 and 2020, Professor Reilly and his team directly informed the *US Physical Activity Guidelines* (2018) and the *Canadian Society for Exercise Physiology Guidelines* (2017) which were subsequently translated into international guidelines for New Zealand (2018), Australia (2018), South Africa (2018) and the UK (2019).

1. Informing WHO strategy and guidance on childhood obesity (2014–2017)

Seeking to drive global action to tackle rising obesity rates, the WHO Director-General established a Commission on Ending Childhood Obesity (ECHO) in 2014 to determine the most effective approaches and interventions. 2 ad hoc working groups were formed to support the Commission, 1of which focused on Science and Evidence. As a recognised expert in birth to age 5 aetiology and prevention, Reilly was asked to join this group (comprising 21 global experts) and through his involvement between 2014 and 2016 [**S1**] drew attention to Strathclyde's cohort study findings [**R1**,**R2**] which shaped the focus and recommendations of the final *Report of the Commission on ending childhood obesity* published in 2016 [**S2**]. This report recognised infancy and early childhood as one of three critical time periods in the life-course and drew attention to the key insight, notably absent in previous guidance documents, that obesity in childhood can *'reduce educational attainment'* [**S2** p.7]. The report was translated into an implementation plan with six priority areas, including early childhood diet and physical activity, which has driven global action by governments and other partners since 2017 [**S3**]. Examples of global and national policy and guidance stemming from this are outlined below.

2. Shaping global guidance on early childhood physical activity (2017-2019)

Building on his work with ECHO, Reilly contributed his technical expertise to the WHO Guideline Development Group (GDG) which produced the first global Guidelines on physical activity, sedentary behaviour, and sleep for children under 5 years of age. This group comprised 16 global experts and Reilly, as the only UK representative, provided expertise in physical activity and sedentary behaviour [**S4**, membership confirmed on pp.vi,14,21]. The GDG met in November 2017 to determine the critical questions and outcomes to be assessed and in April 2018 to review evidence, drawing on members expertise to inform discussion [**S4** p.vii]. Published in April 2019 and targeted at a broad range of policy makers, these guidelines provided detailed recommendations to support the development of *'national plans to increase physical activity, reduce sedentary time and improve time spent sleeping in young children though guidance documents and define critical elements of childcare services and pre-service training for health care and early childhood development professionals'* [**S4** p.vii]. As noted in the document, this guidance *'fills a gap in the WHO recommendations on physical activity, as children under 5 years of age were not included in the Global recommendations on physical activity for health in 2010 and will also contribute to the implementation of the recommendations of the Commission on Ending Childhood Obesity and the Global Action Plan on Physical Activity 2018–2030'* as well as

'the broader Nurturing care for early childhood development framework' [**S4** p.vii]. The guidelines received significant media attention (Altmetric score 999) and were downloaded 144,803 times between April 2019 and 2020 [**S4**]. Further resources to encourage their global implementation have also been developed, including the *WHO Global Standards for Healthy Eating, Physical Activity, Sedentary Behaviour, and Sleep in Early Childhood Education and Care (ECEC) Settings*; (originally scheduled for release in April 2020, but delayed to 2021 due to the COVID-19 pandemic). These Standards describe how early learning and childcare settings should operate (pedagogy, environment, facilities such as 'loose parts' for play, space, outdoor time, opportunities for free play) in order to help the under 5s meet the 2019 guidelines. In doing so they explicitly link meeting the standards with health and educational/cognitive developmental benefits as outlined in the guidelines on the basis of Reilly's research. The document also supports providers to check if they were operating in ways which meet the standards and details how this will be monitored.

3. Driving the development of national guidelines on physical activity (2017–2019)

3.1 US Physical Activity Guidelines (2018)

Reilly's involvement in the Cold Spring Harbor Symposium on Exercise Science and Health in 2015 informed the *US Physical Activity Guidelines* (2018), which were promoted via a USD4,200,000 (01-2018) US government social marketing campaign called 'Move Your Way' (#MYW https://health.gov/moveyourway/), targeted at families, health professionals and adult physical activity 'contemplators'. Comprising 18 experts on the effect of physical activity on health across the lifespan, with Reilly being the only international contributor, the group scoped out the scientific evidence to be reviewed for the guidelines and considered novel approaches to ensure effective implementation [**S5**]. More specifically, Reilly provided expertise on the influence of physical activity on cognition and educational attainment in children and adolescents, and advised on how this could be used to leverage adoption [**S5**]. The value of his contribution is confirmed by the Symposium chair who notes: *'Prof Reilly's participation . . . encouraged us to include cognitive/educational outcomes in the evidence review which was the basis of the 2018 Guidelines. His participation also helped inform the approach taken to achieving guideline impact in the US: Move Your Way has used online materials to disseminate the message that higher levels of physical activity are good for school grades. These materials have been used across the US in schools, homes, healthcare facilities, and communities'* [**S5**].

The campaign, winning multiple awards such as the US Digital Health Awards Gold Award 2019 for evidence-based, clear and effective public health messaging, successfully encouraged health professionals and families to use its factsheets, videos and interactive tools. To the end of February 2020 there were: over 1,700,000 completed views of the campaign's videos, #MYW reached over 50,000,000 individuals, and over 26,000,000 impressions from customised social media ads (Facebook, YouTube, Instagram).

3.2 Canadian Society for Exercise Physiology early years movement guidelines (2017)

Reilly and Janssen joined the Canadian Society for Exercise Physiology Guideline Development group in 2016 and played a key role in the production of *Canadian 24-hour movement guidelines for the Early Years (0-4)* which provide the first evidence-based guidance on the optimal amount of physical activity, sedentary behaviour, and sleep for babies, toddlers, and pre-schoolers. The group brought together 25 international experts and, as the only UK representatives, Reilly and Janssen contributed subject expertise in physical activity, sedentary behaviour and evidence based medicine. Since their launch in November 2017, the guidelines have been widely promoted across Canada, with the Canadian Minister of Health recommending them as *'an important tool to help parents and healthcare professionals support healthy growth and development for Canadian children'* [**S6**]. Receiving global recognition, the guidelines subsequently informed the

development of comparable national guidelines in the UK, South Africa, New Zealand and Australia.

3.3 UK physical activity guidelines (September 2019)

In 2019, Reilly served as a member of the UK Chief Medical Officers (CMOs) Guidelines Writing Group and chaired the Expert Working Group on Under 5s (comprising 7 other experts including Hughes and Janssen) to produce the first evidence-based physical activity guidelines for under 5s in the UK. Comprising 10 members, this working group had a strong Strathclyde presence, with Janssen and Hughes contributing their expertise alongside Reilly [**S7**, input acknowledged on pp.5,51,55,56,62,64]. These were incorporated into the *UK Chief Medical Officers' Physical Activity Guidelines* (published in September 2019 as an update to the more limited 2011 guidance) with the intention of them being *'a catalyst for change in our attitudes to physical activity'* [**S7** p.4]. Though wide-spread adoption across the UK has been hindered by the COVID-19 pandemic, a dissemination and implementation plan is under development by the 4 UK Health Departments to ensure it reaches the intended beneficiaries, namely: 3,750,000 under 5s (and their families) and 586,000 health professionals (including groups in primary care most likely to use the guidelines i.e. over 42,000 GPs, over 17,000 practice nurses, over 3,000 school nurses, plus over 3,000 consultant paediatricians).

3.4 South Africa, Australia, New Zealand early years guidelines (2017-2018)

Reilly also contributed to the South African Guideline Development Group which, in collaboration with the Laureus Sport for Good Foundation South Africa, published the country's first 24-hour Movement Guidelines for Birth to Five Years in December 2018 [**S8**]. These were the first movement guidelines to be issued by a low- to middle-income country. In addition, Reilly and Janssen's work on the Canadian guidelines led to establishment of similar guidelines in Australia [**S9**] and New Zealand [**S10**] in 2017. The *Australian Guidelines for the Early Years* are among the most accessed on the Department of Health website (downloaded over 15,000 times) and have been integrated into training materials for Australia's National Quality Standards and the Australian Curriculum.

5. Sources to corroborate the impact

S1 WHO Working Group on Science and Evidence member biographies, confirming Reilly's involvement as an expert in childhood and adolescent obesity.

S2 WHO (2016) Report of the Commission on Ending Childhood Obesity.

S3 WHO (2017) Report of the Commission on Ending Childhood Obesity Implementation Plan.

S4 WHO (2019) Guidelines on physical activity, sedentary behaviour and sleep for children under 5 Years of Age, with report download figures from WHO website (accessed 6 December 2020).

S5 Factual statement from Chair of Cold Spring Harbor Symposium and Physical Activity Guidelines for Americans, dated 28 October 2019.

S6 **a.** Canadian Society for Exercise Physiology (2017) Canadian 24-Hour Movement Guidelines for the Early Year (0-4 years); **b.** ParticipACTION press release, 'Too much screen time prevents young tots from meeting healthy movement guidelines' 20 November 2017.

S7 UK Government (2019) UK Chief Medical Officers' Physical Activity Guidelines.

S8 Laureus Sport for Good Foundation South Africa, 'Moving, playing, sleeping: starting early with healthy habits', 4 December 2018 (includes a copy of the guidelines).

S9 Australian Department of Health (2017) Australian 24-Hour Movement Guidelines for the Early Years (Birth to 5 years).

S10 New Zealand Ministry of Health (2017) Sit Less, Move More, Sleep Well: Active play guidelines for under-fives.