Perspectives in Public Health

Special issue: Physical activity: wider influences and novel approaches to promotion

- Working with local people as part of a whole-systems approach to physical activity
- To HIIT or not to HIIT? The question pregnant women may be searching for online
- Comparisons of physical activity and sedentary behavior between owners and non-owners of commercial wearable devices
- Is children's health-related quality of life associated with physical fitness and mode of commuting?

A journal of the Royal Society for Public Health

March 2021 Vol 141 No 2

http://pph.sagepub.com

RSPH
ROYAL SOCIETY FOR PUBLIC HEALTH
VISION, VOICE AND PRACTICE

EDITORIAL

Physical activity: wider influences and approaches for promotion

Matt Hobbs
Joint Deputy Editor

Physical activity is not just exercise, it is any bodily movement produced by skeletal muscles that produce energy.[1] The concept that physical activity is beneficial for health and wellbeing is not new. Ancient physicians believed that regular physical activity, or what they termed exercise, led to enhanced health.[2] Susruta in 600 BCE (Before Common Era) was one of the first recorded physicians to prescribe exercise for his patients[3,4] indicating that it should be 'taken' every day, although too much strenuous physical activity could potentially lead to death.[5] Herodicus (500 BCE), a teacher of Hippocrates, also emphasised the therapeutic effects of exercise and Hippocrates was then the first physician to provide a written exercise prescription, a detailed written prescription of walking, for a patient suffering from consumption.[6] Interestingly, he also believed idleness or as we now know physical inactivity, as well as excessive exercise, could lead to disease and death.[2] Later, Galen and others also believed physical activity was positive and that training to strengthen muscles helped achieve good physical condition.[7,8]

The interconnections between health and health behaviours such as physical activity and wider influences such as environmental determinants are also not new; actually they were also strongly marked in ancient medicine.[9] In the 5th Century BC Hippocrates highlighted the seasons and localities of towns, for instance, low or high in altitude and warm or wet in climate, and the subsequent diseases they produced.[9,10] More recently, in the 19th century, environmental changes around sanitation and hygiene were identified as important wider factors of improving public health. Other pioneers recognised the link between the environment and health. Ebenezer Howard, founder of the garden city movement, published *Garden Cities of Tomorrow* where people lived harmoniously together with nature.[11] Fast forward to the present day and the Town and Country Planning Association (TCPA) draw upon some of the principles of a garden city now articulated for a 21st century context,[12] and other principles around designing healthy places and reuniting planning with health.[13,14] What is clear is that physical activity has long been identified as an important behaviour for health. Moreover, these behaviours and health outcomes are also linked to wider influences, for instance, within our environment that surrounds us.

2020 was not an easy year for many of us, with so many competing demands and many of us adapting to our 'new normal'. Consequently, we owe a big thanks to Prof. Jim McKenna, a Professor of Physical Activity and Health and Director of the Active Lifestyles Research Centre, for guest editing this themed issue of *Perspectives in Public Health* which contains a contemporary focus on some encouraging research on the wider influences of physical activity and novel approaches for promotion.

References

1. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep* 1985;**100**(2):126–31.
2. Tipton CM. The history of 'exercise is medicine' in ancient civilizations. *Adv Physiol Educ* 2014;**38**(2):109–17.
3. Susruta A. Susruta Samhita. *Uttar Tantra* 2008;**56**(6):413.
4. Tipton CM. Susruta of India, an unrecognized contributor to the history of exercise physiology. *J Appl Physiol* 2008;**104**:1553–6.
5. Ray P, Gupta HN, Roy M. *Susruta Samhita: a scientific synopsis*. New Delhi: Indian National Science Academy; 1980.
6. Chadwick J, Mann WN. *The medical works of Hippocrates*. Oxford: Blackwell Scientific Publications; 1950.
7. Galen. *Galen's hygiene (De Sanitate Tuenda)*. Springfield, IL: Charles C. Thomas; 1951.
8. Singer P. *Galen: selected works*. Oxford: Oxford University Press; 1997.
9. Berridge V, Gorsky M. Introduction: environment, health and history. In: Berridge V, Gorsky M (eds) *Environment, health and history*. London: Palgrave Macmillan; 2012, pp. 1–22.
10. Hippocrates. *Hippocrates on airs, waters, and places*. London: Wyman & Sons; 1881.
11. Howard E. *Garden cities of tomorrow*. London: Sonnenschein & Co., Ltd.; 1902.
12. Town and Country Planning Association (TCPA). *Garden cities and new towns*. London: TCPA; 2020 Available online at: https://www.tcpa.org.uk/pages/category/garden-cities-and-new-towns
13. Town and Country Planning Association. *Planning healthy weight environments – a TCPA reuniting health with planning project*. London: Public Health England; 2014.
14. Town and Country Planning Association. *Building the foundations – tackling obesity through planning and development*. London: Public Health England; 2016.

Guest editorial

Jim McKenna
Carnegie Professor of Physical Activity and Health and Head of the Active Lifestyles Research Centre in the Carnegie Faculty

A warm welcome to this Special Issue. Seen as a snapshot, it reflects key features in the current state of play in physical activity research. It also reflects the 'who' of the coming generation of exciting researchers, alongside some familiar names. Looking across the titles, the orbit of physical activity research is changing; it is decentring to position itself within wider systems. The topics covered within this issue also highlight recent developments, novel perspectives and existing knowledge gaps.

Given that I live in England, I am especially heartened to see that two of the 'systems' contributions (plus a number of others) are located near me. They are building on the international experience of the US, Canada and Australia to drive a second wave of 'whole systems' (WS) work. I am optimistic that these authors will put flesh-on-the-bones of how to implement WS. Paradoxically, even ideas as compelling as WS need a place to start – by offering tangible actions and pathways – before they can secure widespread change; the acronym of SAGE may help (Start Anywhere, Go Everywhere). Indeed, I am more than impressed by the range of implementation-oriented papers featured here. For too long, implementation has been overlooked as physical activity was seeking to establish itself as a serious scientific subject. Now, implementation is the new game in town.

Given the timing of these papers – prepared and delivered through the COVID-19 pandemic – it will be interesting to see how post-COVID and the 'next new' affects how well our work serves society. I hope these authors, and others, will take on the immense responsibility – perhaps even, obligation – to relate how this once-in-a-lifetime event informs future ways of working. There will be deep wells of interest in how physical activity can contribute to post-COVID recovery, and the content of this Special Issue serves as manifesto for how physical activity researchers can contribute to that work.

At the same time, the field, and this Special Issue with it, is continuing to address methodological issues. Collectively, this proposes that the field is strengthening with every iteration. Crucially, it is addressing the issues of those groups who are at the least well served end of the social divide. To connect to that issue, it makes me think that WS work, for instance, might be helpfully reframed as 'whole society' approaches.

I am also seeing names of authors from agencies that haven't conventionally seen either academic publishing or physical activity as home ground. The benefits of having diverse authors and topics seem obvious, especially regarding diversity of ideas and viewpoints. Perhaps, the biggest of the associated challenges is an enduring one. Newcomers might easily overlook it; distinguishing what constitutes physical activity (as opposed to exercise and/or sport). Evidence from contemporary community surveys – in the UK, and this profoundly affects the WS approaches reported here – still shows the power of the respective frames of 'sport' and 'exercise'. I am reminded of my old PE lecturer telling me, 'No amount of sport will convert people who hate sport'.

My final point relates to the style of the papers. Maybe like me, readers find it progressively harder to carve out blocks of time to read an array of 2000-word papers? If so, I heartily recommend the shorter articles which this journal presents – alongside longer peer-review pieces – and the courage of the authors for trying something new in their promotion of physical activity.

Towards a common purpose: a theoretical model for a whole system approach to physical activity developed in South Tees

DANKS, Kara, SHEARN, Katie <http://orcid.org/0000-0001-7209-8404>, DALKIN, Sonia, FITZGERALD, Mal and BROOM, David R

Towards a common purpose: a theoretical model for a whole system approach to physical activity developed in South Tees

Introduction

Sport England have commissioned 12 Local Delivery Pilots (LDPs) across England (1) that apply a Whole Systems Approach (WSA) to tackling physical inactivity in communities. This paper details the approach taken in the South Tees LDP, 'You've Got This', spanning the local authority areas of Redcar and Cleveland and Middlesbrough. 'You've Got This' have created a partnership beyond traditional physical activity organisations and sport providers, actively engaging with the local voluntary sector, charities, healthcare and housing providers, commissioners, and private sector businesses (2).

The LDP focuses on four 'communities of interest' across South Tees: 1) people waiting for specific types of surgery (prehabilitation), 2) people with or at risk of developing Type 2 Diabetes, 3) people accessing commercial weight loss services and 4) health professionals to utilise physical activity as a clinical pathway. Concurrently, a whole community approach is taken to increasing physical activity in four of the most deprived wards across the area with stubborn health inequalities being 1) Grangetown, 2) Southbank, 3) Brambles and Thorntree, and 4) North Ormesby.

The Common Purpose Model

Whole systems change is overwhelmingly complex. The LDPs reflections on system change have focussed on the ever-changing interconnections between different people in different roles and places. They perceive system change to emerge from people working to achieve a 'common purpose' of 'active lives as a way of life' which is the vision of 'You've Got This'.

The Common Purpose Model was co-developed between the LDP core team and the academic process evaluation team to support learning as part of the ongoing realist process evaluation (3-4). The model illustrates an early understanding of the emergence of common purpose, via a combination of actions and activities driven by the LDP and partners and the cultural and structural influences of change. The Common Purpose Model provides a framework to guide working practices and learning.

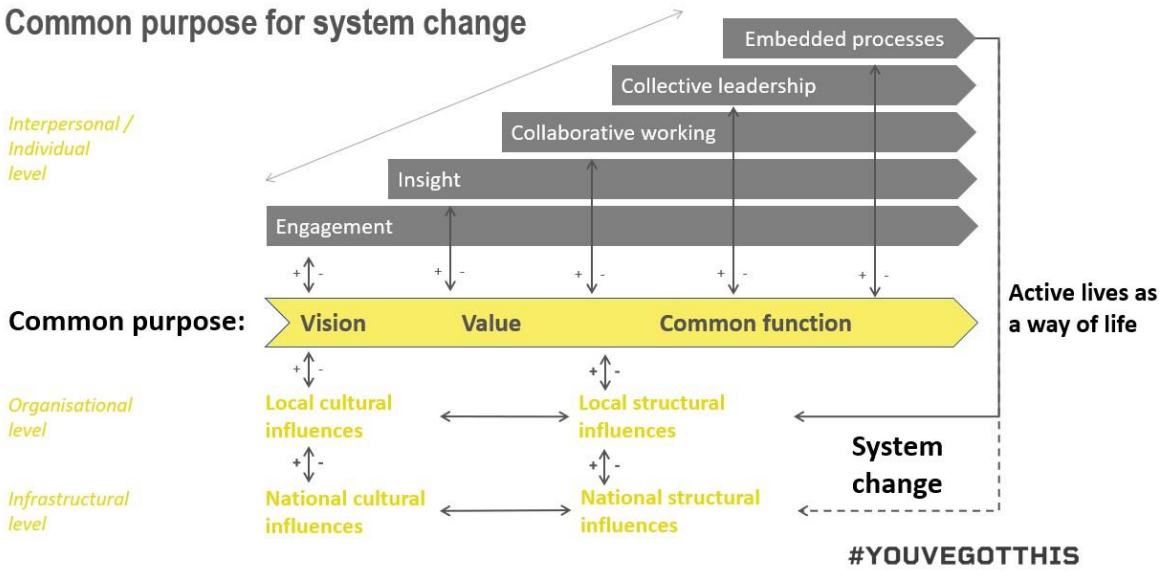

Figure 1: Common Purpose Model for system change.

The model illustrates three key elements which are argued to sustain a common purpose: Vision + Value + Collective function = Common purpose as detailed below:

- Subscribe to the **vision**: 'active lives as a way of life'.
- **Value** that vision. In this case to perceive it has worth relative to their personal or professional objectives.
- Perform a **collective function(s)**. That is, to act in line with the vision that produces a result of some kind.

These elements are shown in the model as flowing from one to another - in line with the ways in which we are seeing system change emerge. It should be recognised, however, that in reality there are feedback loops and the process is nonlinear (5). Furthermore, it is feasible that people can act in line with the vision without consciously subscribing to it.

The LDP activities have primarily been aimed at influencing and/or connecting a wide range of people to engage with the vision, see its value and then act in line with it. Most of these activities described below operate at an individual or interpersonal level. People occupy many different roles within the system including senior leadership, policy makers, management, frontline workers across different specialisms and sectors as well as with individuals in the target wards.

These core activities are defined as follows:

- **Engagement:** Activities which are intended to start a relationship of some kind.
- **Insight:** Activities which are intended to gain a deep understanding of (and empathy towards) someone else's situation. The LDP are utilising behaviour change frameworks, including the influencer model (6), to understand the lives of the people in the target wards as well as stakeholders working or influencing those people.
- **Collaborative working:** Activities which bring skills, expertise, networks together on a project. This includes collaboration internally, as well as collaboration between partners brokered by the LDP.
- **Collective leadership:** Activities or actions where people are working together towards the same vision. This may differ from collaborative working in terms of the higher level of commitment, trust, shared power, shared responsibility for achieving the aim, shared accountability and shared successes.

- **Embedded processes:** Activities or actions which formalise the new ways of working so that they can remain active beyond the individuals and relationships in the LDP and create a legacy.

Individual behaviour and interpersonal relations are influenced by an individuals' skills, history of working together, characteristics and demography. The final element of the model are the external influences that facilitate or constrain progress, separated into cultural influences and structural influences (7):

- **Cultural influences** are the ideas, beliefs and values that operate in the target wards and the organisations. Where these ideas align with the vision and ways of working, it is perceived to be easier to work towards a common purpose. Where they do not, more insight and engagement work is undertaken to attain alignment of sorts.
- **Structural influences** are the processes, practices, hierarchies and roles which exist within and between different parts of the system and constrain choices in some way. Where these structures align with the new ways of working, it is perceived to be easier to work towards a common purpose. Where they do not, more collaborative and collective work is undertaken to change the structures to attain alignment of sorts.

In some instances, local cultural and structural influences are constrained by national cultural and structural influences, for example, national policy, legal, financial and accountability frameworks.

The Common Purpose Model in action

The Common Purpose Model has been utilised in several different ways to support developing understanding and learning. This includes engaging partners as a visual aid or reference point. It has been used directly with health professionals to identify the elements that may be associated with embedding physical activity in GP surgeries.

Conclusion

The Common Purpose Model has been utilised in South Tees as a tool to guide working practices and learning, it is a framework to support stakeholders to manage complexity when promoting 'You've Got This' vision 'active lives as a way of life'.

Reference list

(1) Sport England Transforming the delivery of physical activity locally. Available from: https://www.sportengland.org/news/transforming-the-delivery-of-physical-activity-locally. [Accessed 9 September 2020].

(2) You've Got This website. Available from: youvegotthis.org.uk [Accessed 11 September 2020].

(3) Westhorp G, Stevens K, Rogers PJ. Using realist action research for service redesign. Evaluation. 2016 Jul;22(3):361-79.

(4) Pawson R, Tilley N, Tilley N. Realistic evaluation. London: Sage; 1997.

(5) Byrne, D, Callaghan, G. Complexity Theory and the Social Sciences. London: Routledge; 2014.

(6) Patterson K, Grenny J, Maxfield D, McMillan R, Switzler A. Influencer: The Power to Change Anything. New York: McGraw-Hill; 2008.

(7) De Souza DE. Elaborating the Context-Mechanism-Outcome configuration (CMOc) in realist evaluation: A critical realist perspective. Evaluation. 2013 Apr;19(2):141-54.

Working with Local People as Part of a Whole-systems Approach to Physical Activity: Reflections from Local Delivery Pilots

POTTS, Alexandra, SHEARN, Katie <http://orcid.org/0000-0001-7209-8404>, FRITH, Gabriella <http://orcid.org/0000-0002-2327-2602> and CHRISTY, Elizabeth <http://orcid.org/0000-0003-2738-8976>

Published version

POTTS, Alexandra, SHEARN, Katie, FRITH, Gabriella and CHRISTY, Elizabeth (2021). Working with Local People as Part of a Whole-systems Approach to Physical Activity: Reflections from Local Delivery Pilots. Perspectives in Public Health, 141 (2), 74-75.

Working with Local People as Part of a Whole-systems Approach to Physical Activity: Reflections from Local Delivery Pilots

Alexandra Potts[1], Katie Shearn[2], Gabriella Frith[2], and Elizabeth Christy[2]

[1]Institute for Sport, Physical Activity, and Leisure, Leeds Beckett University, Leeds, United Kingdom

[2] College of Health, Wellbeing and Life Sciences, Sheffield Hallam University, Sheffield, United Kingdom

Author Note

Correspondence concerning this article should be addressed to Alexandra Potts; Institute for Sport, Physical Activity, and Leisure; Leeds Beckett University; Leeds; LS6 3QS; United Kingdom. Telephone: +4411-3812-2394. E-mail: A.Potts@leedsbeckett.ac.uk

Word count: 984

Introduction

Over 11 million people in the United Kingdom are physically inactive; engaging in less than 30 minutes of physical activity (PA) per week, despite overwhelming physical and mental health benefits of regular PA[1]. Furthermore, those from lower socio-economic backgrounds, ethnically diverse communities (e.g., Black, Asian), and those with a disability or long-term health condition are less likely to engage in PA[1]. Raising PA levels and gaining equity amongst these groups represents a major challenge for public health policy and practice both in the UK and globally[2]. Sport England have recognised that to tackle inactivity we must understand that individuals "do not live in a vacuum" and changes are be needed across policy, infrastructure, culture and communities[3]. They invested in 12 Local Delivery Pilots (LDPs) to "use local identities and structures to deliver sustainable increases in activity levels across the country"[3]. This has been described by some LDPs as a whole of systems (WSA) approach.

A WSA "considers an entire system as a whole, from multiple perspectives to understand how its parts can work together to create synergies and solve multiple design problems simultaneously. It is an interdisciplinary, collaborative, and iterative process"[4]. Central to this approach is to work with local people (WwLP) to co-create solutions that are meaningful, challenge societal structures (including cross-sector politics, policy and practice), and cultural norms for long-lasting change[3, 5]. Commitment to WwLP, for example through co-production, can address power imbalances for designing and delivering impact[6] and is central to effective health promotion[7]. Whilst user engagement in design of PA interventions is becoming more common[8] to date, these interventions have not resided within a WSA.

This article aims to provide reflections from researchers embedded within two LDPs, Calderdale (Active Calderdale) and Greater Manchester (GM Local Pilot), around efforts to

WwLP as part of a WSA to enable active lives. While LDPs have approached WwLP differently, the main premise and underlying goals remain the same. For the LDPs to be successful, local people must be involved in the process and trust and respect must be built through ongoing interactions[9]. This approach may enable feelings of ownership over change, glean insight to focus efforts and resources, and can help implement successful and sustained change.

In Practice

LDP "Engagement" Overview

Across and within the LDPs approaches to WwLP differ based on a range of factors related to historical relationships, pilot design, local skills, knowledge, and capacity. It is out of scope for this article to debate the strengths of each approach. Active Calderdale's pilot involves housing two embedded community engagement coordinators (CECs) as part of the core programme team. The CECs are from two of Active Calderdale's priority areas, North and Central Halifax, they have a paid role, and provide integrated insight and understanding, consultation, and delivery with local communities. GM Moving in Greater Manchester has 10 individual boroughs under the umbrella and principles of one pilot. Each of the 10 boroughs have a different approach for WwLP. For example, community workers who are networked into local areas and provide insight; those who facilitate constructive conversations between users to co-produce activities; and direct investment into local voluntary and community and social enterprise (VCSE) sector organisations. These organisations often have pre-existing relationships with community groups, and facilitate them to come together, self-organise, engage with local people, and co-produce solutions to enable active lives utilising the local assets. We drew on activities in these two LDPs in our reflections.

Reflections

The process of WwLP within the LDPs has led to key insights about the potential additionality of these processes within a WSA as outlined below:

- **Building new relationships:** ongoing engagement with communities, where their voices can be influential across multiple spheres of influence reduces cynicism and builds trust between local residents and local services. This opens the possibility of greater reciprocity, engagement with a wider network of local residents, in particular, residents who are seldom heard. Greater trust and understanding between the public sector and those in the community supports the transfer of power, around decision making and use of funds to those in local areas who may best know how to use it.
- **Building local capacity:** communities consider how PA opportunities should be built into existing assets to unlock skills, capabilities, and networks situated within the community, which can lead to sustainable change. Furthermore, embedding capacity within existing assets can help mobilise the integration of PA as part of their offer. Investment at a local community level based on collaborative partnerships may facilitate diverse groups coming together to overcome previous rivalry and entrenched ways of working for the benefit of the local population. This may demonstrate the benefit of shifting from funding small siloed programmes to collaborative investments in a place.
- **Generating insight:** having regular and ongoing input from the community, who are also involved in collective sense-making, may serve as an opportunity to *understand* what the community wants, social norms, and to identify system blockages. Actively listening to the voice of the community may lead to those engaged in governance, policy, and practice to change their established approaches to better meet the needs and aspirations of local people. Furthermore, commitment to ongoing dialogue between local communities and those who work with them may encourage changes to

the system which, over time, work to address the myriad components which interact to constrain individual choices.

Conclusion

Locations are different and accordingly approaches to WwLP may differ. Emerging patterns are appearing whereby concerted efforts to WwLP within a WSA create superior value added relative to stand-alone co-production projects that are not embedded in the wider system. The benefits include building new relationships and local capacity, as well as generating insight that has greater reach and inspires structural and governance changes which currently inhibit progress. These LDPs and evaluations are ongoing and we will continue to investigate the development of WwLP, within a WSA, and ascertain if, how, when, and why they contribute to reducing inactivity.

References

1. Sport England. Active Lives. https://sportengland-production-files.s3.eu-west-2.amazonaws.com/s3fs-public/2020-04/Active%20Lives%20Adult%20November%2018-19%20Report..pdf?BhkAy2K28pd9bDEz_NuisHl2ppuqJtpZ (2018, accessed 13 August 2020).

2. World Health Organization. (2014). Review of social determinants and the health divide in the WHO European Region: final report. https://www.euro.who.int/__data/assets/pdf_file/0004/251878/Review-of-social-determinants-and-the-health-divide-in-the-WHO-European-Region-FINAL-REPORT.pdf (2004, accessed 13 August 2020).

3. Sport England. Local Delivery. www.sportengland.org/campaigns-and-our-work/local-delivery (2020, accessed 13 August 2020).

4. Blizzard JL and Klotz LE. A framework for sustainable whole systems design. *Design Studies* 2012; 33: 456–479.

5. Matheson GO, Klügl M, Engebretsen L, Bendiksen F, Blair SN, Börjesson M, ... and Khan KM. Prevention and management of non-communicable disease: the IOC consensus statement, Lausanne 2013. *Sports Medicine* 2013; 43(11): 1075-1088.

6. Ocloo J and Matthews R. From tokenism to empowerment: progressing patient and public involvement in healthcare improvement. *BMJ quality & safety* 2016; 25(8): 626-632.

7. South J, Bagnall A-M, Standfield JA, Southby KJ and Mehta P. An evidence-based framework on community-centred approaches for health: England, UK. *Health Promotion International* 2017; 24: 356–366.

8. Speake H, Copeland R, Breckon J and Till S. Challenges and opportunities for promoting physical activity in health care: a qualitative enquiry of stakeholder perspectives. *European Journal of Physiotherapy* 2019; 1-8.

9. Hinchcliff R, Greenfield D and Braithwaite J. Is it worth engaging in multi-stakeholder health services research collaborations? Reflections on key benefits, challenges and enabling mechanisms. *International Journal for Quality in Health Care* 2014; 26(2): 124–128.

healthcare

MDPI

Review

The Effect of Physiotherapy Interventions in the Workplace through Active Micro-Break Activities for Employees with Standing and Sedentary Work

Stergios Vitoulas [1], Vasileios Konstantis [1], Irene Drizi [1,2], Sotiria Vrouva [1,3], George A. Koumantakis [1,2] and Vasiliki Sakellari [1,2,*]

[1] Physiotherapy Department, School of Health and Care Sciences, University of West Attica (UNIWA), 12243 Athens, Greece
[2] Laboratory of Advanced Physiotherapy (LAdPhys), Physiotherapy Department, School of Health and Care Sciences, University of West Attica (UNIWA), 12243 Athens, Greece
[3] Laboratory of Neuromuscular and Cardiovascular Study of Motion (LANECASM), Physiotherapy Department, School of Health and Care Sciences, University of West Attica (UNIWA), 12243 Athens, Greece
* Correspondence: vsakellari@uniwa.gr; Tel.: +30-(0)-6979033952

Abstract: Workers worldwide experience a range of occupational musculoskeletal disorders that affect both the functionality of many parts of their body and their overall performance. Physiotherapists provide counseling and treatment programs during work. Recently, physiotherapy interventions have been introduced during work breaks. This study aimed to investigate the value of different types of workplace-based exercise programs administered during work breaks and compare them with counseling methods. Electronic searches were performed in relevant databases by keywords such as: workplace, musculoskeletal disorders, sedentary, standing, employees, micro-breaks, exercise interventions, and ergonomics. Initially, 706 articles were identified. An article sorting procedure was employed by two independent researchers, based on the inclusion and exclusion criteria set for this study, and after the removal of non-relevant articles (n = 391) or duplicates (n = 300), 15 randomized controlled trials (RCTs) remained for qualitative analysis. The methodological quality of the 13 RCTs was performed using the PEDro scale. No risk of bias evaluation was made. The findings suggested that active micro-breaks that contained various exercise programs including stretching, strengthening, torso stabilization, and ergonomic interventions were more beneficial than passive micro-breaks, reducing pain and the feeling of fatigue and increasing employees' mood. It is concluded that micro-breaks are beneficial to employees with either orthostatic or sedentary work.

Keywords: work-related musculoskeletal disorders; ergonomics; injury prevention; exercise; counseling; micro-break activities; musculoskeletal pain

Citation: Vitoulas, S.; Konstantis, V.; Drizi, I.; Vrouva, S.; Koumantakis, G.A.; Sakellari, V. The Effect of Physiotherapy Interventions in the Workplace through Active Micro-Break Activities for Employees with Standing and Sedentary Work. *Healthcare* **2022**, *10*, 2073. https://doi.org/10.3390/healthcare10102073

Academic Editor: Alberto Modenese

Received: 4 September 2022
Accepted: 16 October 2022
Published: 18 October 2022

1. Introduction

Work-related musculoskeletal disorders (WR-MSDs) are the leading cause of injury, absenteeism, and reduced productivity [1]. A variety of professions with different body loading, movement, and external load management requirements are at risk of developing neuromusculoskeletal discomfort, pain, and disability in relation to the workers' ability to manage these occupational-related demands [2–4]. Multiple symptoms, such as discomfort, paresthesia, tiredness, and restricted range of motion have been reported to be related to occupational demands [3]. Hazards in the workplace can be physical, psychological, social, or biomechanical [4]. Repetitive motion, forceful exertions, awkward postures, compression, and mechanical vibration are the key kinetic factors linked to MSDs [2–5].

The incidence of MSDs may decrease with accurate epidemiological knowledge, examination of ergonomic risks and musculoskeletal symptoms, and preparatory or compensatory workplace exercise undertaken at the beginning, during, or at the end of the working

day, respectively [6]. Due to the interruption of work activities for exercise, compensatory workplace exercise is often referred to as a 'short active break' [6]. These pauses are intended to help relieve stress on the musculoskeletal system (muscles and joints) brought on by factors related to the work activities being performed and to correct for unnatural postures [6,7].

Employers and employees are currently trying to reduce the incidence of MSDs, absenteeism from work, and associated costs with the aid of health professionals, such as physiotherapists [5,6]. Workplace-based exercise programs target the neuromusculoskeletal system with the application of resistance, endurance, coordination, balance, postural re-education, and flexibility/stretching exercises [6]. To date, scientists have examined the effectiveness of a variety of programs that involve either exercise or passive breaks in different occupational settings or various ergonomic interventions, either for prolonged standing or for sitting positions [7–9]. A previously conducted systematic review examining the effectiveness of interventions in the workplace for the prevention of upper extremity musculoskeletal disorders reported strong evidence for resistance training, and moderate evidence for stretching programs [7]. Another systematic review examined the benefit of interrupting work in sitting via standing or walking interventions, reporting in general no effect in the reduction of musculoskeletal complaints [8]. A third study examined the efficacy of various work-break schedules for reducing work-related musculoskeletal complaints and disorders in healthy employees when compared to traditional or alternative work-break schedules, concluding that different work-break frequencies and types may not substantially reduce the incidence of musculoskeletal disorders [9]. However, micro-breaks are important not only from a physical but also from a psychological perspective, such as fear of movement, depression, anxiety [9,10], therefore additional outcomes may be required to assess the benefit of such interventions.

Determining the optimal type of break, frequency, and duration to be integrated into the work program could prevent possible occupational injuries without interfering with the work process. Previous systematic reviews either dealt with an array of workplace interventions (exercise studies included) involving upper limb disorders and symptomatology [7] or were concerned with more specific interventions (standing or walking) in sedentary occupations [8]. A third study involved both active and passive micro-break interventions [9]. However, the last two mentioned systematic reviews included studies with a high risk of bias [8,9]. Adherence is of importance in all such interventions and having a wearable device may act as a reminder as well as an incentive to maintain a good physical activity level and reduce sedentariness [11]. The aim of this study was to qualitatively analyze the effects of workplace-based active micro-breaks in the form of exercises targeting the health improvement (pain, disability, muscle performance characteristics, quality of life) delivered in a variety of work environments in studies of moderate-to-high methodological quality.

2. Methods

2.1. Search Strategy

The search strategy was performed using the PICO method to define the research query, while the MeSH (Medical Subject Headings) terms used in the search in the various databases were: workplace, musculoskeletal disorders, sedentary, standing, employees, micro-breaks, exercise interventions, ergonomics, pain, disability, and randomized controlled trials (RCTs).

Electronic searches were performed using the following databases: PubMed, EMBASE, PsycINFO, and ResearchGate. An article-sorting procedure was then performed. Then, each of the two researchers read the title, and the abstract of all studies, and assessed their eligibility according to the inclusion and exclusion criteria (Table 1). Consequently, the eligible articles were reviewed by two independent researchers, after the non-eligible and duplicates were removed. Only RCTs of methodological quality $\geq$6 on the PEDro scale were included in this review (Table 2).

Table 1. Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Employees as participants	Non-employees as participants
Active employee breaks	Exclusively passive breaks
Published from January 2010 onwards	Published until December 2009
At least a 6/10 score on the PEDro scale	Less than a 6/10 score on the PEDro scale
Sufficient number of participants per treatment group	Less than 15 participants per treatment group
Randomized controlled trials	Non-randomized controlled trials

Table 2. Evaluation of articles using the Physiotherapy Evidence Database (PEDro) scale score.

Author, Publication Date	Items										Total Score
	1	2	3	4	5	6	7	8	9	10	
Jay et al., 2011 [12]	X		X			X	X		X	X	6/10
Zebis et al., 2011 [13]	X	X	X					X	X	X	6/10
Jakobsen et al., 2015 [14]	X		X			X	X	X	X	X	7/10
Sundstrup et al., 2014 [15]	X	X	X			X	X	X	X	X	8/10
Muñoz Poblete et al., 2019 [16]	X	X				X	X		X	X	6/10
Andersen et al. 2011 [17]	X	X	X			X	X	X	X	X	8/10
Taulaniemi et al., 2019 [18]	X	X	X			X		X	X	X	7/10
Rasotto et al., 2015 [19]	X	X	X			X		X	X	X	7/10
Gram et al., 2014 [20]	X		X				X	X	X	X	6/10
Ding et al., 2020 [21]	X	X	X	X			X	X	X		7/10
Caputo et al., 2017 [22]	X	X	X			X		X	X	X	7/10
Mehrparvar et al., 2014 [23]	X	X	X			X		X	X	X	7/10
Nakphet et al., 2014 [24]	X	X	X	X			X	X	X		7/10
Lacaze et al., 2010 [25]	X	X	X	X		X	X	X	X	X	9/10
Santos et al., 2020 [26]	X			X		X	X	X	X	X	7/10

Items correspond to the following criteria, 1: random allocation, 2: concealed allocation, 3: baseline comparability, 4: blind subjects, 5: blind therapists, 6: blind assessors, 7: adequate follow up, 8: management as planned or intention-to-treat analysis, 9: between-group comparisons, 10: point estimates and variability.

2.2. Study Design

The current study is a narrative review of the literature. A criterion of inclusion for the articles was a score on the PEDro scale $\geq$6. A total of 15 collected articles [12–26], considered moderate-to-high quality, fulfilled this inclusion criterion.

2.3. Statistical Analysis

This was a narrative review, which consisted of all the essential steps of a systematic review, without proceeding to an analysis and synthesis of quantitative data, such as risk ratio, odds ratio, and mean-standard deviations of every study included. The risk of bias of the included studies as well as the possible causes of heterogeneity between the results of the studies were not assessed. The number of all articles initially identified, assessed, sequentially excluded (with reasons), and those finally included in the study were presented in a flowchart that was created according to the PRISMA checklist used in the systematic review for the recording and documentation of the bibliographic search (Figure 1). Finally, 15 articles were identified as suitable and were analyzed in the review.

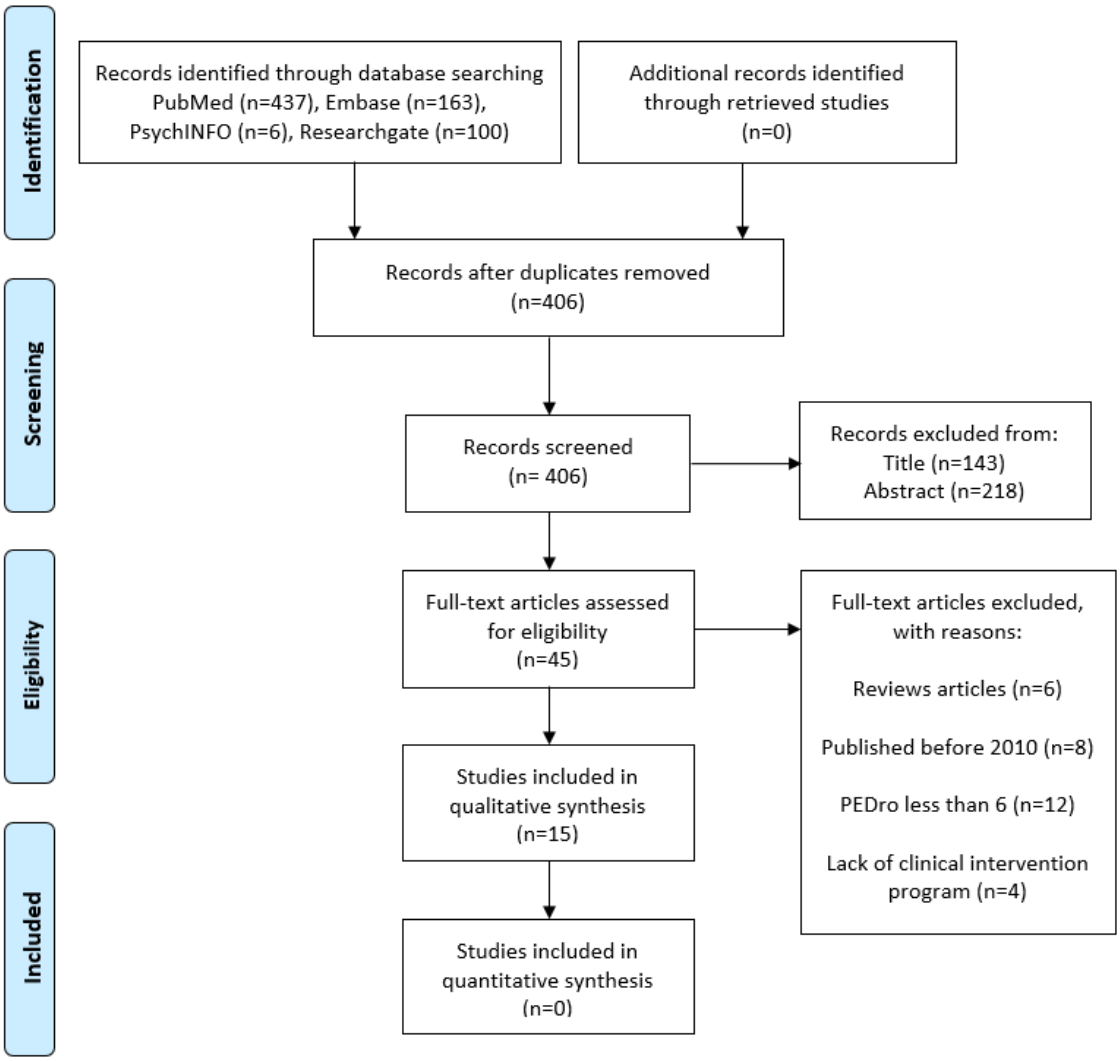

Figure 1. PRISMA flowchart showing the selection procedure for the studies in this review.

3. Results

3.1. Characteristics of the Included Studies

The characteristics of the included studies are analytically presented in the Supplementary Material (Table S1). In summary, the studies included a variety of occupations with participants working either in a standing or in a sitting position. The population of included studies ranged from 30 to 537 participants. The included interventions either targeted muscle strength or stretching of key muscle groups, or a more generalized combination of strength, stretching, and joint mobility. The duration of the exercise programs generally varied between 4 and 20 weeks [12–17,20,22,23,25,26]; however, there was one study that observed participants in 5 equidistant time intervals included within 1 h [24], one at 2 h [21], one at 6 months [19], and another that included a 6- and a 12-month follow-up [18]. Three of the included studies had exclusively recruited female participants, due to the nature of the occupation studied. A range of outcome measures has been utilized (pain intensity or discomfort, pain interference, fatigue, isometric muscle strength of various muscle groups, aerobic fitness, electromyographic activity, productivity, disability, and work-related factors). In general, active exercise breaks help reduce physical pain and fatigue and improve the mood of employees.

3.2. Strengthening Programs in Standing Occupations

The implementation of different designs of resistance training in the workplace showed a reduction in pain intensity in most studies [12–17]. A significant reduction in lumbar pain was observed after intense kettlebell training for 8 weeks (reduction by 57%) in the study of Jay et al. [12], while the contribution of a strengthening program for pain relief among industrial workers of Zebis et al. [13] was significant in the reduction of pain in the intervention group in the areas of the shoulder and neck. Another study by Jakobsen et al. [14] observed a decrease in the lumbar pain intensity with a work-based 10-week exercise program applied in only female healthcare workers. Sundstrup et al. [15] observed a significant improvement in the Work Ability Index (WAI) among slaughterhouse workers, following a 10-week exercise program. Muñoz Poblete et al. [16] explored the effectiveness of a workplace-based muscle resistance training exercise program for the intervention group and a mild stretching program for the control group and concluded that there was a reduction in upper extremity pain after 16 weeks of intervention in favor of the intervention group. Furthermore, Muñoz Poblete et al. [16] found that individuals can benefit from a set of exercises for about 10 to 20 min a day and at least 3 times a week, by adapting strengthening programs to employees' available time. In addition, Andersen et al. [17] found that as little as 2 min of daily progressive resistance training for 10 weeks results in clinically relevant reductions of pain and tenderness in healthy adults with frequent neck/shoulder symptoms.

Specifically, in the study of Jay et al. [12], the strength training increased participants' extensor muscle strength levels in the lumbar spine (mainly those used for lifting), while it did not appear to be effective for the torso flexor muscle groups and the shoulder area. Sundstrup et al. [15] also demonstrated an increase of the muscular strength of the wrist and the upper limb, with an increase of the maximum isometric contraction of the grip in the intervention group. Evidence of statistically significant strengthening in the lumbar muscles was observed in the study of Jakobsen et al. [14] for the workplace-based intervention group. Finally, in the research study of Zebis et al. [13] there were no clear effects of the program on the muscular strength of the included participants.

Another outcome studied was the fatigue and aerobic capacity of the individuals. Sundstrup et al. [15] observed that after the end of the strengthening program there was a significant increase in the time to fatigue in the intervention group, an improvement rate approaching 97%, while there was no change in the control group, and a parallel increase in the WAI. Aerobic capacity was also studied as an outcome by Jay et al. [12], but with no clear effect of the intervention. The studies of Zebis et al. [13] and Jakobsen et al. [14] did not include aerobic capacity as an outcome.

3.3. Home-Based Exercise versus Workplace Exercises in Standing Occupations

The results of Jakobsen et al. [14] were not in favor of home training for healthcare workers, as the workplace-based intervention group excelled in all tested parameters. The intensity of pain was found to decrease in the work-based group more than the home-based group both in the lumbar region and in the shoulder and neck areas. The decrease in pain intensity was observed in 78% of the participants in the work-based intervention group. The intensity of pain decreased in 42% of the participants for the home-based physical exercise group. In addition, muscle strength was found to be higher in the work-based group. Furthermore, the study considered the workplace as the most suitable for increasing mood compared to physical exercise at home.

3.4. Relaxation Exercise, Stress Reduction, and Ergonomic Interventions in Standing Occupations

Taulaniemi et al. [18], in a secondary analysis of an RCT, examined exercises that aimed at relaxation and reduction of stress from a neurophysiological perspective. This research tested a workplace exercise program involving female healthcare workers with nursing duties. After 6 and 12 months, the mean reduction in pain in the exercise group was greater compared to the non-exercise group, while in further analysis, the difference in pain

reduction was greater in the exercise group in relation to the control group. Furthermore, the program improved lumbar mobility, maintained or even increased abdominal muscle strength, and showed that the trainees in the intervention group perceived less feelings of fatigue and had better recovery for work.

The study by Sundstrup et al. [15] compared a workplace strengthening exercise program with a standard ergonomic intervention. The resulting effect of the ergonomic intervention on fatigue, pain intensity, and muscle strengthening were a clear reduction.

3.5. General Programs of Physical Activities in Standing Occupations

Rasotto et al. [19] applied a tailored exercise program composed of exercises for strengthening, stretching, and mobility of body parts in a female working population suffering from musculoskeletal disorders. The results of this research show a reduction in pain in the intervention group. In addition, the grip strength and the strength in the shoulder area muscles increased by 4.9% and 70.6%, respectively. A study by Gram et al. [20] investigated the effect of the combination of aerobic exercise and strengthening as individually tailored exercise programs for male construction workers. They observed a statistically significant increase in maximal aerobic capacity compared to the group that attended the exercise sessions. The study demonstrated good effectiveness for integrating short exercise bouts of 20 min, 3 times a week, into organizational routines among construction workers.

3.6. Effect of Stretching in Sitting Occupations

Six articles studying sedentary occupations were selected as representative of this group. Ding et al. [21], Caputo et al. [22], Mehrparvar et al. [23], Nakphet et al. [24], and Lacaze et al. [25] studied the stretching exercise applied to at least one intervention group, either solely or in combination with another form of activity. In another study by Santos et al. [26], a stretching program was followed by the control group and not the intervention group. In four of the six articles above, musculoskeletal discomfort is mentioned as the main outcome measure. In the study by Lacaze et al. [23], an exercise program consisting of stretching and joint mobilization was applied to call-center operators, which resulted in a significant reduction in post-intervention discomfort by 6.5 points, with the intervention group showing the most statistically significant reduction in the incidence of neck and shoulder discomfort, and discomfort of the spine and buttocks. In the upper and lower extremities, the reduction of discomfort was similar between the two groups.

The results of Ding et al. [21] showed that the most significant relief in terms of perceived discomfort from prolonged sitting work was accomplished by the standing and stretching group for 5 min. Caputo et al. [22] attempted to examine the effectiveness of group resistance work exercises, specifically in the neck and shoulder area in video display unit workers (VDU). Mehrparvar et al. [23] did not find a significant difference between the intervention groups. In the latest study of Nakphet et al. [24], all VDU unit operators in an intervention group showed reduced musculoskeletal discomfort in all parts of the body immediately after the break than at the end of each 20-min work period.

Regarding the effect of stretching on fatigue, the study by Ding et al. [21] included interesting data, where the 5-min standing and stretching group had the best outcome, with a significant reduction in fatigue levels, maintaining the muscles in a non-fatigued state for 30–45 min. The exercise group with a stretching, mobilization, and relaxation program had a positive effect on mental fatigue in the study of Lacaze et al. [25]. In particular, the exercise group appeared to have better results in employee memory and fatigue with fewer speech errors compared to the control group. Santos et al. [26] did not detect a significant difference between the progressive resistance exercise group and the stretching and stretching exercise group. Similarly, Nakphet et al. [24] found no significant difference from the comparison of the stretching and dynamic contraction groups for muscle fatigue. They concluded, however, that any form of activity during the break is beneficial in preventing neck and shoulder fatigue.

According to Mehrparvar et al. [23], both the groups with ergonomic modification of the workstation and the one with workplace exercises, including stretching, reduced their musculoskeletal pain in a similar way, except for lumbar pain. Stretching in the intervention group reduced lower back pain more than in the ergonomic group. In the study of Caputo et al. [22] pain and pain-related chronic neck pain disability decreased similarly and without significant differences between the neck-shoulder resistance exercise group and the conventional stretching and postural exercise group.

4. Discussion

Most of the strengthening programs employed in the three studies [12,13,15,16] were performed 3 times a week, with an average duration of 20 min per session. It is known that the muscles are strengthened more sufficiently when they undergo dynamic and progressive training with concentric and eccentric high-intensity contractions and with a maximum of 8 to 12 contractions using dumbbells, elastic bands, and anti-gravity exercises [27]. Studies, such as the ones of Jay et al. [12] and Zebis et al. [13], found statistically significant reductions in the pain of shoulder and neck areas compared to the control group. Muñoz Poblete et al. [16] concluded that there was a reduction in upper extremity pain after 16 weeks of a set of exercises for about 10 to 20 min/day and at least 3 times/week, in favor of the strengthening group. Finally, Andersen et al. [17] found that as little as 2 min of daily progressive resistance training for 10 weeks results in clinically relevant reductions of pain in adults with frequent neck/shoulder symptoms. Other studies [12,14] found that lumbar pain was significantly reduced compared with the control group.

Kettlebell exercises focused on the upper extremities and lumbar region have been shown to have a positive effect on combating pain [12]. It is reported that generally, in a home program, it is difficult to perform exercises using equipment such as kettlebells [12] or other special resistance bands, as a supervisor is constantly needed to give advice and watch out for injuries [14]. Thus, providing videos or posters depicting the exercises is an affordable financial solution, which, however, cannot replace the trainer himself. According to Jakobsen et al. [14], exercise in a familiar environment does not have a positive effect on employees, which highlights the importance of the concept of exercise in the workplace.

The contribution of stretching and mobilization exercises to pain intensity is not clearly supported by the current literature [21–26]. The benefits of stretching may be mainly related to its recovery benefits. Still, studies such the one by da Costa and Vieira [28] emphasize the need to use stretching programs in the workplace accompanied by other types of exercise, emphasizing that it cannot stand alone as a treatment method to reduce work-related musculoskeletal disorders.

Strengthening exercises are time-consuming and highly individualized, whereas micro-break activities can last for about 2 min. Nevertheless, the inclusion of stretching exercises between breaks in working hours is feasible despite its practical difficulties. For instance, the time needed to complete the exercise process may extend the duration of the micro-break. Based on the American College of Sports Medicine, which refers to the guidance for prescribing exercise [27], the employee needs a stretching activity of 10–30 s and 3–5 repetitions, with the total time of the whole procedure lasting a little more than the normal duration of a short break, in order to gain the benefits of the stretching. Active stretching normally does not cause additional compression or tension to the tissues and joints, as it is based on voluntary movement resulting in the restoration of extracellular matrix homeostasis and normal arrangement of tissue structures [28]. Therefore, the classic form of static stretching cannot meet the requirements of rehabilitation and prevention of musculoskeletal injuries in standing occupations [29], while additional movement promotes the healing process more easily.

Methods such as the No Lifting Policy need to be further analyzed in the modern professional world, as it involves financial issues as well [30]. There is a need for further study of interval exercises and ergonomic intervention in the workplace, through well-designed studies. Another important emerging method used in order to return to or

remain at work for workers with chronic musculoskeletal condition, is a personalized self-management program that contains a set of psycho-educational techniques based on behavioral and cognitive education [31]. A commonly accepted program of short break workouts has not yet been formulated for sitting professionals. According to Jepsen and Thompsen [32], stretching alone cannot be a method of preventing disorders for people working in computer workstations. A recent review came to a similar statement, concluding that both stretching exercises and ergonomic intervention have not shown satisfactory results on their own, in terms of work-related musculoskeletal pain and discomfort [33]. Therefore, the combination of resistance/strengthening exercise with stretching and/or ergonomic intervention in the workplace is recommended.

Ylinen et al. [34] observed that isometric strength training and dynamic endurance training effectively reduced chronic neck pain and disability, while aerobic exercise and stretching alone, performed by the control group, proved to be much less beneficial. Stretching leads to several benefits, such as reducing discomfort caused by prolonged sedentary behavior [35], reducing pressure on the intervertebral discs [36], removal of lactic acid, increase in blood circulation, and stimulation and alertness of workers [37,38]. Stretching can also increase the range of motion and reduce the pain [39,40]. An important point of attention that should not be omitted in respect to stretching and resistance/strengthening exercises is the inclusion of warm-up time [41].

Regarding active and passive breaks, Ding et al. [21] stated that active cessation of work in standing and stretching for 5 min was significantly more beneficial than passive breaks on the chair. On the other hand, Nakphet et al. [24] stated that there is no significant difference between active and passive breaks in the sedentary work environment.

In contrast to stretching, resistance/strength training has been studied extensively, with most results being supportive [12–17,26]. Among the types of exercise proposed are strength training [34,40,41], endurance training [34,41], and muscle coordination training [41] to alleviate pain. However, the most appropriate type of exercise has not yet been identified. Tomanova et al. [42] suggest stabilization exercises as well as stretching and relaxation for effective treatment of lower back pain. Sipaviciene and Kliziene [43] compared the lumbar stabilization exercise with the lumbar muscle strengthening exercise in patients who perform sedentary work, with the group that activated the deep stabilizers of the trunk and received pelvic control training presenting the best results in terms of pain and disability.

Two other important factors that need to be identified to determine the most appropriate type of break are the frequency and duration of the short breaks. Regarding the frequency, there is a discrepancy between the surveys with the short breaks varying from 10 s to 15 min every 6 min and 2 working hours, respectively. Vijendren et al. [44] suggested micro breaks of 20 s to 30 s every 20 min to 30 min of work. As reported, a short program of stretching exercises every 30 min reduced musculoskeletal discomfort [45], while a corresponding stretching program every 15 min reduced discomfort, eye strain, and shoulder strain [46]. A similar program of frequent cessation of activity for 5 min every 30 min of work improved the productivity of employees [47].

Ultimately, in terms of productivity, there is no evidence that general micro-breaks have a detrimental effect on working productivity, as older studies have implied [48], and which has not been recently verified [9].

5. Conclusions

Breaks and micro-breaks were found to be applicable to employees during standing and sitting occupations. Active breaks with a specified exercise program were more beneficial than passive breaks. Exercise in the workplace is recommended over exercise at home or in places other than work. Short breaks are recommended for at least 10 to 15 min every 40 to 60 min of continuous work, otherwise it would be preferable to take a break of 3 or 5 min every 30 min, regardless of the lunch break.

In standing occupations, active stretching and strengthening exercises are the two predominant types of exercises used for the prevention and rehabilitation of musculoskeletal injuries during work breaks. In addition, the most preferable exercise for sedentary occupations is that of stretching, followed by resistance and strengthening exercise. When the worker is exposed to prolonged sedentary postures, the lumbar spine, the neck, shoulder, upper extremities, wrist, and the back are mainly affected. Thus, exercise that has a preventive and therapeutic role puts emphasis on these areas. Ideally, an active workout/microbreak program in the workplace that includes stretching, strengthening, torso stabilization as well as ergonomic interventions in the workplace, should focus on the needs of each profession.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/healthcare10102073/s1, Table S1: Details of included studies.

Author Contributions: S.V. (Stergios Vitoulas), data curation, investigation, methodology, visualization, writing—original draft; V.K., data curation, investigation, methodology, visualization, writing—original draft; I.D., conceptualization, data curation, methodology, visualization, writing—original draft, writing—review and editing; S.V. (Sotiria Vrouva), conceptualization, methodology, supervision, visualization, writing—original draft, writing—review and editing; G.A.K., data curation, validation, visualization, writing—review and editing; V.S., conceptualization, methodology, supervision, visualization, writing—original draft, writing—review and editing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Hossain, M.D.; Aftab, A.; Al Imam, M.H.; Mahmud, I.; Chowdhury, I.A.; Kabir, R.I.; Sarker, M. Prevalence of work related musculoskeletal disorders (WMSDs) and ergonomic risk assessment among readymade garment workers of Bangladesh: A cross sectional study. *PLoS ONE* **2018**, *13*, e0200122. [CrossRef] [PubMed]
2. Yao, Y.; Zhao, S.; An, Z.; Wang, S.; Li, H.; Lu, L.; Yao, S. The associations of work style and physical exercise with the risk of work-related musculoskeletal disorders in nurses. *Int. J. Occup. Med. Environ. Health* **2019**, *32*, 15–24. [CrossRef] [PubMed]
3. Vieira, E.R.; Schneider, P.; Guidera, C.; Gadotti, I.C.; Brunt, D. Work-related musculoskeletal disorders among physical therapists: A systematic review. *J. Back Musculoskelet. Rehabil.* **2016**, *29*, 417–428. [CrossRef] [PubMed]
4. Sundstrup, E.; Jakobsen, M.D.; Jay, K.; Brandt, M.; Andersen, L.L. High intensity physical exercise and pain in the neck and upper limb among slaughterhouse workers: Cross-sectional study. *BioMed. Res. Int.* **2014**, *2014*, 218546. [CrossRef]
5. Werderman, D.S. Reducing Work-Related Musculoskeletal Disorders in Radiologic Technologists. *Radiol. Technol.* **2020**, *92*, 33–48.
6. Soares, C.O.; Pereira, B.F.; Pereira Gomes, M.V.; Marcondes, L.P.; de Campos Gomes, F.; de Melo-Neto, J.S. Preventive factors against work-related musculoskeletal disorders: Narrative review. *Rev. Bras. Med. Trab.* **2020**, *17*, 415–430. [CrossRef]
7. Van Eerd, D.; Munhall, C.; Irvin, E.; Rempel, D.; Brewer, S.; van der Beek, A.J.; Dennerlein, J.T.; Tullar, J.; Skivington, K.; Pinion, C.; et al. Effectiveness of workplace interventions in the prevention of upper extremity musculoskeletal disorders and symptoms: An update of the evidence. *Occup. Environ. Med.* **2016**, *73*, 62–70. [CrossRef]
8. Parry, S.P.; Coenen, P.; Shrestha, N.; O'Sullivan, P.B.; Maher, C.G.; Straker, L.M. Workplace interventions for increasing standing or walking for decreasing musculoskeletal symptoms in sedentary workers. *Cochrane. Database Syst. Rev.* **2019**, CD012487. [CrossRef]
9. Luger, T.; Maher, C.G.; Rieger, M.A.; Steinhilber, B. Work-break schedules for preventing musculoskeletal symptoms and disorders in healthy workers. *Cochrane Database Syst. Rev.* **2019**, *7*, CD012886. [CrossRef]
10. Wang, H.; Xu, G.; Liang, C.; Li, Z. Coping with job stress for hospital nurses during the COVID-19 crisis: The joint roles of micro-breaks and psychological detachment. *J. Nurs. Manag.* 2021; *Online Ahead of Print*.
11. Yen, H.Y.; Huang, H.Y. Comparisons of physical activity and sedentary behavior between owners and non-owners of commercial wearable devices. *Perspect. Public Health* **2021**, *141*, 89–96. [CrossRef]
12. Jay, K.; Frisch, D.; Hansen, K.; Zebis, M.K.; Andersen, C.H.; Montersen, O.S.; Andersen, L.L. Kettlebell training for musculoskeletal and cardiovascular health, a randomized controlled trial. *Scand. J. Work Environ. Health* **2011**, *37*, 196–203. [CrossRef] [PubMed]

13. Zebis, M.K.; Andersen, L.L.; Pedersen, M.T.; Mortensen, P.; Andersen, C.H.; Pedersen, M.M.; Boysen, M.; Roessler, K.K.; Hannerz, H.; Mortensen, O.S.; et al. Implementation of neck/shoulder exercises for pain relief among industrial workers, a randomized controlled trial. *BMC Musculoskelet. Disord.* **2011**, *12*, 205. [CrossRef] [PubMed]
14. Jakobsen, M.D.; Sundstrup, E.; Brandt, M.; Jay, K.; Aagaard, P.; Andersen, L.L. Effect of workplace- versus home-based physical exercise on musculoskeletal pain among healthcare workers: A cluster randomized controlled trial. *Scand. J. Work Environ. Health* **2015**, *41*, 153–163. [CrossRef] [PubMed]
15. Sundstrup, E.; Jakobsen, M.D.; Brandt, M.; Jay, K.; Persson, R.; Aagaard, P.; Andersen, L.L. Workplace strength training prevents deterioration of work ability among workers with chronic pain and work disability: A randomized controlled trial. *Scand. J. Work Environ. Health* **2014**, *40*, 244–251. [CrossRef]
16. Muñoz Poblete, C.; Bascour-Sandoval, C.; Inostroza-Quiroz, J.; Solano-López, R.; Soto-Rotriguez, F. Effectiveness of workplace based muscle resistance training exercise program in preventing musculoskeletal dysfunction of the upper limbs in manufacturing workers. *J. Occup. Rehabil.* **2019**, *29*, 810–821. [CrossRef]
17. Andersen, L.L.; Saervoll, C.A.; Mortensen, O.S.; Poulsen, O.M.; Hannerz, H.; Zebis, M.K. Effectiveness of small daily amounts of progressive resistance training for frequent neck/shoulder pain: Randomised controlled trial. *Pain* **2011**, *152*, 440–446. [CrossRef]
18. Taulaniemi, A.; Kankaanpaa, M.; Tokola, K.; Parkkari, J.; Suni, J.H. Neuromuscular exercise reduces low back pain intensity and improves physical functioning in nursing duties among female healthcare workers, secondary analysis of a randomised controlled trial. *BMC Musculoskelet. Disord.* **2019**, *20*, 328. [CrossRef]
19. Rasotto, C.; Bergamin, M.; Sieverdes, J.C.; Gobbo, S.; Alberton, C.L.; Neunhaeuserer, D.; Maso, S.; Zaccaria, M.; Ermolao, A. A tailored workplace exercise program for women at risk for neck and upper limb musculoskeletal disorders, a randomized controlled trial. *J. Occup. Environ. Med.* **2015**, *57*, 178–183. [CrossRef]
20. Gram, B.; Holtermann, A.; Sogaard, K.; Sjogaard, G. Effect of individualized worksite exercise training on aerobic capacity and muscle strength among construction workers a randomized controlled intervention study. *Scand. J. Work Environ. Health* **2012**, *38*, 467–475. [CrossRef]
21. Ding, Y.; Cao, Y.; Duffy, V.G.; Zhang, X. It is Time to Have a Rest: How do break types affect muscular activity and perceived discomfort during prolonged sitting work. *Saf. Health Work* **2020**, *11*, 207–214. [CrossRef]
22. Caputo, G.M.; Di Bari, M.; Orellana, J.N. Group-based exercise at workplace: Short-term effects of neck and shoulder resistance training in video display unit workers with work-related chronic neck pain—A pilot randomized trial. *Clin. Rheumatol.* **2017**, *36*, 2325–2333. [CrossRef] [PubMed]
23. Mehrparvar, A.H.; Heydari, M.; Mirmohammadi, S.J.; Mostaghaci, M.; Davari, M.H.; Taheri, M. Ergonomic intervention, workplace exercises and musculoskeletal complaints: A comparative study. *Med. J. Islam. Repub. Iran.* **2014**, *28*, 69.
24. Nakphet, N.; Chaikumarn, M.; Janwantanakul, P. Effect of different types of rest-break interventions on neck and shoulder muscle activity, perceived discomfort and productivity in symptomatic VDU operators: A randomized controlled trial. *Int. J. Occup. Saf. Ergon.* **2014**, *20*, 339–353. [CrossRef]
25. Lacaze De Castro, D.H.; De, C.N. Sacco, I.; Rocha, L.E.; De Braganca, P.C.A.; Casarotto, R.A. Stretching and joint mobilization exercises reduce call-center operators' musculoskeletal discomfort and fatigue. *Clinics (Sao Paulo)* **2010**, *65*, 657–662. [CrossRef]
26. Santos, H.G.; Chiavegato, L.D.; Valentim, D.P.; Padula, R.S. Effectiveness of a progressive resistance exercise program for industrial workers during breaks on perceived fatigue control, a cluster randomized controlled trial. *BMC Public Health* **2020**, *20*, 849. [CrossRef] [PubMed]
27. Garber, C.E.; Blissmer, B.; Deschenes, M.R.; Franklin, B.A.; Lamonte, M.J.; Lee, I.M.; Nieman, D.C.; Swain, D.P. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Med. Sci. Sports Exerc.* **2011**, *43*, 1334–1359. [CrossRef] [PubMed]
28. da Costa, B.R.; Vieira, E.R. Stretching to reduce work-related musculoskeletal disorders: A systematic review. *J. Rehabil. Med.* **2008**, *40*, 321–328. [CrossRef]
29. Coleman, W.K.A.; Lowndes, B.R.; Buus, R.J.; Hallbeck, M.S. Evidence-based intraoperative microbreak activities for reducing musculoskeletal injuries in the operating room. *Work* **2018**, *60*, 649–659. [CrossRef]
30. Engkvist, I.L. Evaluation of an intervention comprising a no lifting policy in Australian hospitals. *Appl. Ergon.* **2006**, *37*, 141–148. [CrossRef]
31. Johnston, V.; Jull, G.; Sheppard, D.M.; Ellis, N. Applying principles of self-management to facilitate workers to return to or remain at work with a chronic musculoskeletal condition. *Man. Ther.* **2013**, *18*, 274–280. [CrossRef]
32. Jepsen, J.R.; Thomsen, G. Prevention of upper limb symptoms and signs of nerve afflictions in computer operators: The effect of intervention by stretching. *J. Occup. Med. Toxicol.* **2008**, *3*, 1. [CrossRef]
33. Gasibat, Q.; Simbak, N.B.; Aziz, A.A. Stretching exercises to prevent work-related musculoskeletal disorders A review article. *Am. J. Sports Sci. Med.* **2017**, *5*, 27–37. [CrossRef]
34. Ylinen, J.; Takala, E.P.; Nykanen, M.; Hakkinen, A.; Malkia, E.; Pohjolainen, T.; Karppi, S.L.; Kautiainen, H.; Airaksinen, O. Active neck muscle training in the treatment of chronic neck pain in women: A randomized controlled trial. *JAMA* **2003**, *289*, 2509–2516. [CrossRef]
35. Galinsky, T.L.; Swanson, N.; Sauter, S.; Dunkin, R.; Hurrell, J.; Schleifer, L. Supplementary breaks and stretching exercises for data entry operators: A follow-up field study. *Am. J. Ind. Med.* **2007**, *50*, 519–527. [CrossRef] [PubMed]

36. Waongenngarm, P.; Areerak, K.; Janwantanakul, P. The effects of breaks on low back pain, discomfort, and work productivity in office workers: A systematic review of randomized and non-randomized controlled trials. *Appl. Ergon.* **2018**, *68*, 230–239. [CrossRef] [PubMed]
37. Thompson, D.A. *Effect of Exercise Breaks on Musculoskeletal Strain among Data-Entry Operators: A Case Study*; Sauter, S., Dainoff, M., Smith, M., Eds.; Promoting Health and Productivity in the Computerized Office: Models of Successful Ergonomic Intervention; Taylor and Francis: London, UK, 1990; pp. 118–127.
38. Carter, J.B.; Banister, E.W. Musculoskeletal problems in VDT work: A review. *Ergonomics* **1994**, *37*, 1623–1648. [CrossRef] [PubMed]
39. Choi, S.D.; Woletz, T. Do stretching programs prevent work-related musculoskeletal Disorders? *J. Saf. Health Environ. Res.* **2010**, *63*, 1–19.
40. Hagberg, M.; Harms-Ringdahl, K.; Nisell, R.; Hjelm, E.W. Rehabilitation of neck-shoulder pain in women industrial workers: A randomized trial comparing isometric shoulder endurance training with isometric shoulder strength training. *Arch. Phys. Med. Rehabil.* **2000**, *81*, 1051–1058. [CrossRef] [PubMed]
41. Waling, K.; Sundelin, G.; Ahlgren, C.; Järvholm, B. Perceived pain before and after three exercise programs: A controlled clinical trial of women with work-related trapezius myalgia. *Pain* **2000**, *85*, 201–207. [CrossRef]
42. Tomanova, M.; Lippert-Grüner, M.; Lhotska, L. Specific rehabilitation exercise for the treatment of patients with chronic low back pain. *J. Phys. Ther. Sci.* **2015**, *27*, 2413–2417. [CrossRef] [PubMed]
43. Sipaviciene, S.; Kliziene, I. Effect of different exercise programs on non-specific chronic low back pain and disability in people who perform sedentary work. *Clin. Biomech.* **2020**, *73*, 17–27. [CrossRef]
44. Vijendren, A.; Devereux, G.; Tietjen, A.; Duffield, K.; Van Rompaey, V.; Van de Heyning, P.; Yung, M. The Ipswich Microbreak Technique to alleviate neck and shoulder discomfort during microscopic procedures. *Appl. Ergon.* **2020**, *83*, 102679. [CrossRef] [PubMed]
45. Fenety, A.; Walker, J.M. Short-term effects of workstation exercises on musculoskeletal discomfort and postural changes in seated video display unit workers. *Phys. Ther.* **2002**, *82*, 578–589. [CrossRef] [PubMed]
46. Balci, R.; Aghazadeh, F. Effects of exercise breaks on performance, muscular load, and perceived discomfort in data entry and cognitive tasks. *Comput. Ind. Eng.* **2004**, *46*, 399–411. [CrossRef]
47. Hargreaves, E.A.; Hayr, K.T.; Jenkins, M.; Perry, T.; Peddie, M. Interrupting sedentary time in the workplace using regular short activity breaks: Practicality from an employee perspective. *J. Occup. Environ. Med.* **2020**, *62*, 317–324. [CrossRef] [PubMed]
48. Mclean, L.; Tingley, M.; Scott, R.N.; Rickards, J. Computer terminal work and the benefit of microbreaks. *Appl. Ergon.* **2001**, *32*, 225–237. [CrossRef]

International Journal of
Environmental Research and Public Health

MDPI

Review

Shaping Pathways to Child Health: A Systematic Review of Street-Scale Interventions in City Streets

Adriana Ortegon-Sanchez [1,*], Laura Vaughan [2], Nicola Christie [1] and Rosemary R. C. McEachan [3,*]

[1] Centre for Transport Studies, Department of Civil, Environmental and Geomatic Engineering, UCL, London WC1E 6BT, UK; nicola.christie@ucl.ac.uk
[2] Space Syntax Laboratory, The Bartlett School of Architecture, UCL, London WC1E 6BT, UK; l.vaughan@ucl.ac.uk
[3] Bradford Institute for Health Research, Bradford Teaching Hospitals NHS Foundation Trust, Bradford BD9 6RJ, UK
* Correspondence: adriana.ortegon.10@ucl.ac.uk (A.O.-S.); rosie.mceachan@bthft.nhs.uk (R.R.C.M.)

Abstract: Street-level built environment factors, for example, walking infrastructure, building density, availability of public transport, and proliferation of fast-food outlets can impact on health by influencing our ability to engage in healthy behaviour. Unhealthy environments are often clustered in deprived areas, thus interventions to improve the built environments may improve health and reduce inequalities. The aim of this review was to identify whether street-level built environment interventions can improve children's health in high income countries. A secondary aim was to describe key built environment elements targeted in interventions and research gaps. A systematic review of published literature was conducted by a multi-disciplinary team. Ten intervention papers were included. Physical activity or play was the only health outcome assessed. Most interventions described temporary changes including closure of streets to traffic (N = 6), which were mainly located in deprived neighbourhoods, or the addition of technology to 'gamify' active travel to school (N = 2). Two studies reported permanent changes to street design. There was limited evidence that closing streets to traffic was associated with increases in activity or play and inconclusive evidence with changes to street design and using technology to gamify active travel. Our ability to draw conclusions was hampered by inadequate study designs. Description of interventions was poor. Rigorous evaluation of built environment interventions remains challenging. We recommend a multi-disciplinary approach to evaluation, explicit reporting of built environment indicators targeted in interventions and offer solutions to others working in this area.

Keywords: built environment; streets; interventions; children; deprivation; health; playstreets; play streets

Citation: Ortegon-Sanchez, A.; Vaughan, L.; Christie, N.; McEachan, R.R.C. Shaping Pathways to Child Health: A Systematic Review of Street-Scale Interventions in City Streets. *Int. J. Environ. Res. Public Health* **2022**, *19*, 5227. https://doi.org/10.3390/ijerph19095227

Academic Editor: Paul B. Tchounwou

Received: 31 January 2022
Accepted: 20 April 2022
Published: 25 April 2022

1. Introduction

Non communicable diseases (NCDs) such as cardiovascular disease (for example, heart attacks and stroke), cancer, respiratory disease and diabetes kill an estimated 41 million people globally each year, and yet are largely preventable [1]. A healthy lifestyle (for example, having a healthy diet, exercising, avoiding smoking or alcohol use), or lack thereof, is a key contributor to our risk of developing NCD [1]. Childhood is a critical time period for improving health, as evidence shows that early life exposure to key stressors can affect disease risk in later life [2]. Healthy behaviour patterns that are established in childhood [3] and adolescence track into adulthood [4], and thus encouraging a healthy lifestyle can have benefits across the life-course.

In high income countries, the burden of NCDs fall more heavily on communities living in deprived areas [5], due to a conglomeration of interrelated risks. Unhealthy lifestyle patterns are more prevalent in deprived communities which means these groups are more likely to develop physical health conditions such as raised blood pressure and obesity that

are precursors to NCDs [6]. Families in deprived areas are likely to experience greater stresses that are in turn related to unhealthy behaviour [6]. Finally, communities in deprived areas are likely to be living in areas with a range of environmental risk factors such as pollution [6], lack of access to high quality green space [7,8], and high density/poor quality built environments [9], which can both directly, and indirectly via behaviour, influence the progression of disease [6].

Recognition of the importance of the built environment in determining health outcomes is nothing new. Indeed, poverty, impoverished environments, and poor health was observed by many of the earliest medical researchers, with social reformers such as Octavia Hill recognising the importance of preserving the common lands and parks to provide lungs for city dwellers [10]. These environmental injustices serve to heighten health inequalities and, as they are spatially persistent, are hard to address. It is very difficult to change patterns of spatial injustice in the city, such as the location of polluting factories, unsafe roads, or lack of access to parks. For example, in a study of mortality in relation to poverty in childhood, it was found that "the fundamental relation between spatial patterns of social deprivation and spatial patterns of mortality is so robust that a century of change in inner London has failed to disrupt it" [11].

The difficulties in changing environments means that historically, efforts to improve lifestyle behaviours have targeted individual behaviour change [12], which is problematic as it assumes equal agency between different population groups. For families living in deprived areas where there are structural barriers, such as constraints on walking, fast food swamps, high levels of traffic, lack of green space, or fears about safety, it can be more difficult to lead a healthy lifestyle. The risk then is that policies focusing on individual behaviour change only serve to heighten health inequalities [13], with more affluent groups being better able to take advantage of preventive activities, thus improving health, whilst less affluent groups are left behind. Interventions which aim to improve environmental determinants of health have the potential to reduce inequalities, if efforts are targeted in areas of most need.

Our own recent meta-narrative review of 108 studies [14] exploring associations between built environment indicators and health outcomes found ten built environment categories implicated in children's health. These included residential density, street connectivity, land use diversity, walkability, pedestrian infrastructure, physical activity facilities, availability of open space, safety from traffic and crime, traffic levels and social support for undertaking activities such as active travel. Health outcomes typically measured included physical activity or active travel, and obesity. However, we found a wide variation in the ways in which built environment indicators were conceptualised and measured across different disciplines which hampered interpretation of the literature. We posit that it is important to understand the built environment at 'street scale' to appropriately capture the characteristics of the built environment at the scale at which they are experienced by users on the ground.

Previous reviews of intervention studies have suggested a potential role for environmental factors in influencing health behaviours, predominantly physical activity. In an umbrella review covering a variety of place-based interventions, McGowan et al. identified infrastructure changes related to housing, provision of active travel infrastructure, public transport and amenities, and green space to be potentially linked to health outcomes, in particular, physical activity [15]. They raised a note of caution in that some of these 'place-based' interventions required active change from local residents in order to improve health. For example, improvements to cycle paths are only beneficial if residents actively use the new facilities [15], and improvements to green spaces will result in increased use only if communities feel safe using these spaces [16].

Three reviews focusing specifically on urban green space interventions found some evidence that multi-component interventions combining infrastructure changes with other approaches designed to encourage use of green space were effective in increasing physical activity amongst children and adults [17–19], and that involving communities in redesign-

ing spaces was associated with increases in park use [19], but that there was too little evidence to draw conclusions about whether these interventions had a measurable impact on health inequalities [18].

There has been limited research focused on built environment interventions targeted at young people. In their review, Audrey and Batista-Ferrer [20] found some evidence to support interventions to reduce road traffic injuries (e.g., 20 mph zones or walking infrastructure improvement), and active travel interventions (including changes to the built environment) as important for children. Similar to Hunter et al. [18], they reported that few studies explicitly examined impact on health inequalities. All of the reviews discussed above highlighted a number of methodological issues with the types of evaluations presented likely to introduce substantial sources of bias, for example, non-randomised designs, lack of control groups, quality of outcome measures, literature which hinders our ability to make conclusions about their utility. Further, Roberts et al. [19] commented on the inadequate description of intervention content, potentially hindering replicability.

The aim of this study was to review the evidence of built environment interventions on children's health outcomes. We chose to base our review within high and upper-middle income countries as evidence shows that deprived communities experience greater health inequalities in these settings, and thus there is greater potential for impact for effective built environment interventions.

Importantly, our intention was to capture studies of how the urban built environment interacts with children's lives, using keywords that relate to streets, in order to capture studies that considered the built environment as a measurable, human-scale environment. We also aimed to describe key intervention features and quality of studies and provide recommendations for researchers working in this area.

2. Materials and Methods

This systematic review of published literature was completed by a multidisciplinary team. Given the methodological considerations raised in previous reviews, we kept our inclusion broad to capture a range of study designs. A PICO summary was created to guide the review process as follows:

Population of interest: Children aged under 18 living in high and upper-middle income countries

Intervention: Any intervention which involved physical changes to street-level built environment. We defined the built environment as the complex space created by the interaction of various physical structures that support human activity such as roads and streets, pavements, buildings, street furniture or open spaces, among others.

Control: Any study design was included—it was not necessary to have a control arm

Outcome: Child health outcomes (for example reported Body Mass Index—BMI) or activities (for example observed park use, parent-reported play or active travel to school).

2.1. Search Strategy

A structured keyword search was conducted in four relevant databases, Medline and Embase (Medical and Biomedical sciences), PsycInfo (Behavioural and Social sciences) and Scopus (Physical sciences, Health Sciences, Social Sciences and Life Sciences) on 8 November 2021. Based on their knowledge of the literature in their fields, the research team identified the keywords for the search within four concepts: (i) Streets, (ii) Built Environment (including urban open spaces or infrastructure, public spaces, or land use), (iii) Health Activities and Health Outcomes and (iv) Children. The full search strategies for all databases are presented in Supplementary Material S1.

2.2. Study Inclusion Criteria

Studies were eligible for full-text review if they included (i) objective or standardised subjective measures of streets and the built environment; (ii) objective or self-reported measures of children's physical activity or health; (iii) considered a permanent or temporary

change or intervention to the built environment; and were (iv) completed from 2010 onwards in upper-middle and high-income countries accordingly to the World Bank classification (http://data.worldbank.org/about/country-classifications, accessed on 8 November 2021). Studies were excluded if they reported (i) interventions which did not change the built environment but only considered changes to policies and/or programmes, (ii) interventions exclusively related to cycling and food environments, or (iii) were reviews, protocols or studies to validate tools or methods or were studies not published in English. Conference papers, books and grey literature were not eligible for inclusion but were inspected to identify relevant references.

2.3. Data Extraction

Two researchers (A.O.-S., R.R.C.M.) extracted the following main characteristics: authors, publication year, study area, study location, study design, sample size, sample age, health activities/health outcomes, methods of analysis and key findings. Another researcher (RM) extracted information on intervention characteristics using the TIDieR (template for intervention description and replication) checklist [21]. Missing information was reported.

2.4. Quality Assessment

Risk of bias and study quality was assessed using a tool adapted from similar reviews of environmental interventions [18,22]. Two reviewers (A.O.-S., R.R.C.M.) independently scored the included studies on eleven criteria. The two independent quality assessments resulted in initial agreement for seven out of ten studies. Disagreements were resolved by discussion. One criterion (attrition) was only scored where studies reported relevant study designs (for example, more than one study period). One point was awarded if the study met the criteria, thus studies could score between 10–11 points. In line with previous reviews, a score of >9 was considered high quality (see full details of the quality assessment criteria in Supplementary Material S2 Table S2.1). The assessment was completed to methodically appraise the risk of bias and uncertainty in the results presented by the reviewed studies. However, the scores were not used as an exclusion criterion as, based on previous reviews, it was anticipated that few studies would be categorised as high quality, considering the intrinsic difficulties associated with the evaluation of built environment interventions.

3. Results

3.1. Study Selection

The search retrieved 941 studies, after removing duplicates, all of which were screened against the eligibility criteria in Title, Abstract and Keywords by two authors. Ten studies were identified as eligible for full-text review (Figure 1).

3.2. Study Characteristics

The ten studies found all involved an intervention to change the street-level built environment and an attempt to evaluate the impact on health outcomes amongst children. Table 1 provides details on the studies. Most were conducted in the USA [23–26] with the remainder in the UK [27,28], Belgium [29], Germany [30] and Chile [31]. One paper reported a multinational intervention conducted across the UK and Canada [32].

The interventions described fell into three main categories: (i) street closure interventions: play streets, involving the temporary closure of streets to motorised vehicles to facilitate outdoor play, physical activity or cycling [23–26,29,31]; (ii) street design interventions: design features of the built environment to promote health [27,30]; (iii) walk to school technology interventions: addition of temporary technology (sensors and swipecards) to incentivise walking to school [28,32]. Five studies explicitly noted that interventions were conducted in areas of high deprivation [23,25,26,30,31]. Four of these were street closure studies. Of these, three studies were reported to have been completed in low-income areas in the US in settings such as Columbus, Ohio [23], and in areas with higher-than-average

rates of disease in Brownsville, Texas [25] and San Francisco [26]. One study was completed in low-income neighbourhoods in Santiago, Chile, in an area also characterized by drug dealing issues [31]. Of the two street design interventions, one was developed in a large housing estate in Leipzig, Germany, with above average unemployment rates, low education levels and below average income levels [30].

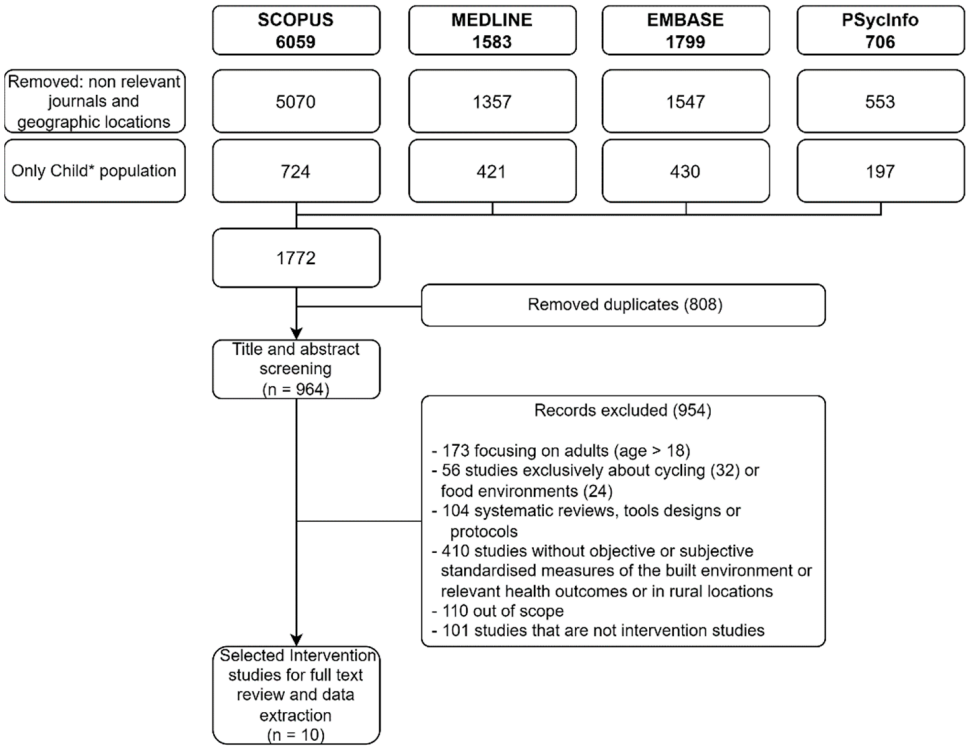

Figure 1. Flow diagram of study selection. (* indicates truncation at the end of the word Child to expand the search to include any ending of the root word child, such as child's, children, childhood).

The age range of children included in the evaluation was specified in five studies, the most common distinctions were between pre-school, children, and teenagers. Adult presence was a consideration in all cases, with some instances taking account of adults as part of a broader analysis of how families respond to an intervention (e.g., [25]), with others focusing on adult supervision of younger children (e.g., [27]). Most recorded male/female numbers, but only five of the ten quantified sex differences. Ethnic differences were recorded and analysed only in one case [25]. The total number of recruited child and teenager participants reported in the papers ranged from 80 [28] to 3817 [32]. Since many of the interventions were temporary events, various studies reported observed participants over the duration of the event as sample sizes; these varied from 293 [31] to 2577 [25].

Primary outcomes assessed in studies centred on physical activity conceptualised as outdoor play or activity [23–27,30], moderate to vigorous physical activity [28,29], step-count [31], and active travel/walking to and from school [32]. Key tools to measure physical outcomes included objective instruments such as accelerometers [28,29], pedometers [31] and swipe card technology [32], standardised observations tools such as the SOPARC [24–26,30], bespoke observation tools [27], or self-reported activity [23,28,31,32]. Some also used surveys or interviews to capture attitudes towards the intervention [23,26,32].

Table 1. Intervention study characteristics.

Study | Origin | Intervention | Quality	Setting	Sample	Outcomes	Design and Analysis
Street closure interventions				
Adhikhari et al., 2021. USA. Play streets (2/10)	One street in a low-income neighbourhood. Columbus, Ohio, USA	N = 69 caregivers of children aged 2–11 (mean age 7) who attended event. 62% of children male N (observed) = 350 children (6 events)	Parent-reported outdoor play (days per week) Parent-reported social connectedness	Cross-sectional, post intervention survey Descriptive analysis
Cortinez-O'Ryan et al., 2017. Chile. Juega en tu Barrio (Play in your neighbourhood) (8/10)	Two neighbourhoods in Santiago. Intervention neighbourhood—85% of population in lower income quintiles. Drug-dealing was common and there had been a recent shooting before the project. Control neighbourhood—93% of population in two lowest income quintiles.	N = 100 Age 4–12 (median age 9 years old for intervention) and 7 years old for control) 51% female 75% low socio-economic position. N (observed) = 293	Objective physical activity (PA): Movband digital pedometer worn over 7 days measuring steps. Parent -reported outdoor play (days per week) Observed physical activity or street use: counts of children in street at key time points during intervention.	Controlled pre-test (pre-intervention)-post-test (last two weeks of the intervention) design Non-parametric inferential statistics (Wilcoxon matched pair, Mann–Whitney U test, McNemar's test)
D'Haese et al. 2015. Belgium. Play streets (7/11)	19 Play Street projects that lasted 7 consecutive days located within Ghent.	N = 167 children, of which 126 has accelerometer data. Age 6–12 (Mean age 9 years, standard deviation 2 years) 55% male 40% has low family socio-economic status	Objective physical activity -moderate to vigorous (MVPA) Objective sedentary time (ST) (Both measurements assessed via accelerometer worn for 8 days and analysed at intervention times 14.00–19.00 and for the entire day)	Non-equivalent control group pretest (occurring during normal week)-posttest (occurring during playstreet week) design. Design was counterbalanced so 'control' condition happened after play street Four level linear regression model was used.
Pollack-Porter et al. 2019. USA. Play streets (3/10)	Chicago, 3rd largest city in US in 2016. Eleven play streets (out of 162 held in summer 2018) included, located in the South region. Target areas were selected for observation.	Age assessed visually by researchers for: child teen, adult or senior. N (observed) = 1741. 1101 children (50% male) and 640 teens (62% male) were observed.	Observed physical activity or street use using SOPARC tool: active or sedentary behaviour.	Descriptive: cross-sectional post intervention; not controlled. Means, standard deviations, and odds ratios reported.
Salazar-Collier et al. 2018. USA. Cyclobias (5/10)	Brownsville, Texas. Town on Texas–Mexico border. One of the poorest cities in the US. Mostly minority city with many low-income residents and documented high rates of disease. 2–3 mile route between parks (4 events)	N (observed) = 5542 participants were observed of which 2577 were children (1646) and teens (931). Age group: child, teen, adult or senior. Adult questionnaire was also distributed (not reported here).	Observed physical activity or street use using SOPARC tool: -by type: cycling, walking, running, other. By intensity: vigorous, moderate, sedentary. (Assessed along route during 15-min intervals within first and third quarter of each hour for which the event was held).	Descriptive; cross-sectional, not controlled. Chi-square test to explore whether physical activity type or intensity varied by age, ethnicity and gender.

Table 1. *Cont.*

Study | Origin | Intervention | Quality	Setting	Sample	Outcomes	Design and Analysis
Zieff et al. 2016. USA. Play streets (4/10)	San Francisco. Low-income neighbourhoods selected (minimum 16% below poverty line), with higher rates than average of chronic disease, and low levels of recreational amenities. 3 Play Street sites, 1 comparison neighborhood San Francisco, USA	N = 541. 429 children in intervention (38.4%) and 12 in comparison (4.9%). 79 teens in interventions (7.1%) and 21 in comparison (8.6%) Ethnicity (overall sample): Intervention: 23.5% White, 28.1% Black, 30.3% Latino, 18.0% others. Comparison: 11.5% White, 57.2% Black, 16.0% Latino, 12.3% Others	Observed physical activity or street use using SOPARC tool. (Participants' activities observed for first 15 min of each of the 4 h of play streets). Reported community engagement.	Cross-sectional, controlled observational evaluation with survey. Comparator neighborhoods were selected based on demographic data (race/ethnicity), recreational amenities and health disparities.
Street design interventions				
Biddulph 2012. UK. Homezones (4/10)	Seven new-build Homezone schemes with a 'comprehensive' range of characteristics.	N (observed) = 420. Pre-school children (64), children (245) and teenagers (111) were observed across the seven schemes	Observed physical activity or street use: 'Passing through', 'active playing', 'hanging out' Time in street: 'briefly', 'a while', 'longer' Social activity: 'talking', 'observing', 'not socializing'.	Case study approach. Cross-sectional post intervention; not controlled. Observations of activity/street use studies during 6-h observation period during summer holidays. Numbers of observations reported.
Igel et al. 2020. Germany. Movement enhancing footpaths (7/10)	A large housing estate in Leipzig, with above average unemployment rates, low education levels and below average income levels. Leipzig (Germany)	N (observed) = 929 503 at baseline (114 young children, 276 children and 113 adolescents) 426 observed at follow-up (75 young children, 252 children and 99 adolescents). Young child (0–5 years). Child (6–12 years). Adolescent (13–18 years).	Observed physical activity or street use using SOPARC tool. Categorised into 1: vigorously active and 0: sedentary/walking.	Natural experiment pre-test (baseline), post-test. Each footpath was observed by trained staff on three days (two weekdays and one Sunday) during school term before (T0, August 2019) and after (T1, Sept/Oct 2019) the changes. Multivariate logistic regression analyses reported.
Walk to school technology interventions				
Coombes and Jones, 2016. UK. Beat the street (8/11)	Three neighbourhoods in the city of Norwich, covering area approximately 5.7 km^2 Two primary schools took part. One in intervention area, and one approximately 7.5 km away on other side of the city. The intervention took place across 9 weeks.	N = 80 children aged 8–10 years old Intervention: N = 51 (62.7% female) Control: N = 29 (41.4% female).	Objective physical activity -moderate to vigorous (MVPA) during school days: (Assessed via ActiGraph GT1M accelerometer). Self-reported travel to school: mode to and from school (assessed via travel diary). Engagement measure: number of times each study participant touched a beatbox with smart card.	Pilot non-randomised controlled evaluation Three time points: baseline (week 0), during intervention (week 7), post intervention (week 20) Multiple regression models adjusting for sex, school year, baseline physical activity level, baseline device wear time and change in device wear time between baseline and post intervention. Conducted an 'intention-t—treat analysis' and a 'per-protocol analysis' which included an engagement measure.

Table 1. *Cont.*

Study | Origin | Intervention | Quality	Setting	Sample	Outcomes	Design and Analysis
Hunter et al. 2015. UK/Canada. Beat the street international competition (4/11)	Included 12 primary and secondary schools from three cities (London and Reading in UK, and Vancouver in Canada). Walking routes to/from school for 12 primary schools in the three cities.	N = 3817 children aged 9–13 (mean age 11.5 (SD 0.7)). 8% recruited from Vancouver, 66% London, and 26% Reading. N = 2068 provided questionnaire data at baseline and N = 1025 at post intervention. UK Figures only: 55% female, 50% White, 13% Asian, 8% Black, 29% other.	Objective travel to school: Number of walks to and from school assessed via the smart card technology. Self-reported travel to school: mode of travel, attitudes towards walking, active travel and social aspects of physical activity.	Uncontrolled pre- and post- mixed methods evaluation Primary outcome (number walks) assessed continuously through 4-week intervention. Survey measures assessed at baseline, and week 4 (immediate post intervention). Descriptive statistics

The level of detail in describing the built environment ranged from the use of geographical data to capture the amount of additional open spaces for play [26], to more descriptive accounts of available amenities and facilities, land-uses (mixed or residential), and type and conditions of housing [27,31]. The latter also described the permeability and connectivity of the sites, distinguishing between streets that were cul-de-sacs and those that were not; streets with designated play areas, and those that simply made it possible by eliminating cars. Biddulph (2012) also measured traffic speed across the sample and provided maps for each of the areas where the intervention was being implemented. The two travel-to-school interventions [28,32] did not systematically describe the built environment.

Study Design and Risk of Bias

Generally, risk of bias was high, with no studies reaching the threshold of 9/11 for 'high quality studies' identified in previous reviews. The predominant missing aspects in the studies were those related to randomisation, exposure and representativeness. No studies used randomisation to assign exposure, and no studies explored whether there was evidence of a concurrent intervention which may have influenced the results. The representativeness of the study populations included in the review were insufficiently described in all included studies.

The strongest papers (scoring > 7/8) reported quasi-experimental studies which included a pre-test/post-test design either with ([31] 8/11, [29] 7/11, [28] 8/11) or without a control group ([30] 7/10). One paper reported a pre–post test design without a control group ([32] 4/10), but scored lower on the quality assessment because the lack of control limited the comparability of baseline characteristics, high attrition (50%) and follow-up was completed immediately post-intervention. One study reported a controlled post-test design ([26] 5/11). Four studies reported post-test evaluations with no control group ([23] 2/10, [27] 4/10, [24] 3/10, [25] 5/10). Supplementary Material S2 (Table S2.2) contains details of risk of bias for the included studies.

3.3. Description of Interventions

Table 2 summarises the key features of the included interventions. A full description of the interventions using The Template for Intervention Description and Replication (TIDieR) can be found in Supplementary Material S3 (Table S3) [33].

The six street-closure interventions generally aimed to create safe opportunities for outdoor play for children and communities. These interventions targeted four separate built environment categories identified as important for children's health [14]: increasing availability or proximity to public open and social spaces, increasing perceptions of safety from traffic and crime, reducing traffic and promoting social support, and other psychosocial factors.

Table 2. Summary of key street closure interventions characteristics.

Intervention [a] Name | [b] Aim | [c] Target Audience	[d] Street Level Change | [e] BE Categories	Additional Activities	Frequency/Dose	Who Delivered	Community Engagement in Development	Costs
Adhikhari et al., 2021: [a] Play streets [b] To create safe opportunities for outdoor play [c] Children aged 5–17	[d] *Temporary:* Closure of residential street block to traffic [e] 1,2,3,4	Various: sports, demonstrations, health screening, free healthy meals.	Every two weeks for 3 h over a two-month period. Total of 4 sessions.	Volunteers to staff the events, police to patrol	Unclear: Local stakeholders were engaged before event.	Not reported. Intervention funded by Healthy Neighbourhoods
Cortinez-O'Ryan et al., 2017: [a] Juega en tu Barrio' (Play in your neighbourhood) [b] To change the neighbourhood's social and physical environment, and individual behaviours in order to increase physical activity and opportunities for play [c] Families with children living in the area	[d] *Temporary:* Closure of four residential street blocks to traffic with traffic cones and wardens [e] 1,2,3,4	Monitoring of behaviour, play materials (e.g., skipping rope, balls, kites) given to children. Group games organised. Communities provided additional activities.	Twice a week for 12 weeks for 3 h between 17.30–20.30. 26 sessions planned; 24 were delivered.	Local community organisation (CicloRecreoVia) and volunteers from local community to turn away cars.	Intervention tailored to local community preference. Meetings were held with neighbours and stakeholders to obtain input on feasibility, acceptability and design. Strategies proposed were included.	The overall intervention cost (resources, uniforms, stewards and coordinator fees) for the 26 sessions was US $2275.
D'Haese et al. 2015: [a] Play streets [b] To change the neighbourhood and social environment to provide safe places to play to increase physical activity and reduce sedentary time. [c] Families with children living in the area	[d] *Temporary:* Closing residential street to traffic using fences/signs [e] 1,2,3,4	City council offers a box with play equipment that can be hired for free during the intervention period. Box includes balloons, flags chalks, sport equipment. Other equipment also available including trampoline, bouncy castle. There is option to apply for one organised activity.	Dependent on community preference. Street can be playstreet for up to 14 days during summer vacation. Duration between 1400–1900	Local community members. Insurance provided by council	Community led intervention. Volunteers have to make an application to apply. Majority of households in the street have to agree with the application. Communities can also organise their own activities (e.g., barbeque).	Not reported
Pollack Porter et al. 2019: [a] Play streets [b] To close streets to create safe places and free opportunities for active play. [c] Families with children living in the area	[d] *Temporary:* Closure of street to traffic to facilitate play [e] 1,2,3,4	Various activities which varied according to location: for example, DJ for dance area, inflatable play spaces, games. Local services were also present at some offering health screening.	Implemented on one day for 3–5 h and were in summer months. A total of 162 play streets were implemented in 2018.	Planning of play streets was facilitated by two commissioned organisations, funded by the Chicago department of public health. These organisations supported local hosting organisations (local neighbourhood organisations) to apply for play streets in their area, including seed corn funds for organisation and activities. Support in programming activities was also provided.	Intervention was delivered by local hosting organisations. No further details given.	Seed grants of between US $4000–5000 paid to two delegate agencies who then selected hosting partners in their respective regions. From this budget, delegate agencies provided hosting partners with seed grants of up to US $1000 to cover staff stipends, food, and money for materials (e.g., jump ropes). In-kind donations were also received.

Table 2. *Cont.*

Intervention [a] Name | [b] Aim | [c] Target Audience	[d] Street Level Change | [e] BE Categories	Additional Activities	Frequency/Dose	Who Delivered	Community Engagement in Development	Costs
Salazar-Collier et al. 2018: [a] CycloBia [b] To close streets to motorized traffic to allow residents the opportunity to engage in physical activity freely. [c] Local Residents	[d] *Temporary:* Closure of 2–3-mile route to motorised traffic, connecting 4 city parks [e] 2,3,4	Physical activity hubs in the city parks offer alternative activities such as free group exercise classes, live music, health concessions and rest areas.	Held between 4–6 times a year on selected streets. Streets closed for 4 h on Friday nights in spring/summer and Sunday afternoons during autumn/winter	The event was hosted by multiple departments and leaders of the city including the mayor, commissioners, Traffic Department, Health Department, Parks and Recreation Department, Police Department, and Transportation Department.	Mentions that the events were supported by a community advisory board, composed of >200 organisations and individuals.	Not reported
Zieff et al. 2016: [a] Play streets [b] Temporarily closing urban streets to vehicular traffic to provide open space for children and youth to play and increase youth activity time [c] Pre-teen youth living in the area, but was open to all	[d] *Temporary:* Temporary closure of 1–2 street blocks to traffic [e] 1,2,3,4	A range of organised activities were provided by the event organisers. Local communities were also encouraged to implement their own activities.	Held at weekend, length of closure not specified. Total of four events held in summer 2013.	Partnership of non-profit organisations in the San Francisco area.	Communities were involved to varying degrees in different communities—in some areas, additional activities were organised, in others, no further activities took place.	Not reported. The Play streets were funded by the Partnership for a Healthier America who selected San Francisco as a pilot site.
Street Design Interventions						
Biddulph 2012: [a] Homezones [b] To redesign streets to prioritise people and not traffic to make them safe places to live and play [c] Families living in the area	[d] *Permanent* Shared surfaces with no clear priorities for cars/pedestrians, natural and non-natural street features/furniture, areas for people to sit, house frontage [e] 4,5	None	N/A	Local developers	Not reported	Not reported
Igel et al. 2020: [a] Movement enhancing footpaths [b] To create attractive places for physical activity (PA) and social interactions and changing social norms with respect to PA and active play in the public sphere. [c] Young children who use footpaths	[d] *Permanent* Decorations (labyrinth, 'mirror me', hopscotch grid) implemented on two footpaths. [e] 4,5	Not reported	N/A	Implemented by the GRUNAU moves community-based health project.	Followed a participatory planning process with 140 students from two primary schools and a landscape architect. Together they developed and piloted the designs. Children voted on the final selection.	Not reported

Table 2. *Cont.*

Intervention [a] Name | [b] Aim | [c] Target Audience	[d] Street Level Change | [e] BE Categories	Additional Activities	Frequency/Dose	Who Delivered	Community Engagement in Development	Costs
Walk to school Technology Interventions						
Coombes and Jones 2016: [a] Beat the Street [b] To 'gamify' physical activity and encourage active travel to and from school [c] Primary school children.	[d] *Temporary* Beat box sensors attached to key outdoor locations [e] 4	Competition between schools to win prizes. Promotion events. Behaviour change techniques: feedback on performance, setting goals, monitoring progress, encouraging comparison, rewarding positive behaviour.	Daily over a nine-week period	Schools were key delivery partners	Not reported	Not reported
Hunter et al. 2015: [a] International walk to school competition (with beat the street) [b] To use an international competition to encourage active travel to school [c] Primary and secondary school children	[d] *Temporary* Sensors attached to lampposts at public transport links and school gates marking walking routes around 1 km in length [e] 4	International competition based on points accumulated by swiping card against sensors on route to school. Incentive: donations to charity based on points accrued. Prizes donated by local businesses. Participants could get feedback on behaviour via a website.	4 week long intervention	Technology developed by a health IT company. Competition implemented by the project team.	Schools could provide their own in-house rewards. No further detail on community engagement provided	Not reported

Built Environment (BE) categories targeted: 1—Availability or proximity to public open spaces, 2—Safety from traffic and crime, 3—Traffic levels, 4—Social support and psychosocial factors, 5—Pedestrian infrastructure/street environment design.

These interventions were all temporary and ranged in frequency including regular events (e.g., twice a week for 12 weeks [31]; every 2 weeks for 2 months [23]; 4–6 times a year [25] to more ad-hoc events [24,26,29]. When implemented, the street closures were in place for a number of hours and tended to be held during the summer months. Closures were mainly within residential blocks, although one study reported city-wide closures of roads totalling 2–3 miles to link up key city parks. Alongside the street closures, a variety of additional activities were implemented. These were primarily based on community preferences and included, for example, organised sports activities for children, providing of entertainment, or provision of information regarding other services available within the area. Additional equipment was often provided, either for group entertainment (e.g., inflatables, such as bouncy castles) or for individuals (e.g., sports equipment). Some playstreet initiatives were directly led by communities who had to apply to be able to hold the event [29]. Other initiatives tailored the activities to community preferences via regular meetings with community representatives [26,31]. It was unclear how communities were engaged in three of the studies [23–25]. Some play streets were supported by commissioned local community members [31], community hosting organisations [24] or non-profit organisations [26]. Most reported using volunteers to help hold the events, for example by helping to enforce the street closure or by holding additional activities. Two studies reported police involvement in helping to patrol streets and enforce road closures. The costs of holding the events were rarely reported, with the exception of one study [31], who reported that overall costs for 26 playstreet sessions was US $2275. Pollack Porter et al. [24] mentioned seed grants of between US $4000–5000 paid to two delegate agencies who then selected hosting partners in their respective regions. From this budget, delegate agencies provided hosting partners with seed grants of up to US $1000 to cover staff stipends, food, and money for materials (e.g., jump ropes).

The two intervention studies which implemented permanent changes to the environment with specific design features did not include any additional community activities. In terms of built environment categories, these targeted pedestrian infrastructure or street environment design, and to the extent that they encouraged communities to use these spaces, they could also increase social support indirectly. The latter type of intervention varied in scope, with the most comprehensive reported by Biddulph [27], which described environment changes to reprioritise streets to make them safe places to play. The types of changes implemented here included having shared surfaces, with no clear priorities for cars or pedestrians, with various types of street furniture designed to encourage individuals to spend time in the environment. The changes were implemented by local developers and local community engagement was not reported. Igel et al. [30] described implementation of movement-enhancing footpaths to create attractive places for children to play. This included a permanent decoration for children's street games which was intended to encourage play. This change was implemented by a community-based health project and was the result of participatory planning process with students from two local primary schools to help decide on the final design. No costs were reported for either intervention reported by the authors.

Finally, two studies [28,32] explored the implementation of a 'beat the street' intervention which was targeted at school children to encourage active travel to school. Reflecting on the 10 built environment categories identified previously [14], these interventions targeted only the social support and psychosocial factors category. The interventions included temporary changes to the local environment around schools by adding 'beat box' sensors to key locations on the route to and from school. Participants were given a swipecard and ask to touch the sensor with their card on the walk to school. This intervention was supported by other activities including competitions between schools based on points accrued and provision of incentives. These interventions were delivered in school and length ranged from four weeks [32] to nine weeks [28]. It was unclear whether schools were involved in the development of the intervention, although some engagement was

reported, where schools developed their own in-house competitions and rewards [32]. The costs of implementing these interventions were not reported.

3.4. Impact of Interventions

Due to the diversity of study designs and measurements, we were not able to summarise findings quantitatively. Below we present a narrative review for each type of intervention, studies with a stronger design are discussed first. Full details can be found in Supplementary Material S4 (Table S4), and the results are summarised in Figure 2.

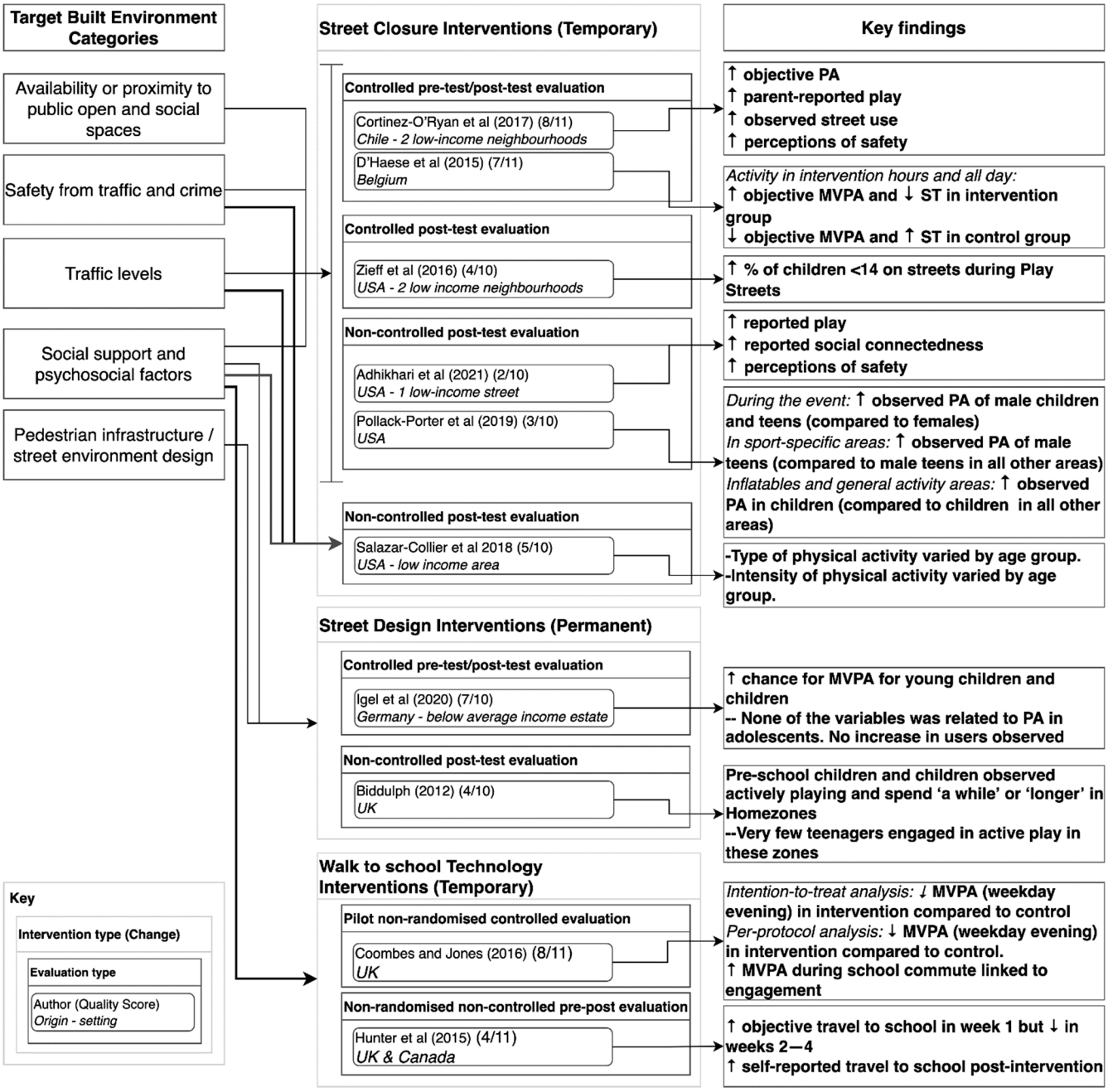

Figure 2. Targeted built environment categories, interventions and key findings.

3.4.1. Street Closure Interventions

Of the two controlled pre-test/post-test evaluations, Cortinez-O'Ryan et al. [31] found a significant increase in the number of steps children took during weekdays and during

intervention hours as assessed via a pedometer, and a corresponding increase in parental self-reported daily and weekly outdoor play. D'Haese et al. [29] found a significant effect of play streets on sedentary behaviour assessed via accelerometry. In the intervention group, sedentary behaviour was lower (138 min/day) when play streets were being implemented than on a normal day than on the non-intervention week (146 min/day). In the control group, sedentary behaviour was higher during the intervention week (164 min/day) than the non-intervention week (156 min/day).

In their post-test controlled evaluation Zieff et al. [26] found that the percentage of children below 14 years of age on the streets increased from 5% to 38% during play streets compared with a comparison day. They also found that there were more instances of children engaging in vigorous physical activity outside as assessed via observations on playstreet days versus comparison days. They did not find much engagement amongst teenagers and they concluded that the focus of the intervention on families might have discouraged teenager involvement.

Two play street interventions reported only post-test, non-controlled evaluations, making it difficult to attribute any patterns in physical activity to the intervention. Adhikhari et al. [23] reported that of 69 caregivers surveyed at the event, 55% said their children played outside on 5–7 weeks, and 16% said they played out 1–2 days a week. They reported that 55% of caregivers said their children would be playing inside if not for the playstreet. Fifty-three percent reported that their children played more as a result of the playstreet. They also reported a range of ancillary benefits including children making new friends, feeling part of the community and availability of health lunches. Pollack Porter et al. [24] observed 1741 children at teenagers across 11 playstreet events. They observed that teenage males were more often observed being physically active than females at the events, and that males were most often seen in areas of the events with sports equipment or facilities. However, within these areas, there were no differences in the amount of physical activity engaged in by males or females. Children were most often active in parts of the event which included inflatables or other general activity areas.

3.4.2. Street Design Interventions

Igel et al. [30] reported a non-controlled pre–post evaluation of decorated footpaths in a deprived district of Leipzig, Germany, which were developed using a participatory approach with local children. Compared to a baseline period, the authors found a greater chance of observing active play on the footpaths. However, the authors reported that no increase in users could be observed. Hence, the footpath intervention was considered as potentially supportive for spontaneous active play 'on the way'

Biddulph [27] presented their findings on Homezones study in a mainly narrative form using a non-controlled post-test evaluation. They conducted limited observations and found the streets were used by a wide range of community members. They observed 40% of pre-school children and 50% of children are actively playing in homezones, but found that very few teenagers engaged in active play in these zones. They found greater numbers of pre-school children and children spending longer in the spaces compared with adults, highlighting the impact of investment in shared space that is designated as car free. Although the costs of these permanent interventions were not specified, the author emphasises that a low budget investment, rather than expensive surface treatments might be just as impactful. The author's insight into urban design principles is apparent in his recommendation that such interventions are located in streets that are well connected to well-used routes.

3.4.3. Walk to School Technology Interventions

A pilot non-randomised controlled evaluation of the Beat the Street intervention [28] was inconclusive, finding a small but significant negative effect of the intervention on levels of moderate to vigorous physical activity in school children, with those in the intervention group reporting on average 7 min less than those in the control group. They found some

evidence of a significant effect with engagement whereby moderate to vigorous physical activity on days when participants actively swiped a beat box sensor were higher, although these effects were small with a cumulative effect of 3.5 min of activity per day across morning and afternoon commutes for children who engaged in the intervention on an average of 14.5 days. However, as this was a pilot study (N = 80 children) it was not powered to find significant effects and thus results should be interpreted with caution. Hunter et al. [32] did not include a control group in their evaluation but reported data from 3817 children who registered to use the swipe cards. Over a four week period they found that the number of walks registered by the swipe cards decreased from 29% in week 1 to 12% in week 4, which the authors noted could be attributed to the timing (at the start of the school year in the autumn, meaning that there was a short lead-in time for the project), and the lack in some instances of clarity regarding roles and responsibilities. A sub-sample of N = 1025 reported questionnaire data ad baseline and post intervention. The figure reporting walking to school at least once a week rose from 77% to 86% post intervention. Both studies, as would be expected, emphasised the importance of incorporating exercise in a child's daily routine.

4. Discussion

This study aimed to review the impact of interventions modifying the built environment at a street level on children's health. Despite the increasing recognition of the importance of the built environment for children's health we found there was limited literature exploring street-level built environment interventions. While recognising the complexity of undertaking studies in the urban built environment, given the challenge of isolating the spatial variable from the myriad other factors that may shape outcomes, we found that many studies were at risk of bias due to study designs lacking a comparator group, or being without baseline measurements. However, of the literature reviewed, it is possible to tentatively conclude that street closure interventions are related to an increase in physical activity or play amongst children. It could additionally be inferred that street closure interventions can have positive impacts in increasing the availability of safe public spaces in deprived settings. There was insufficient evidence to generalise from the results of street design interventions, or interventions that added technology to the local environment to 'gamify' active travel to school.

It was evident that although the interventions reviewed aim to improve children's experience of the street by altering the built environment, there was a lack of description of the specific built environment attributes that relate to the characteristics of the street and to the contextual area where the intervention was to be implemented (e.g., whether it is a residential or a mixed-use street, whether it is a local street or a main road, what type of buildings or land uses are in the block, whether it was shaded or not, and so on). The ten interventions found here highlight this point further: while the studies all captured demographic and socio-economic data in a reasonably consistent manner, the physical setting of the interventions, the specific built environment characteristics of their location, and contextual factors, were rarely described in a consistent way. So, for example, the Beat the Street interventions mention motorised traffic levels, but there is no information on where the children lived in relation to the school, what routes they took, and to what extent fear of traffic impeded their participation. Even maps of the intervention study locales were rarely provided, (the only exception was [27], who provided sketch maps and detailed plans of the designed interventions). Indeed, ref. [31] state that building in GPS and GIS (namely geolocation and spatial analysis) of interventions would "greatly benefit" future research as it would "account for children's location, enhancing the accuracy of the estimation of the intervention's contribution" [31] (p. 13). Moreover, beyond the changes to the built environment, street closure interventions were often multi-component, however, other key information such as other activities taking place, level of community engagement, and costs, were often not reported. This lack of detail when describing the intervention in terms not only of what is being done, but also where it is being done and why, poses yet another

barrier against replicability. For example, lack of consistency was observed for reporting of the socio-economic characteristics of the area and street where the intervention took place and whether the interventions aimed specifically to address safety or accessibility issues in the area. Consequently, safety and improved access to public spaces or to community resources was reported more as an additional benefit than as an achieved aim. Future research should ensure comprehensive reporting of the built environment context in which intervention studies are located to fully contextualise their effects.

In terms of considerations for upstream planning of the built environment, although the evidence from the studies included in this review is not particularly robust, the studies suggest, as it has been found in previous reviews, that there is scope to widen intervention types. Rather than focusing on permanent changes to physical infrastructure or radical transformations of the built environment for eliciting healthier behaviours, the evidence suggests that soft (namely removable) and temporary measures can deliver increases in positive health outcomes such as play, physical activity and increases in social connections while the intervention is in place. Caveats remain regarding whether there are benefits to the entire population or whether the interventions that are positive for children are also positive for teenagers. Similarly, our review shows that a question remains about whether the studied interventions can have a greater positive impact if the community is actively engaged in the design and delivery of the intervention. Evidence from the public health field has suggested that community led and/or delivered interventions are effective at improving a range of health outcomes [34]. From the studies we reviewed in relation to changing the built environment, it seems plausible that increased community engagement could not only result in even better health outcomes, but also in positive process outcomes related to strengthening the social capital in the community alongside an increased sense of ownership of the interventions. Indeed, research suggests that not only are real-world changes in the built environment important in soliciting more reliable evidence, by involving the communities in which behaviour change is sought, a greater attention to the wider socio-cultural context will be held [35], improving the likelihood of impact [34].

One of the unique aspects of our review relates to our approach to describing the interventions. We used the TIDieR framework [33] as a concise and comprehensive reporting structure. In addition, we expanded the framework in two ways. Firstly, we applied a systematic approach to categorising the content of interventions that effectively expanded the TIDieR framework with our previous categorisation of key built environment indicators to measure in studies of child health [14]. We incorporated the targeted built environment categories in the TIDieR framework as we propose that the description of interventions needs a more precise account of the anticipated changes to the built environment. This description of the built environment changes can be approached in a systematic manner by following the 10 key categories relevant to children's health [14]. Secondly, we included more detail regarding the level of community engagement for the design and implementation of the intervention as we assessed this was needed in order to capture clear evidence on the study's setting in order to enhance the replicability of the intervention. Finally, our updated reporting frameworks explicitly describes the level of engagement and results by sex, ethnicity and different age categories (especially differentiating children and teenagers), however, we found these details were rarely reported in the reviewed studies, which highlighted that greater precision in the reporting of these items was needed.

We found a wide range in the quality of evaluations assessed against standard checklists, with few studies that could be classified as 'high quality'. It is notable that despite concerns with the design of built environment intervention evaluations raised by reviewers in 2015 [17,20], there has apparently been limited advancement in the field. We must acknowledge that evaluating street-based interventions, especially temporary ones, is very challenging. Following the strict rules that are commonly used for public health evaluation where the randomised controlled trial is seen as the 'gold standard' [36] is challenging on a number of levels. Built environment interventions can rarely be randomised, and

researchers are often dependent on external partners to implement such interventions, making it hard to control research timelines if unexpected factors hinder progress. Selection bias can also be an issue. For example, if the built environment is improved to provide more opportunities for physical activity, this may result in those individuals who are already more active moving to the neighbourhood, making it difficult to ascertain if the intervention has increased activity in those not already active [37]. However, there are opportunities to strengthen the evidence based in this area. We encourage researchers when designing evaluations to consider including control sites where possible, ideally matched by key neighbourhood characteristics such ethnicity, socio-economic status and built-environment characteristics (e.g., walkability); to include both baseline and multiple follow-up data collection to explore whether interventions can effect change over the longer term; to use standardised tools to assess health related outcomes; and to include qualitative approaches to consider the context and mechanisms which might affect the success or failure of interventions [38]. These suggestions will facilitate understanding of the potential longevity of the intervention, and could also serve as a proof of concept to highlight the value or the need associated with making the intervention (e.g., a street closure) permanent, for example by pedestrianizing certain streets.

However, even the best designed evaluations will have limited replicability if the key features of the intervention are not adequately described. We therefore recommend use of the adapted TIDieR framework which incorporates a detailed description of how the built environment is modified, using the 10 indicator list reported in our recent meta-narrative review of the associations between built environment measurements and child's health (Ortegon-Sanchez et al., 2021). In addition, the extent to which communities are involved in the design (and maintenance) of built environment interventions should be reported, along with costs of delivery. We also acknowledge that in many cases the practitioners implementing the interventions might not have the resources to allocate to conducting monitoring and evaluation, which is why we are suggesting an adapted TIDieR framework as a simple, yet thorough, tool to start the process of presenting comprehensive and systematic descriptions of the key elements of these types of interventions. We invite others to build upon our proposed framework in future research and implementation to aid standardisation of reporting in this field. Where possible, we urge those funding built environment interventions to ensure that there are resources for conducting evaluations using qualitative or quantitative methods (for example, controlled pre and post evaluations using standardised outcome measures).

We mentioned at the start the persistence of built environment obstacles to poor health, and how deprivation is disproportionately aligned with an impoverished built environment. A recent paper highlights our concluding point: that the social determinants of health "are socially distributed and that their influence on health may not be equal across socioeconomic groups" [39] (p. 999)—importantly, the physical characteristics of children's home environment is more significant than for the population at large. While the authors highlight the quality of housing and the importance of access to a garden, it is clear from our own research that the outdoor surroundings of home are just as important, especially in areas where indoor and private play spaces are limited. Thus, a focus on interventions in such environments would help even out the unevenness of children's environments and help improve their long-term health outcomes. Policy and decision-makers should work with communities to prioritise built environment interventions in areas of higher deprivation, to provide communities with safe, accessible, well maintained and welcoming environments which promote healthy behaviours. Moreover, policy makers should focus on establishing close collaborations with the communities in deprived areas to, as much as possible, facilitate the co-production of these health promoting interventions so that the communities can shape the interventions to address their needs, and so that they feel a sense of ownership of the intervention which will, most likely, lead to better outcomes.

5. Strengths and Limitations

Our study had a number of strengths. It was conducted by a multi-disciplinary team incorporating expertise from the built environment, transport and public health. It focused on interventions at the 'street' level in order to capture the most meaningful aspects of everyday use of the children's local environment and applied a standardised approach to describe the content of interventions in order to aid identification of key intervention ingredients. However, there were some limitations. We found limited published evidence in this area, with all identified studies focusing solely on physical activity or play outcomes. Indeed, many studies are also inconsistent in the way they measure physical activity, for which standardised and validated measurements would be additionally beneficial (Sones et al., 2019). There were also limitations with the design of evaluations and description of interventions which made it difficult to assess their impact. Our review focused on published literature and did not include grey literature where it is possible there could be other examples of built environment interventions. However, given that other authors have highlighted inconsistencies with reporting of interventions and a lack of formal evaluation methods in grey literature in this area (e.g., [40]), we suspect that their exclusion has not impacted on our ability to summarise the state of the literature in this field. We focused our review in high and upper-middle income countries, which means the limited conclusions we can draw may not have relevance to lower income areas.

6. Conclusions

Modifying the built environment to improve children's health offers an exciting opportunity to improve health, especially for those living with deprivation, due to the propensity of impoverished children living in areas which suffer from being polluted, obesogenic, and so on. However, at present there is limited evidence on what types of built environment changes might result in the most significant health improvement. We found the current state of literature to be narrow in focus, with many methodological weaknesses relating to intervention description, evaluation design and the selection of outcome measures. From our review, we can tentatively infer that street closure interventions may be effective in increasing physical activity and play in children. It seems likely also that interventions that involve the local community in the design stages are more likely to affect change. We can also conclude that the state of intervention evidence in this area is sorely lacking, which we suspect is due in part to the difficulties of conducting 'real world' evaluations in this area. In the face of competing budget demands, this lack of evidence may limit the confidence of policy-makers in making investments in the built environment to improve health. To overcome these obstacles and build the evidence base in this area it will be important for researchers to work closely with policy and decision-makers at all stages of the planning process. Researchers need to be responsive and flexible in their approach to deal with unanticipated delays or opportunities, and to recognise the time and budgetary constraints of work in policy domains. Policy makers need to commit to involving researchers at an early stage of planning to ensure that before/after testing is made possible so that adequate evaluation of interventions can take place. Together with the focus on evaluation, a focus on systematically reporting the interventions characteristics, costs and identified effects, using a framework as the one suggested in this review, will provide a better understanding of how interventions at the street level can have an effect on children's health and how they can be replicated. Hence, a commitment to better evaluation and reporting of interventions constitutes an opportunity to shape the pathways to rebalancing the inequalities of children's health environments.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/ijerph19095227/s1, Supplementary Material S1 Full search strategies for all databases. Supplementary Material S2: Table S2.1: Quality Assessment Criteria and Results; Table S2.2: Adapted quality assessment results; Supplementary Material S3: Table S3: TIDieR analysis of the interventions. The Template for Intervention Description and Replication (TIDieR) a

standardised checklist and guide commonly used to analyse health interventions; Supplementary Material S4: Table S4: Effect of interventions.

Author Contributions: Conceptualization, R.R.C.M., L.V., N.C. and A.O.-S.; methodology, R.R.C.M., L.V., N.C. and A.O.-S.; formal analysis, R.R.C.M., L.V. and A.O.-S.; investigation, A.O.-S.; writing—original draft preparation, R.R.C.M., L.V. and A.O.-S.; writing—review and editing, R.R.C.M., L.V., N.C. and A.O.-S.; visualization, A.O.-S.; supervision, R.R.C.M. and L.V.; project administration; funding acquisition, R.R.C.M., L.V. and N.C. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the UK Prevention Research Partnership (MR/S037527/1), which is funded by the British Heart Foundation, Cancer Research UK, Chief Scientist Office of the Scottish Government Health and Social Care Directorates, Engineering and Physical Sciences Research Council, Economic and Social Research Council, Health and Social Care Research and Development Division (Welsh Government), Medical Research Council, National Institute for Health Research, Natural Environment. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. R.R.C.M. is supported by the National Institute for Health Research Applied Research Collaboration for Yorkshire and Humber (NIHR200166). The views expressed in this paper are those of the authors and not necessarily those of the NIHR or UK Department of Health and Social Care.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. World Health Organization. *Noncommunicable Diseases: Key Facts*; World Health Organization: Geneva, Switzerland, 2021.
2. Jaddoe, V.W.V.; Felix, J.F.; Andersen, A.-M.N.; Charles, M.-A.; Chatzi, L.; Corpeleijn, E.; Donner, N.; Elhakeem, A.; Eriksson, J.G.; Foong, R.; et al. The LifeCycle Project-EU Child Cohort Network: A federated analysis infrastructure and harmonized data of more than 250,000 children and parents. *Eur. J. Epidemiol.* **2020**, *35*, 709–724. [CrossRef]
3. Lioret, S.; Campbell, K.J.; McNaughton, S.A.; Cameron, A.J.; Salmon, J.; Abbott, G.; Hesketh, K.D. Lifestyle Patterns Begin in Early Childhood, Persist and Are Socioeconomically Patterned, Confirming the Importance of Early Life Interventions. *Nutrients* **2020**, *12*, 724. [CrossRef] [PubMed]
4. Lawrence, E.; Mollborn, S.; Goode, J.; Pampel, F. Health Lifestyles and the Transition to Adulthood. *Socius* **2020**, *6*, 1–17. [CrossRef]
5. Marmot, M.; Friel, S.; Bell, R.; Houweling, T.A.; Taylor, S.; on behalf of the Commission on Social Determinants of Health. Closing the gap in a generation: Health equity through action on the social determinants of health. *Lancet* **2008**, *372*, 1661–1669. [CrossRef]
6. Marmot, M.; Bell, R. Social determinants and non-communicable diseases: Time for integrated action. *BMJ* **2019**, *364*, l251. [CrossRef]
7. Rigolon, A. A complex landscape of inequity in access to urban parks: A literature review. *Landsc. Urban Plan.* **2016**, *153*, 160–169. [CrossRef]
8. McEachan, R.R.; Yang, T.C.; Roberts, H.; Pickett, K.E.; Arseneau-Powell, D.; Gidlow, C.J.; Wright, J.; Nieuwenhuijsen, M. Availability, use of, and satisfaction with green space, and children's mental wellbeing at age 4 years in a multicultural, deprived, urban area: Results from the Born in Bradford cohort study. *Lancet Planet. Health* **2018**, *2*, e244–e254. [CrossRef]
9. Gelormino, E.; Melis, G.; Marietta, C.; Costa, G. From built environment to health inequalities: An explanatory framework based on evidence. *Prev. Med. Rep.* **2015**, *2*, 737–745. [CrossRef]
10. Power, A. *City Survivors: Bringing up Children in Disadvantaged Neighbourhoods*; Policy Press: Bristol, UK, 2007. [CrossRef]
11. Dorling, D.; Mitchell, R.; Shaw, M.; Orford, S.; Smith, G.D. The Ghost of Christmas Past: Health effects of poverty in London in 1896 and 1991. *BMJ* **2000**, *321*, 1547–1551. [CrossRef] [PubMed]
12. Kriznik, N.M.; Kinmonth, A.L.; Ling, T.; Kelly, M.P. Moving beyond individual choice in policies to reduce health inequalities: The integration of dynamic with individual explanations. *J. Public Health* **2018**, *40*, 764–775. [CrossRef] [PubMed]
13. Capewell, S.; Graham, H. Will Cardiovascular Disease Prevention Widen Health Inequalities? *PLoS Med.* **2010**, *7*, e1000320. [CrossRef] [PubMed]
14. Ortegon-Sanchez, A.; McEachan, R.R.C.; Albert, A.; Cartwright, C.; Christie, N.; Dhanani, A.; Islam, S.; Ucci, M.; Vaughan, L. Measuring the Built Environment in Studies of Child Health—A Meta-Narrative Review of Associations. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10741. [CrossRef]
15. McGowan, V.J.; Buckner, S.; Mead, R.; McGill, E.; Ronzi, S.; Beyer, F.; Bambra, C. Examining the effectiveness of place-based interventions to improve public health and reduce health inequalities: An umbrella review. *BMC Public Health* **2021**, *21*, 1888. [CrossRef] [PubMed]

16. Cronin-De-Chavez, A.; Islam, S.; McEachan, R.R. Not a level playing field: A qualitative study exploring structural, community and individual determinants of greenspace use amongst low-income multi-ethnic families. *Health Place* **2019**, *56*, 118–126. [CrossRef] [PubMed]
17. Hunter, R.F.; Christian, H.; Veitch, J.; Astell-Burt, T.; Hipp, J.; Schipperijn, J. The impact of interventions to promote physical activity in urban green space: A systematic review and recommendations for future research. *Soc. Sci. Med.* **2015**, *124*, 246–256. [CrossRef]
18. Hunter, R.; Cleland, C.; Cleary, A.; Droomers, M.; Wheeler, B.; Sinnett, D.; Nieuwenhuijsen, M.; Braubach, M. Environmental, health, wellbeing, social and equity effects of urban green space interventions: A meta-narrative evidence synthesis. *Environ. Int.* **2019**, *130*, 104923. [CrossRef] [PubMed]
19. Roberts, H.; McEachan, R.; Margary, T.; Conner, M.; Kellar, I. Identifying Effective Behavior Change Techniques in Built Environment Interventions to Increase Use of Green Space: A Systematic Review. *Environ. Behav.* **2016**, *50*, 28–55. [CrossRef]
20. Audrey, S.; Batista-Ferrer, H. Healthy urban environments for children and young people: A systematic review of intervention studies. *Health Place* **2015**, *36*, 97–117. [CrossRef]
21. Hoffmann, T.C.; Glasziou, P.P.; Boutron, I.; Milne, R.; Perera, R.; Moher, D.; Altman, D.G.; Barbour, V.; Macdonald, H.; Johnston, M.; et al. Better reporting of interventions: Template for intervention description and replication (TIDieR) checklist and guide. *BMJ* **2014**, *348*, g1687. [CrossRef]
22. Twohig-Bennett, C.; Jones, A. The health benefits of the great outdoors: A systematic review and meta-analysis of greenspace exposure and health outcomes. *Environ. Res.* **2018**, *166*, 628–637. [CrossRef]
23. Adhikhari, D.; Henderson, T.; Dolce, M.; Banks, A.; Zaim, H.; Onwuka, A.; Jones, N. An evaluation of PlayStreets in the South Side neighborhood of Columbus, Ohio. *Perspect. Public Health* **2021**, *141*, 97–101. [CrossRef]
24. Porter, K.M.P.; Prochnow, T.; Mahoney, P.; Delgado, H.; Hamilton, C.N.B.; Wilkins, E.; Meyer, M.R.U. Transforming City Streets To Promote Physical Activity And Health Equity. *Health Aff.* **2019**, *38*, 1475–1483. [CrossRef] [PubMed]
25. Salazar-Collier, C.L.; Reininger, B.; Gowen, R.; Rodriguez, A.; Wilkinson, A. Evaluation of Event Physical Activity Engagement at an Open Streets Initiative Within a Texas–Mexico Border Town. *J. Phys. Act. Heath* **2018**, *15*, 605–612. [CrossRef]
26. Zieff, S.G.; Chaudhuri, A.; Musselman, E. Creating neighborhood recreational space for youth and children in the urban environment: Play(ing in the) Streets in San Francisco. *Child. Youth Serv. Rev.* **2016**, *70*, 95–101. [CrossRef]
27. Biddulph, M. Radical streets? The impact of innovative street designs on liveability and activity in residential areas. *Urban Des. Int.* **2012**, *17*, 178–205. [CrossRef]
28. Coombes, E.; Jones, A. Gamification of active travel to school: A pilot evaluation of the Beat the Street physical activity intervention. *Health Place* **2016**, *39*, 62–69. [CrossRef] [PubMed]
29. D'Haese, S.; Van Dyck, D.; De Bourdeaudhuij, I.; Deforche, B.; Cardon, G. Organizing "Play Streets" during school vacations can increase physical activity and decrease sedentary time in children. *Int. J. Behav. Nutr. Phys. Act.* **2015**, *12*, 14. [CrossRef]
30. Igel, U.; Gausche, R.; Krapf, A.; Lück, M.; Kiess, W.; Grande, G. "Movement-enhancing footpaths"—A natural experiment on street design and physical activity in children in a deprived district of Leipzig, Germany. *Prev. Med. Rep.* **2020**, *20*, 101197. [CrossRef]
31. Cortinez-O'Ryan, A.; Albagli, A.; Sadarangani, K.P.; Aguilar-Farias, N. Reclaiming streets for outdoor play: A process and impact evaluation of "Juega en tu Barrio" (Play in your Neighborhood), an intervention to increase physical activity and opportunities for play. *PLoS ONE* **2017**, *12*, e0180172. [CrossRef]
32. Hunter, R.F.; De Silva, D.; Reynolds, V.; Bird, W.; Fox, K.R. International inter-school competition to encourage children to walk to school: A mixed methods feasibility study. *BMC Res. Notes* **2015**, *8*, 19. [CrossRef]
33. Cotterill, S.; Knowles, S.; Martindale, A.-M.; Elvey, R.; Howard, S.; Coupe, N.; Wilson, P.; Spence, M. Getting messier with TIDieR: Embracing context and complexity in intervention reporting. *BMC Med Res. Methodol.* **2018**, *18*, 12. [CrossRef]
34. O'Mara-Eves, A.; Brunton, G.; Oliver, S.; Kavanagh, J.; Jamal, F.; Thomas, J. The effectiveness of community engagement in public health interventions for disadvantaged groups: A meta-analysis. *BMC Public Health* **2015**, *15*, 129. [CrossRef] [PubMed]
35. Sones, M.; Fuller, D.; Kestens, Y.; Winters, M. If we build it, who will come? The case for attention to equity in healthy community design. *Br. J. Sports Med.* **2018**, *53*, 467–468. [CrossRef] [PubMed]
36. Zimmerman, F.J. Population Health Science: Fulfilling the Mission of Public Health. *Milbank Q.* **2020**, *99*, 9–23. [CrossRef] [PubMed]
37. Boone-Heinonen, J.; Guilkey, D.K.; Evenson, K.R.; Gordon-Larsen, P. Residential self-selection bias in the estimation of built environment effects on physical activity between adolescence and young adulthood. *Int. J. Behav. Nutr. Phys. Act.* **2010**, *7*, 70. [CrossRef]
38. Panter, J.; Guell, C.; Humphreys, D.; Ogilvie, D. Title: Can changing the physical environment promote walking and cycling? A systematic review of what works and how. *Health Place* **2019**, *58*, 102161. [CrossRef]
39. Pearce, A.; Dundas, R.; Whitehead, M.; Taylor-Robinson, D. Pathways to inequalities in child health. *Arch. Dis. Child.* **2019**, *104*, 998–1003. [CrossRef]
40. Bridges, C.N.; Prochnow, T.; Wilkins, E.C.; Porter, K.M.P.; Meyer, M.R.U. Examining the Implementation of Play Streets: A Systematic Review of the Grey Literature. *J. Public Health Manag. Pract.* **2020**, *26*, E1–E10. [CrossRef]

children

MDPI

Article

Testing the Mystic School Mobile Application to Promote Active Commuting to School in Spanish Adolescents: The PACO Study

Romina Gisele Saucedo-Araujo [1], Francisco Javier Huertas-Delgado [2,*], Yaira María Barranco-Ruiz [3], Isaac José Pérez-López [4], Susana Aznar-Laín [5,6], Palma Chillón [1] and Manuel Herrador-Colmenero [1,2]

1 Department of Physical Education and Sports, PROFITH "PROmoting FITness and Health through Physical Activity" Research Group, Sport and Health University Research Institute (iMUDS), Faculty of Sport Sciences, University of Granada, 18011 Granada, Spain
2 La Inmaculada Teacher Training Centre, University of Granada, 18013 Granada, Spain
3 Department of Physical Education and Sports, PROFITH "PROmoting FITness and Health through Physical Activity" Research Group, Sport and Health University Research Institute (iMUDS), Faculty of Education and Sport Sciences, University of Granada, 52071 Melilla, Spain
4 Department of Physical Education and Sports, "Educación Física y Transformación Social", SEJ546 Research Group, Faculty of Sport Sciences, University of Granada, 18071 Granada, Spain
5 PAFS Research Group, Faculty of Sports Sciences, University of Castilla-La Mancha, 13071 Toledo, Spain
6 CIBER of Frailty and Healthy Aging (CIBERFES), 28029 Madrid, Spain
* Correspondence: fjhuertas@ugr.es; Tel.: +34-958-20-58-61; Fax: +34-958-28-74-69

Abstract: Active commuting to and/or from school (ACS) is an opportunity to increase daily physical activity (PA) levels in young people. Mobile-device interventions focused on promoting the practice of health-related PA can be more cost-effective than traditional interventions in this population. Objective: To analyze the adolescents' opinion of the mobile application (app) Mystic School, which was designed to promote ACS in Spanish adolescents. Methods: A total of 44 students (14–15 years old) from Granada and Jaén participated in the test of the Mystic School app during two phases: phase 1 (n = 10) for 2 weeks and phase 2 (n = 34) for 1 month. Each phase included an app presentation, a follow-up, and focus group sessions. The qualitative analysis was carried out through NVivo software. Results: In phase 1, adolescents reported improvements in the design and functioning, such as the avatar movement, virtual steps utilities, and multiplayer function. These suggestions were included in phase 2. After phase 2, adolescents reported that it is important to add the possibility of playing without an Internet connection to the game, to include more competitive options, prizes, and to increase the difficulty of the levels. In both phases, problems with the step number counting remained. Conclusion: The Mystic School app can be a useful tool for the physical education teacher to integrate the content from this curriculum related to the promotion of PA, such as ACS.

Keywords: exercise; health; technologies; physical education lesson; school-based intervention

Citation: Saucedo-Araujo, R.G.; Huertas-Delgado, F.J.; Barranco-Ruiz, Y.M.; Pérez-López, I.J.; Aznar-Laín, S.; Chillón, P.; Herrador-Colmenero, M. Testing the Mystic School Mobile Application to Promote Active Commuting to School in Spanish Adolescents: The PACO Study. *Children* **2022**, *9*, 1997. https://doi.org/10.3390/children9121997

Academic Editor: Zoe Knowles

Received: 7 November 2022
Accepted: 15 December 2022
Published: 19 December 2022

1. Introduction

The socio-ecological model for active living [1] comprises four domains of physical activity (PA): recreation activities, active transport, occupational activities, and household activities. Consequently, increasing the time devoted to the active-transport domain throughout the day is important to achieve an active lifestyle. In this sense, active commuting to and/or from school (ACS) should be important for young people. ACS is defined as the use of active modes of transportation, such as walking, cycling, or skateboarding, which employs energy expenditure for commuting to and/or from school [2]. Thus, ACS has been considered an alternative for improving individual health by accumulating daily PA [3], as well as providing many benefits, such as improvements to body composition, cardiorespiratory fitness [4,5], and psychological health with better self-efficacy and autonomy [6].

Additionally, ACS offers benefits for the environment, such as reductions in air pollution and traffic jams [7]. Despite the individual and social benefits, the trends in ACS have decreased in some countries (i.e., the Czech Republic [8], the United States [9], England [10], and Canada [11]). A recent Spanish study [12] showed that around 60% of adolescents used ACS, remaining stable between 2010 and 2017. According to the scientific literature on the interventions that were carried out, there is a need for high-quality and attractive interventions to maintain or increase ACS behavior in children and adolescents [2,13,14].

From this perspective, the growing number of mobile-device users has created opportunities to develop attractive mobile applications (apps) [15] that convert the mobile phone into an effective tool to increase adherence to PA interventions [16]. Accordingly, mobile apps are attractive to young people because of their easy daily use and the large number of options. In this line, an alternative strategy to replace passive with active screen time is using the mobile device through active video games (AVGs), which require PA to play the game, more than conventional hand-controlled games [17]. In the last few years, AVGs, or "exergames", emerged as an innovative intervention to increase PA levels with the aim of reducing childhood obesity [18].

AVG-based interventions to increase PA levels have been frequently implemented from primary schools to universities [19–21]. In concordance with a recent systematic review, AVGs can be an effective tool for adolescents [22]. Therefore, due to their potential benefits, AVGs need to be investigated in depth. Qualitative research through focus groups is currently used as a self-contained method and in combination with other research methods, such as surveys or in-depth interviews [23]. Focus groups are very useful in testing new products or concepts in order to guarantee their success [24], as is the case in the present study. Consequently, to ensure the success of the app, it is necessary to know the users' opinions.

To our knowledge, even though ACS is a potential PA domain to be promoted in young people, there are few interventions or tools based on AVGs using mobile apps that have been developed and tested considering the opinions of adolescents. Thus, the aim of this study was to analyze the adolescent's opinion of the mobile app Mystic School, designed to promote ACS in Spanish adolescents.

2. Materials and Methods

2.1. Study Design

This study adopted a qualitative research methodology based on focus groups. This type of qualitative methodology consists of a group of individuals selected and assembled by researchers to discuss and comment on, from their personal experience, the subject of the research [24]. Specifically, in the present study, an AVG app called Mystic School was the product analyzed and improved by focus groups considering their user experience.

2.2. Description of the Mystic School App

The Mystic School is a mobile app based on an AVG whose main purpose is to encourage walking as a mode of commuting to increase the levels of daily PA in young people. The Mystic School software was designed for the Android Operation System from the Spanish 4.0 version (Ice Cream Sandwich) and posteriors. For its functionality, the Mystic School app includes an accelerometer and a GPS to record the number of steps and distance. Real steps while adolescents walk during the day are transformed into virtual steps to complete the game. These virtual steps allow players to move an avatar through the different Mystic School screens, which are organized as different levels inside a maze. The video game is placed in a school context. The first screen (level 1) starts when the player finishes a physical education (PE) lesson, and the teacher asks the player and his/her classmates to help pick the material up. From here, the players need to accumulate real steps to be able to move the avatar within the game in order to collect the materials that the PE teacher has requested. In the storage room, they find a strange ball that transports them to a school in ruins, located in the parallel universe of Mystic School (Figure 1). Every

task completed in the game allows them to obtain rewards to continue advancing to the different levels of the game through different screens.

Figure 1. Registration in the video game and first explanation screen (Spanish version).

The Mystic School app may be played individually or with up to 3 players (in the same group). Each adolescent must choose an avatar. The virtual steps may help the students obtain different objects and prizes while they advance toward the last level. In addition, in the app, the student can choose a "special skill" (see Figure 2). Each skill is an advantage for each player (two players cannot have the same skill in the same group).

Figure 2. User registration and special skill selection (Spanish version).

The four skills are:

- "Eyes of Lynx": Discover the contents of the treasure chest (in each level of play, there are different chests with hidden objects) before it is opened;
- "Spirit of Chronos": Recorded steps are worth twice as much when collected during a 30 min period per day (e.g., from 12:00 to 12:30);
- "Eternal Friendship": Share steps with another avatar in the same group;
- "Arm of Hercules": Share an item with another avatar in the same group.

2.3. Participants and Recruitment

Participants of this qualitative study belonged to the "Pedalea y Anda al cOle: PACO" (Cycling and Walk to School) study. The PACO study was designed to encourage ACS among Spanish students within the PE curriculum for compulsory secondary education (14–15 years old) [25]. The PACO study was approved by the Review Committee for Research Involving Human Subjects at the University of Granada (Reference: 162/CEIH/2016). For this qualitative study, participants were recruited in two different phases (phase 1 and phase 2) from four public schools in the cities of Granada, Jaén, and Toledo. In phase 1, the sample was selected via convenience from Granada (non-randomized sampling) in the 2016–2017 academic year, whereas, in phase 2, a random

sampling from Granada, Jaén, and Toledo was used (the 2018–2019 academic year). Initial contact was made with the PE teacher and the school staff at secondary schools to explain the study to them. Then, according to the selection criteria of the study explained below, for the secondary schools that agreed to participate, we sent an informed-consent form to the students' legally authorized representatives (parents/legal guardians). Afterward, the physical education teacher collected the parents' informed consent.

The following inclusion criteria were applied to the participants: (1) attend 3rd-grade compulsory secondary education (14–15 years old), (2) have an Android Operation System mobile phone, (3) have access to the Internet, and (4) play the Mystic School app during the intervention.

2.4. Procedure

2.4.1. Phase 1

Adolescents from 2 high schools located in Granada (Spain) were invited to take part in the study. A total sample of 14 participants (6 boys and 8 girls) played the Mystic School app during the testing period (two weeks). Phase 1 included one app presentation session, two weeks to test the Mystic School app, and, finally, one focus group session (see Table 1).

Table 1. Schedule during PE lessons.

PHASE 1 (Play for Two Weeks)		
Title	**Description**	**Duration**
Session I. Mystic School presentation	Deep explanation of how the Mystic School app is used.	20 min
Session II. Focus group	Questions about the perception and experience of playing the Mystic School app.	15 min

Personal resources: one researcher; Facilities: classroom; Material resources: computer projector and Internet connection.

The contents of "Session I. Mystic School presentation" were (1) an introductory presentation of the Mystic School app; (2) a brief tutorial of how to download the Mystic School app; (3) a demonstration of the steps to install the application; and (4) once the Mystic School app was installed, the research team explained the characteristics of the game.

The PE teachers at both schools supported us all the time to encourage the students to participate. However, not all of the adolescents could participate because they had limited access to the Internet on their mobile phones. Another reason was that some adolescents were in an exam period or they were not able to use their mobile phones during the week.

The contents of "Session II. Focus group" were based on carrying out a focus group implemented two weeks after experiencing and playing the Mystic School game. Only the participants that played during the two weeks were invited to join the focus group (during the sessions, it was recorded who had attended and played during the indicated period). Four participants did not attend a focus group because one had a broken phone and the others had no time to play. The same researcher who led the meetings with the students and the full process acted as the moderator (who guided the group). The focus group sessions had an average duration of 15 min. The topics were discussed in the groups anonymously. During the focus group sessions, a total of 20 questions (File S1 (Supplementary Materials)) were discussed. After analyzing the registers of the focus group, the questions were divided into seven categories: (1) the usability of the app; (2) the assessment of the design; (3) the usefulness of social networks in the game; (4) an understanding of the degree of usefulness in the game; (5) an understanding of the game and the design; (6) the usability of social networks in the game; and (7) the overall user satisfaction and impact on daily habits. These contributions made by the participants were discussed by the research team to be incorporated into the app.

2.4.2. Phase 2

The Mystic School app was implemented over 4 sessions in 1 month (1 session per week) during the PE lessons (see Table 2).

Table 2. Schedule during PE lessons.

PHASE 2 (Play for One Month)		
Title	**Description**	**Duration**
Session I. App presentation	Deep explanation of how the Mystic School app is used.	25 min
Session II. First impressions	General questions on usage and whether they found any difficulties or failures.	10 min
Session III. Knowing failures and progress in the app	Questions about its use, how many steps they recorded, and their current levels in the Mystic School app.	15 min
Session IV. Progress in the app and daily habits	Questions about their general opinions of the Mystic School app.	20 min
Session V. Focus group	Different questions about their perceptions, habits, and implementation regarding the Mystic School app.	10 min

Personal resources: one researcher; Facilities: classroom; Material resources: computer projector and Internet connection.

After the 4 sessions, the participants from the class groups located in Toledo (n = 20) did not meet one inclusion criterion (use the app for one month), and they were excluded. Therefore, they were not invited to take part in the focus group. A total of 34 students participated in the study. A focus group of 4 participants was held in Granada, and a second focus group of 4 participants was held in Jaén. They participated in the entire session, and they talked about their user experiences (Figure 3).

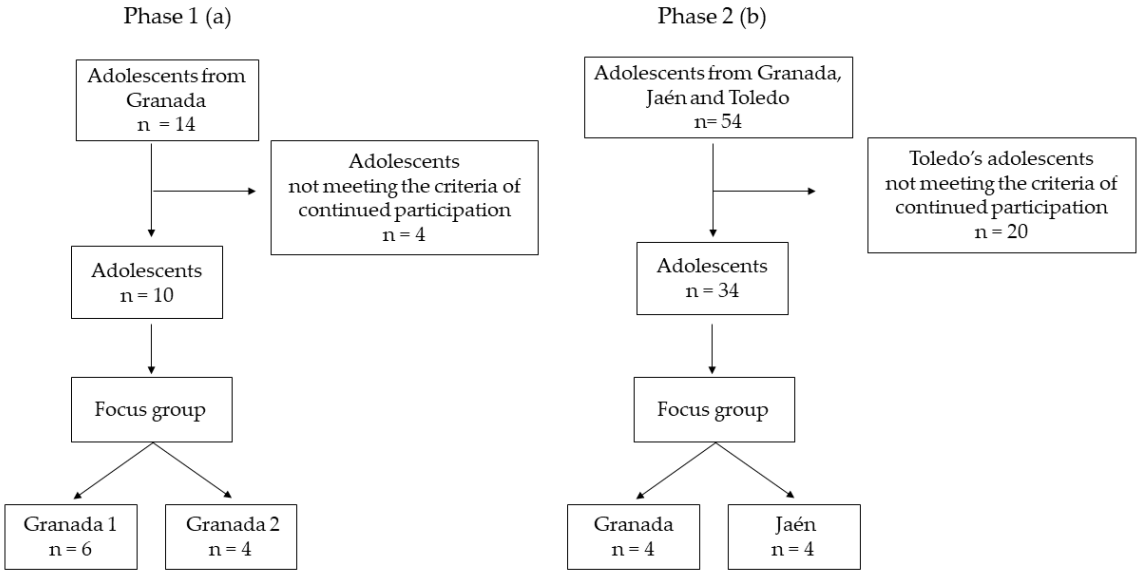

Figure 3. Flowchart of participants for phase 1 (plot **a**) and phase 2 (plot **b**).

Focus group: The mean duration of the focus groups was approximately 10 min. As a reward for their participation, the focus group participants received a healthy breakfast.

2.5. Data Analysis

The text of both focus groups was analyzed through qualitative methods using the software NVivo 11 plus. The following phases were carried out:

(1) Transcriptions were read several times to obtain a sense of the overall data;
(2) The text was divided into meaning units;

(3) The meaning units were coded, and these codes were compared, contrasted, and sorted into themes, while maintaining fidelity with the text.

3. Results

The results obtained from the focus group questions were organized in two parts: (1) the adolescents' perception of the app and (2) aspects to improve in terms of design, operation, and general satisfaction. The results will be organized in the two phases previously indicated in the study.

Phase 1

The comments in both groups were: (a) the game did not correctly record the steps, or there were more steps without having moved from the site; (b) sometimes, it did not work; and (c) they wanted more personalization of the avatar. Many comments were consequences of the situation that the game did not correctly record the steps, which was a main technical issue (Table 3).

Table 3. Adolescents' perceptions about the app Mystic School in phase 1.

Content	Phase 1
Design	*"The movement of the avatar is a bit strange because you hit it and it gets stuck with different objects"* *"The movement is a bit uncomfortable. You spend more time trying to make the avatar walk than you do walking in real life"*
Active videogame failures	*"It's a bit weird, because sometimes I gain a lot of steps when I walk and sometimes, I gain almost no steps at all"* *"The steps magically appear"* *"My screen has locked up and won't even let me move my avatar"* *"My GPS is working properly, and it does not let me move the avatar"* *"I walked from my house to the school, and I didn't move from where I was in the video game. I did the same route again and I didn't move either"*
Difficulties	*"The video game closed by itself, and I had to open it again"* *"In some places the avatar gets stuck and can't move forward"* *"I advance a level and I don't really know how I got there"*
Suggestions for improvement	*"Instead of pressing a few seconds to move the avatar, it would be better to move the avatar with the arrows like in other games"* *"There should be a story section and a multiplayer section"* *"We are made for competition. An application to play against others is better than alone"*

Although the degree of satisfaction was positive, the students indicated that they would return to play if the avatar's movement in the maze improved. Therefore, they found several software bugs that made the daily use of the app difficult. The most relevant comments were that the Mystic School app did not work correctly and it did not count the steps as the player expected. On the other hand, the students suggested improvements, such as changing the avatar (being customizable), more competitive tasks, and being able to play single and multiplayer. The adolescents played an average of 4 out of 10 levels. Because of the previous reasons, the adolescents provided a low use of the app and, consequently, few opinions.

The computer developers focused on correcting app errors, such as not recording the steps correctly, leaving the blank screen unexpectedly, and technical issues (i.e., the brightness of the animation). In addition, the computer experts improved the functioning of the GPS. Therefore, the avatar's way of movement was changed, as mentioned by the students prior to phase 2.

Phase 2

The participants highlighted aspects for improvement in terms of the design of the Mystic School app, the time they spent playing, and what they liked most about the app (Table 4).

Table 4. Adolescents' perceptions about the app Mystic School in phase 2.

Content	Phase 2
Suggestions for improvement	*"I would like to get in the app and that it loads quicker"* *"It would be nice that there is prize that allows you to get into another secret map"* *"Put in the app that enemy players can steal 1000 steps"* *"More achievements, collect more steps and you get a prize because there were levels where you didn't have to do anything"* *"I would like an offline mode to play when I don't have Internet connection"*
Playing time	*"My partner wasn't walking and couldn't move forward, so I wanted to pass steps to her, but it didn't work"* *"I put the application in the background and when I opened it again, my avatar appeared in a different place"* *"I have not been able to play because we have a lot of exams and other activities"*
Active video games-positive aspects	*"It's an original idea"* *"The graphics are good to begin"* *"The concept was well thought out"* *"It's an entertaining and fun application to promote Physical Activity"*

In relation to the content "suggestions for improvement", students answered the first question: "What aspects would improve the Mystic School app?" They stressed the use of the mobile app without an Internet connection since some of them did not have a service that provided Internet. They also commented that more prizes should be provided during the game as rewards for reaching a certain number of steps. In addition, they proposed an increment in competitiveness and difficulty during the different levels of the game.

In the content "playing time" (second question), "How much time have you spent playing?", it was observed that some of the participants had not played enough. There were different reasons: (a) the software did not work; (b) they had many extracurricular activities; and (c) they had many exams. Finally, the participants were asked what they liked most about the game. About the content's "positive aspects", the participants said that the app was an original idea, and the design was good.

4. Discussion

In the current study, a mobile app was developed to promote ACS in adolescents. The participants found the Mystic School app a fun alternative for play, despite some technical problems, such as when recording steps. In addition, the adolescents suggested some improvements to make the application work better.

A meta-analysis [16] provided evidence that the effectiveness of mobile phone apps in increasing PA is better in the short term. Furthermore, the reason can be the intensity of the player activity, due to adolescents often losing interest in playing games for longer periods. Randomized controlled trial designs, larger sample sizes, and validated activity measurements beyond the school day are needed. Limited evidence is available on the long-term efficacy of AVGs for PA promotion [26].

The perception of the Mystic School app was positive. The students liked playing in groups because they could share experiences. Once again, the need for socialization and cooperative learning among all members is confirmed [27]. Thus, identifying what makes an app fun and engaging is important for an optimal game design [28]. It is important to focus on more user-identifiable characters, such as high-level realistic graphics and well-defined instructions; this has been suggested by a recent systematic review as one of the most important points for a successful healthy-lifestyle promotion [29]. In addition, the adolescents wanted more competitive challenges. Consequently, initial gamification mechanisms, such as competitions and challenges, were used and increased during the intervention because competitiveness was found to be associated with greater enjoyment [30]. In addition, Shameli et al. [31] observed that during walking competitions, the average user increases PA by 23%.

According to Sallis et al. [32], who recommended that interventions should provide greater incentives, the final focus group was given the reward of a healthy breakfast. In addition, each adolescent received a bracelet and a backpack (by raffle) for their participation. Moreover, points-based reward systems were implemented to increase student commitment, which only worked at first. As previous literature confirmed [33], this type of system seems not to have a long-term impact. However, making something enjoyable depends on intrinsic motivation based on satisfying fundamental needs (i.e., relatedness, competence and autonomy [34]), but current AVGs have failed to adequately meet all of these needs. In our study on AVGs, the researchers should have provided more motivational tools for the adolescents to engage them in play and keeping their adherence to accumulating steps.

In light of the results, it is important to use different resources to increase PA in adolescents, and smartphone apps are crucial in this process. Around 94% of adolescents own or have access to smartphones, and 89% of them indicate that they access the Internet almost constantly or several times a day [35]. In addition, a number of different mobile apps are now available that increase PA, such as Pokémon Go [36] and Zombie Run [37]. The evidence of a meta-analysis showed that a smartphone-based intervention might be a promising strategy to increase steps in young people [38]. Therefore, these tools can have different purposes if the right approach is designed to motivate adolescents to change their behaviors, such as increasing PA. After the implementation of this AVG, the adolescents showed interest and initiative to use it. This type of proposal can be a useful tool to complement or add to the PE curriculum, although it should be analyzed to corroborate if it increases PA. Another lesson learned from the implementation of the AVG is that the difficult technical problems within the app cannot be solved by the researchers and computer experts are required. So, as researchers, we firstly suggest having enough economical budget to contract with a computer business and have a complete and finalized app before using it for research. Innovative digital tools as pedagogical resources in PE have been previously carried out [39–41]. The incorporation of mobile apps into the PE program is also underway [42]. Therefore, the implementation of this app within the educational curricula can enhance the potential benefits.

5. Strengths and Limitations

The strengths of this study included the novel AVG app use and its application in educational contexts. In addition, focus groups and qualitative methodology were included by collaborating with experts in this type of analysis. Nevertheless, some limitations must be acknowledged, such as the use of a convenience sample in phase 1, the fact that the AVG was only available for Android software, and the different circumstances and ways of implementing the app between the two phases due to COVID-19.

6. Conclusions

The Mystic School app was positively accepted by the adolescents, although the software required some technical improvements (i.e., design and development) for better engagement and enjoyment of the adolescents. Therefore, the app's shortcomings show that its usability should be improved. After the testing in both phases, it is confirmed that the Mystic School app might be a good game to promote PA by increasing the number of steps. In addition, some technical modifications should be completed regarding the design of the software after experiencing and listening to the participants. Consequently, AVG games, such as Mystic School, are proposed as useful tools in PE lessons. Future works should implement some active methodology activities with the AVG to increase the motivation and adherence of the participants within the PE curriculum.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/children9121997/s1, File S1. Questions about the application.

Author Contributions: Conceptualization, R.G.S.-A., Y.M.B.-R., I.J.P.-L. and P.C.; methodology, R.G.S.-A., F.J.H.-D., P.C. and M.H.-C.; writing—original draft preparation, R.G.S.-A., M.H.-C., F.J.H.-D. and P.C. writing—review and editing, M.H.-C., F.J.H.-D., P.C., S.A.-L. and Y.M.B.-R.; supervision of the app, M.H.-C., F.J.H.-D. and P.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Spanish Ministry of Economy, Industry and Competitiveness and the European Regional Development Fund (DEP2016-75598-R, MINECO/FEDER, UE). Additionally, this study took place thanks to funding from the University of Granada Plan Propio de Investigación 2016—Excellence actions: Unit of Excellence on Exercise and Health (UCEES)—and the Junta de Andalucía, Consejería de Conocimiento, Investigación y Universidades, European Regional Development Fund (ref. SOMM17/6107/UGR).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of Granada (Reference: 162/CEIH/2016) on 6 June 2016.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: The authors would like to acknowledge all participating schools, students, parents, teachers, and school principals. In addition, we are grateful to Isabel Belmonte and Sara Espejo for their assistance in the development and design of Mystic School.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

ACS	Active commuting to/from school
GPS	Global positioning system
MVPA	Moderate-to-vigorous physical activity
PA	Physical activity
PE	Physical education
App	Application

References

1. Sallis, J.F.; Cervero, R.B.; Ascher, W.; Henderson, K.A.; Kraft, M.K.; Kerr, J. An ecological approach to creating active living communities. *Annu. Rev. Public Health* **2006**, *27*, 297–322. [CrossRef] [PubMed]
2. Ruiz-Hermosa, A.; Álvarez-Bueno, C.; Cavero-Redondo, I.; Martínez-Vizcaíno, V.; Redondo-Tébar, A.; Sánchez-López, M. Active Commuting to and from School, Cognitive Performance, and Academic Achievement in Children and Adolescents: A Systematic Review and Meta-Analysis of Observational Studies. *Int. J. Env. Res. Public Health* **2019**, *16*, 1839. [CrossRef]
3. Chillon, P.; Ortega, F.B.; Ruiz, J.R.; Veidebaum, T.; Oja, L.; Maestu, J.; Sjostrom, M. Active commuting to school in children and adolescents: An opportunity to increase physical activity and fitness. *Scand. J. Public Health* **2010**, *38*, 873–879. [CrossRef] [PubMed]
4. Saucedo-Araujo, R.G.; Huertas-Delgado, F.J.; Villa-González, E.; Ávila-García, M.; Gálvez-Fernández, P.; Tercedor, P. Is children's health-related quality of life associated with physical fitness and mode of commuting? PREVIENE Project. *Perspect. Public Health* **2021**, *141*, 102–110. [CrossRef]
5. Villa-González, E.; Ruiz, J.R.; Chillón, P. Associations between Active Commuting to School and Health-Related Physical Fitness in Spanish School-Aged Children: A Cross-Sectional Study. *Int. J. Environ. Res. Public Health* **2015**, *12*, 10362–10373. [CrossRef]
6. Herrador-Colmenero, M.; Villa-Gonzalez, E.; Chillon, P. Children who commute to school unaccompanied have greater autonomy and perceptions of safety. *Acta Paediatr.* **2017**, *106*, 2042–2047. [CrossRef]
7. Huertas-Delgado, F.J.; Herrador-Colmenero, M.; Villa-Gonzalez, E.; Aranda-Balboa, M.J.; Caceres, M.V.; Mandic, S.; Chillon, P. Parental perceptions of barriers to active commuting to school in Spanish children and adolescents. *Eur. J. Public Health* **2017**, *27*, 416–421. [CrossRef]
8. Haug, E.; Smith, O.R.F.; Bucksch, J.; Brindley, C.; Pavelka, J.; Hamrik, Z.; Inchley, J.; Roberts, C.; Mathisen, F.K.S.; Sigmundová, D. 12-Year Trends in Active School Transport across Four European Countries—Findings from the Health Behaviour in School-Aged Children (HBSC) Study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 2118. [CrossRef] [PubMed]
9. McDonald, N.C.; Brown, A.L.; Marchetti, L.M.; Pedroso, M.S. US school travel, 2009: An assessment of trends. *Am. J. Prev. Med.* **2011**, *41*, 146–151. [CrossRef]

10. Department for Transport. Trips to and from School by Main Mode—Region and Area Type: Great Britain, 2012/13. London (England). Available online: https://www.gov.uk/government/statistical-data-sets/nts99-travel-by-region-and-area-type-of-residence (accessed on 6 November 2022).
11. Gray, C.E.; Larouche, R.; Barnes, J.D.; Colley, R.C.; Bonne, J.C.; Arthur, M.; Cameron, C.; Chaput, J.-P.; Faulkner, G.; Janssen, I.; et al. Are we driving our kids to unhealthy habits? Results of the active healthy kids Canada 2013 report card on physical activity for children and youth. *Int. J. Environ. Res. Public Health* **2014**, *11*, 6009–6020. [CrossRef]
12. Gálvez-Fernández, P.; Herrador-Colmenero, M.; Esteban-Cornejo, I.; Castro-Piñero, J.; Molina-García, J.; Queralt, A.; Aznar, S.; Abarca-Sos, A.; González-Cutre, D.; Vidal-Conti, J.; et al. Active commuting to school among 36,781 Spanish children and adolescents: A temporal trend study. *Scand. J. Med. Sci. Sports* **2021**, *31*, 914–924. [CrossRef]
13. Dinu, M.; Pagliai, G.; Macchi, C.; Sofi, F. Active Commuting and Multiple Health Outcomes: A Systematic Review and Meta-Analysis. *Sport. Med.* **2019**, *49*, 437–452. [CrossRef] [PubMed]
14. Henriques-Neto, D.; Peralta, M.; Garradas, S.; Pelegrini, A.; Pinto, A.A.; Sánchez-Miguel, P.A.; Marques, A. Active Commuting and Physical Fitness: A Systematic Review. *Int. J. Environ. Res. Public Health* **2020**, *17*, 2721. [CrossRef] [PubMed]
15. Kumar, S.; Nilsen, W.J.; Abernethy, A.; Atienza, A.; Patrick, K.; Pavel, M.; Riley, W.T.; Shar, A.; Spring, B.; Spruijt-Metz, D.; et al. Mobile health technology evaluation: The mHealth evidence workshop. *Am. J. Prev. Med.* **2013**, *45*, 228–236. [CrossRef]
16. Romeo, A.; Edney, S.; Plotnikoff, R.; Curtis, R.; Ryan, J.; Sanders, I.; Crozier, A.; Maher, C. Can Smartphone Apps Increase Physical Activity? Systematic Review and Meta-Analysis. *J. Med. Internet Res.* **2019**, *21*, e12053. [CrossRef] [PubMed]
17. LeBlanc, A.G.; Chaput, J.P.; McFarlane, A.; Colley, R.C.; Thivel, D.; Biddle, S.J.; Maddison, R.; Leatherdale, S.T.; Tremblay, M.S. Active video games and health indicators in children and youth: A systematic review. *PLoS ONE* **2013**, *8*, e65351. [CrossRef]
18. Maddison, R.; Mhurchu, C.N.; Jull, A.; Jiang, Y.; Prapavessis, H.; Rodgers, A. Energy expended playing video console games: An opportunity to increase children's physical activity? *Pediatr. Exerc. Sci.* **2007**, *19*, 334–343. [CrossRef]
19. Barkley, J.E.; Lepp, A.; Glickman, E.L. 'Pokémon Go!' May Promote Walking, Discourage Sedentary Behavior in College Students. *Games Health J.* **2017**, *6*, 165–170. [CrossRef]
20. Norris, E.; Hamer, M.; Stamatakis, E. Active Video Games in Schools and Effects on Physical Activity and Health: A Systematic Review. *J. Pediatr.* **2016**, *172*, 40–46.e45. [CrossRef]
21. Wong, F.Y. Influence of Pokémon Go on physical activity levels of university players: A cross-sectional study. *Int. J. Health Geogr.* **2017**, *16*, 8. [CrossRef]
22. Williams, W.M.; Ayres, C.G. Can Active Video Games Improve Physical Activity in Adolescents? A Review of RCT. *Int. J. Environ. Res. Public Health* **2020**, *17*, 669. [CrossRef]
23. Morgan, D.L. Focus Groups. *Annu. Rev. Sociol.* **1996**, *22*, 129–152. [CrossRef]
24. Ivankovich-Guillén, C.I.; Araya-Quesada, Y. Focus groups: Técnica de investigación cualitativa en investigación de mercados. *Rev. Cienc. Econ.* **2011**, *29*, 545–554. [CrossRef]
25. Chillón, P.; Gálvez-Fernández, P.; Huertas-Delgado, F.J.; Herrador-Colmenero, M.; Barranco-Ruiz, Y.; Villa-González, E.; Aranda-Balboa, M.J.; Saucedo-Araujo, R.G.; Campos-Garzón, P.; Molina-Soberanes, D.; et al. A School-Based Randomized Controlled Trial to Promote Cycling to School in Adolescents: The PACO Study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 2066. [CrossRef]
26. Biddiss, E.; Irwin, J. Active video games to promote physical activity in children and youth: A systematic review. *Arch. Pediatr. Adolesc. Med.* **2010**, *164*, 664–672. [CrossRef]
27. Méndez-Giménez, A.; Fernández-Rio, J. El aprendizaje cooperativo: Modelo pedagógico para Educación Física. *Retos. Nuevas Tend. Educ. Física Deporte Y Recreac.* **2016**, *29*, 201–206.
28. Norozi, K.; Haworth, R.; Dempsey, A.A.; Endres, K.; Altamirano-Diaz, L. Are Active Video Games Effective at Eliciting Moderate-Intensity Physical Activity in Children, and Do They Enjoy Playing Them? *CJC Open* **2020**, *2*, 555–562. [CrossRef]
29. Schwarz, A.F.; Huertas-Delgado, F.J.; Cardon, G.; DeSmet, A. Design Features Associated with User Engagement in Digital Games for Healthy Lifestyle Promotion in Youth: A Systematic Review of Qualitative and Quantitative Studies. *Games Health J.* **2020**, *9*, 150–163. [CrossRef]
30. Frederick-Recascino, C.M.; Schuster-Smith, H. Competition and intrinsic motivation in physical activity: A comparison of two groups. *J. Sport Behav.* **2003**, *26*, 240–254.
31. Shameli, A.; Althoff, T.; Saberi, A.; Leskovec, J. How gamification affects physical activity: Large-scale analysis of walking challenges in a mobile application. In Proceedings of the 26th International Conference on World Wide Web Companion, Perth, Australia, 3–7 April 2017; pp. 455–463.
32. Sallis, J.F.; Alcaraz, J.E.; McKenzie, T.L.; Hovell, M.F. Predictors of change in children's physical activity over 20 months: Variations by gender and level of adiposity. *Am. J. Prev. Med.* **1999**, *16*, 222–229. [CrossRef]
33. Ahn, S.J.; Johnsen, K.; Ball, C. Points-Based Reward Systems in Gamification Impact Children's Physical Activity Strategies and Psychological Needs. *Health Duc. Behav.* **2019**, *46*, 417–425. [CrossRef]
34. Deci, E.L.; Ryan, R.M. The 'What' and 'Why' of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychol. Inq.* **2000**, *11*, 227–268. [CrossRef]
35. Anderson, M.; Jiang, J. Teens, Social Media & Technology. Available online: http://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/ (accessed on 6 November 2022).
36. Khamzina, M.; Parab, K.V.; An, R.; Bullard, T.; Grigsby-Toussaint, D.S. Impact of Pokémon Go on Physical Activity: A Systematic Review and Meta-Analysis. *Am. J. Prev. Med.* **2020**, *58*, 270–282. [CrossRef] [PubMed]

37. Direito, A.; Jiang, Y.; Whittaker, R.; Maddison, R. Apps for IMproving FITness and Increasing Physical Activity among Young People: The AIMFIT Pragmatic Randomized Controlled Trial. *J. Med. Internet Res.* **2015**, *17*, e210. [CrossRef]
38. He, Z.; Wu, H.; Yu, F.; Fu, J.; Sun, S.; Huang, T.; Wang, R.; Chen, D.; Zhao, G.; Quan, M. Effects of Smartphone-Based Interventions on Physical Activity in Children and Adolescents: Systematic Review and Meta-analysis. *JMIR Mhealth Uhealth* **2021**, *9*, e22601. [CrossRef]
39. Aznar Díaz, I.; Cáceres Reche, M.D.P.; Trujillo Torres, J.M.; Romero Rodríguez, J.M. Impacto de las apps móviles en la actividad física: Un meta-análisis. *Retos* **2019**, *36*, 52–57. [CrossRef]
40. Baños, R.F.; Extremera, A.B. Novedosas herramientas digitales como recursos pedagógicos en la educación física. *EmásF Rev. Digit. De Educ. Física* **2018**, *52*, 79–91.
41. Crompton, H.; Burke, D. The use of mobile learning in higher education: A systematic review. *Comput. Educ.* **2018**, *123*, 53–64. [CrossRef]
42. Yu, H.; Kulinna, P.H.; Lorenz, K.A. An Integration of Mobile Applications into Physical Education Programs. *Strategies* **2018**, *31*, 13–19. [CrossRef]

Moving on From the Delphi Study: The Development of a Physical Activity Training Programme Prototype Through Co-produced Qualitative Research

Qualitative Health Research
2022, Vol. 32(13) 1952–1964

DOI: 10.1177/10497323221126535
journals.sagepub.com/home/qhr


Javier Monforte[1,2], Chris Davis[3], Shaesta Saleem, and Brett Smith[1,4]

Abstract

This research developed from a co-produced project called Moving Social Work. The purpose of this ongoing project is to train social workers in how to promote physical activity for and to disabled people. The first stage of the project consisted of building evidence to design a training programme prototype. As part of this stage, a Delphi study was conducted to ask leading experts about what should be included in the prototype. Questionnaires were sent to participants until consensus was reached. In reflecting on the results, people involved in the study commented that there was more about the experts' opinions than percentages of agreement. Our co-production partners resolved that the Delphi was insufficient and called for detailed conversations with the experts. In response to this call, follow-up interviews with 10 experts who participated in the final questionnaire round of the Delphi were carried out. The interviews were co-produced, dyadic and data prompted. Dialogical inquiry was used to frame and co-analyse data. The results illuminate the capacity of qualitative research to justify, rectify, complicate, clarify, concretize, expand and question consensus-based evidence. The implications of the results for Moving Social Work are discussed. Beyond the empirical border of the project, wider contributions to literature are presented. As part of these, two key statements are highlighted and warranted: dialogical inquiry supports the practice of co-produced research, and Delphi studies should be followed by a Big Q qualitative study.

Keywords

co-production, dialogical inquiry, data prompted interviews, dyadic interviews, online interviews, social work, physical activity promotion

Introduction

In England, four in ten disabled adults feel that they can do as much physical activity (PA) as they want, and eight in ten would like to do more PA (Activity Alliance, 2022). These facts suggest that disabled people face multiple barriers to getting and staying physically active. Frequently reported barriers to PA include high costs, ableist environments, and lack of transportation and equipment (Jaarsma et al., 2019; Mascarinas & Blauwet, 2018). However, another significant blocker is the insufficient flow of PA information, meaning that valuable PA information is not reaching the people who are looking to access it (Jaarsma et al., 2019). Improving the flow of PA information is not easy. But one of the keys is identifying trusted collectives of influencers known as messengers, and then helping these messengers understand the target audience and use different types of delivery methods.

Healthcare professionals (HCPs) have been consistently identified as a key PA messenger collective, and several interventions have been established to support them promoting PA (Brannan et al., 2019; Vishnubala & Pringle, 2021). However, HCPs are not the only workforce that can and should have conversations about PA

[1]Department of Sport and Exercise Sciences, Durham University, Durham, UK
[2]Departamento de Educación Física y Deportiva, Universitat de València, València, Spain
[3]We can Move, Active Gloucestershire, Gloucester, UK
[4]Learning Disabilities, Autism and Mental Health, Lancashire County Council, Lancashire, UK

Corresponding Author:
Brett Smith, Department of Sport and Exercise Sciences, Durham University, 42 Old Elvet, Durham DH1 3HN, UK.
Email: brett.smith@durham.ac.uk

with disabled people. Under the umbrella of a co-produced project called 'Get Yourself Active', a study found that disabled people also view social workers (SWs) as credible and desirable messengers. As the authors reflected:

> The identification of SWs was significant as they had not been highlighted as a key messenger group before by disabled people in the physical activity literature. Not only was this the first study in which SWs had been identified by disabled people as key physical activity messengers, but disabled people also often viewed SWs as "better" messengers than health professionals. ((Smith & Wightman, 2019), p. 3428)

Extending the cited study, Smith et al. (forthcoming) established nine evidence-based reasons why SWs should promote PA for disabled people. Two of such reasons are that HCPs do not want to be the only professional group of PA messengers, and that interprofessional collaboration between health and social care professionals is more effective. Despite the existing rationale, SWs remain largely unaware of their potential as PA messengers and have not received any training in order to develop their knowledge, confidence and skills. This means that a good opportunity to support disabled people reach relevant PA information is currently being missed.

To initiate a paradigm shift, a project funded by Sport England and the National Institute for Health Research called 'Moving Social Work' (MSW) was launched. Set in the UK, the purpose of this ongoing project is to provide structured training and education for the SWs of today and tomorrow on how to successfully promote PA for disabled people. MSW is an 'Equitable and Experientially-informed' co-production project (Smith et al., 2022). This means that equitable partnerships between different people with relevant lived experience shape the research from beginning to end. Conceived together with The Moving Social Work Co-production Collective, the first stage of MSW consisted of building evidence to inform the design of a training programme prototype. To do so, two studies were designed.

The first study was a scoping review. With this, we learned valuable lessons about how HCPs have been and are being trained in PA promotion, specifically what contents they are taught and how (Netherway et al., 2021). Although this knowledge was useful, we could not merely transport what has been done in the realm of health care to social care. General practitioners, for example, and SWs, have different professional standards and interests. Partners from the co-production group, including but not limited to disabled people and SWs, highlighted the need of taking these differences into account, and called for training resources that suit the skills of SWs, as well as their professional ethos and culture.

Considering the foregoing, the second study aimed to determine which culturally appropriate contents and teaching methods should be used in the training programme prototype. Additionally, it aimed to identify what are the potential barriers that could jeopardise the intended success of the programme in action. To conduct such a study, we used a Delphi method. This method has been recommended for curriculum design in higher education since the 70's (Reeves & Jauch, 1978). Moreover, recent studies used it to develop training programmes in PA promotion. For instance, Wattanapisit et al. (2019) used it to identify and prioritise key elements for PA counselling in medical education, arguing that 'the characteristics of the Delphi study, using a series of questionnaires, helped to achieve the consensus of expert opinion and avoid problems arising from a few powerful participants and group pressures' (p. 1).

Participants selected for our Delphi study included experts in physical activity and health, social work and disability, with some experts being experts in two or all these domains, and having experiential knowledge (e.g. having a long-term impairment). Sixty experts were initially recruited, and twenty filled in the third and last questionnaire round. The results of the Delphi study are published in Monforte et al. (2022) and summarised in the Figure 1. This figure will have an important role in this article for reasons revealed later.

As can be observed in the Figure, 8 contents, 7 teaching methods and 10 potential barriers crossed the established consensus threshold in the Delphi study. According to the logics of the Delphi method, the training programme prototype would be composed of the mentioned items. In parallel, including the items that did not reach consensus (i.e. those that were not rated as important or indispensable by at least 80% of the experts in the last round) would not be a priority or would not be recommended.

The evidence from this Delphi study was regarded by people involved in the project as incredibly useful insofar as it offered more specific elements of PA promotion training than the available literature. Simultaneously, however, the study provoked a slight but significant dissatisfaction among researchers, experts and co-production partners.

First, researchers involved in the project reflected that the Delphi atomized those who participated in it, and that access to the rationale underpinning their preferences was limited. Second, although some experts said to us that they 'enjoyed the process' and 'learned from it', others were critical with the Delphi. For example, one expert commented: 'I didn't like it. I'm much happier talking about the issues… I can see why you would do it because presumably that [i.e. the Delphi Method] does fit some

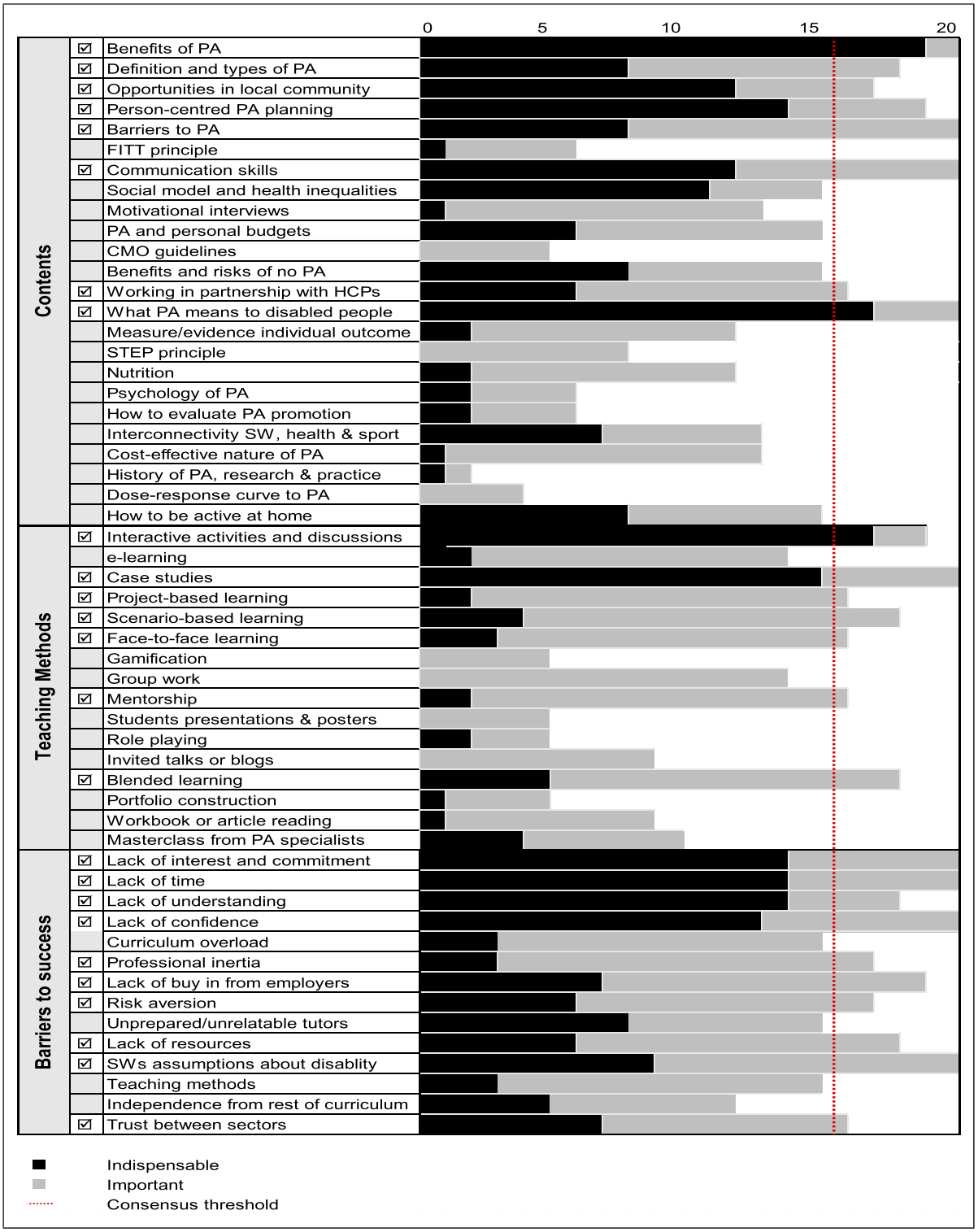

Figure 1. The Delphi study results. Modified from Monforte et al. (2022). To interpret the figure, please consider the following. An item reaches consensus when it is deemed important or indispensable by at least 80% of the experts, namely 16 experts or more. The number of experts that deemed an item indispensable are represented in black. The number of experts who regarded an item as important is indicated in grey. To exemplify, the item "Benefits of PA" reaches consensus because a 100% of experts considered this item either indispensable (95% of them) or important (5%). That is why there is a ☑ next to it. In contrast, the item "Nutrition" did not reached consensus because just 12 experts considered it indispensable (10%) or important (50%).

people, but it doesn't fit me'. Similarly, another participant said: 'I found the [Delphi] process a bit limited in terms of what you could say (…) It didn't feel like I was getting into the depth of why we were making our points'. Finally, some members of the advisory board and the co-production collective of the project said that they were interested in knowing more about the experts' ideas and why they left some key content outside consensus. Overall, everybody was on the same page: conducting a follow-up study on expert opinions was pertinent.

In a focus meeting with the Moving Social Work Co-production Collective, we considered the practical consequences that this new research could have for the whole project. Some suggested that the study would help us constructing a more detailed and coherent training programme prototype. Others highlighted the usefulness of gathering specific recommendations on how to apply the identified teaching contents and methods to real practice. Admittedly, however, much of the interest about doing this research was curiosity driven. We all craved to hear the voices of the experts and know more about the background and meaning of their opinions. The question we asked ourselves was: What would we find out if we talk to the experts? However imprecise, this became our research question.

Methods and Methodology

Philosophical Stance

The design of this study is underpinned by ontological relativism (i.e. reality is multiple and mind-dependent) and epistemological constructionism (i.e. knowledge about reality is constructed and subjective). More concretely, the study is inspired by dialogism, which assumes that individuals are relational beings who construct knowledge through an open-ended dialogue with other people (Frank, 2005). As Wells et al. (2021) suggested, a dialogical approach can be particularly suitable for research teams that wish to 'privilege the voices of co-researchers from diverse social, political, and epistemic positions' or, put differently, to 'democratize expertise by recognizing various kinds of knowledge' (p. 499). As such, dialogism serves as a coherent philosophical base for co-production processes, insofar as it opens a dialogical space that allows academics and non-academics establishing equitable partnerships and working together in the production of knowledge.

The Co-Researchers and Their Critical Friends

As highlighted, members of the MSW co-production group expressed their willingness to know more about the Delphi experts' views and called for qualitative interviews to generate further knowledge. Accordingly, they were asked if, and how, they would like to be involved in the interview study.

Javier, the lead author of the Delphi study, prepared an easy-read document explaining what becoming a co-researcher in this study would involve. That document was largely inspired by (Smith et al., 2022) as well as the published and unpublished work of Liddiard et al. (2019). Additionally, Javier organised a drop-in session with people in the co-production group to clarify any doubt amongst those interested. Two members of the group, *SecondAuthor* and *ThirdAuthor*, expressed their willingness to participate. *SecondAuthor* is a carer and a sport, health, and leisure professional who works in a local community to help disabled people get active. Meanwhile, *ThirdAuthor* is a qualified social worker whose work has focused on supporting disabled people. The remaining co-production members (including disabled people, activists, social work lecturers, students and professionals, and physical activity champions) agreed to be 'critical friends' of the interview study, that is, to offer their feedback and challenge the work by the core research team comprised by the first three authors. (Smith et al., 2009), the lead investigator of the MSW project and an expert on qualitative interviewing, dialogism and co-production (see blinded-for-peer-review), joined the study as a critical friend too. Hence, the rigor of this study is enhanced by two kinds of critical friends: key people with relevant lived experience or experiential knowledge, and a prominent scholar with relevant academic knowledge.

Deciding on the Style of Interviewing

In a series of videocalls, the three leading co-researchers dialogued about how to collect interview data, and what type or combination of types of interviews could be used. Resulting from this dialogue, different decisions were made. First, the interviews would be carried out via Zoom. This was an easy resolution insofar as both the experts and the co-researchers lived in different geographical locations across the UK. Javier reviewed recent literature on the challenges, opportunities and recommendations in Zoom interviewing (e.g. Archibald et al., 2019; Fouda, 2020; Oliffe et al., 2021). Then, he discussed key points with Chris and Shaesta who, being Zoom users themselves, clearly understood the concessions involved in having conversations through videoconference.

Second, it was agreed data-prompted interviews would be used. This method refers to the use of data gathered prior to the interview as a way of stimulating and facilitating discussion during the interview (Kwasnicka et al., 2015). Namely, it was decided to use

as a prompt the Delphi results and, more concretely, the Figure 1 displayed earlier in this paper. This would be displayed during the interviews using the 'share screen' function of Zoom. Finally, the three co-researchers decided to conduct dyadic interviews, which involve two, as opposed to one single interviewee in each interview. It has been argued that this kind of interview combine some of the advantages of the focus group interview (e.g. the opportunity for participants to support and prompt each other) while reducing some of its drawbacks (e.g. the limited access offered by larger groups to detailed responses from each participant) (Caldwell, 2014; Morgan et al., 2013). In our context, dyadic interviews were chosen to originate dialogue between experts falling under different areas of expertise (e.g. physical activity/social work). In a Delphi study, experts are free of direct interaction with other experts, and thus their views are to be evaluated on their merit only (Hirschhorn, 2019). In dyadic interviews, the logic is inversed: the views of an expert are created from interaction with another expert and evaluated in relation the other expert's views.

Following the above decisions, Javier, Chris and Shaesta co-designed an interview guide. Figure 1 was its central component. As visual methods scholars have discussed, the idea is that using a visual material (such as a figure) as a prompt 'may be more linguistically flexible than an interview schedule', in that discussion of the figure 'can pave the way for wider dialogue' (Leonard & McKnight, 2015, p. 632). The figure would be presented to the experts, and the principal task of the interviewers would be facilitating discussion around it. Shaesta showed concern about the complexities of this task and the realisation that every interview would be different from the rest, and largely unpredictable. She asked: 'What if we do not know what to ask? Wouldn't it be better to have some prepared questions?' Following further conversation, 'pocket questions' were designed to support the interviewing process (Smith & Sparkes, 2016).

Participants and Recruitment

The participants of this study are key experts that took part in all the rounds of our previous Delphi study. At the end of the Delphi, we asked them to indicate if they would be willing to participate in a follow up research. From a group of 20 participants, six voiced their readiness to participate. As Malterud et al. (2016) sustained, the more relevant information a sample has, the fewer participants are needed. However, despite that the six highly qualified and influential experts alone could (arguably) provide very rich information, we hoped to get a more varied range of dyads. Hence, we persevered until four more participants accepted. The final sample of 10 experts equals the 50% of the sample that responded to all the questionnaire rounds of the Delphi study.

Our first attempt was to assign the dyads purposively through using Doodle, a web-based scheduling tool, useful to set up meetings with team members and participants. To start with, we created two Doodle surveys and sent them to two pairs of experts. None of the schedules matched. At this point, we realised about the actual complexity of managing five schedules (three co-interviewers and two busy interview participants per interview). We recovered from this recruiting failure (Clark & Sousa, 2020) by setting another strategy, which consisted of asking all the participants to fill a single doodle. One expert emailed us to express that she changed her mind; she preferred to participate in the next participatory stage of the project, instead of the interview study. Thus, another effort was made to recruit one more participant. Eventually, the dyads were formed based on availability. Relevant information about the participants (names are pseudonyms) is shared in Table 1. The participants gave their written consent to voluntarily partaking in this study and were offered a £20 thank you voucher conditional to the interview completion. The study has the ethical approval of Durham University (SPORT-2020-02-18T17_18_37-dmgf98).

Using Multiple Interviewers

The possibility of using multiple interviewers in qualitative research is not new. Bechofer, Elliott and McCrone (Bechofer et al., 1984) suggested that involving more than one interviewer can provide a greater sense of a casual conversation rather than a formal interview, but also facilitate issues such as observing reactions, changing the subject, and employing diverse interviewing tactics throughout. Although challenging, group interviewing was suitable for this co-produced research, which intended to include the three main co-researchers in every research stage. Initially, the three co-researchers were available to conduct the interviews altogether. However, Shaesta could not participate in the first interview given the incompatibility of her agenda and the experts'. She participated in the next two interviews, but further job obligations first and unexpected personal problems later made impossible for her to keep involved in the remaining data collection. Largely, then, the work was conducted by two interviewers. Recent literature has signalled the potential affordances of using two interviewers and offered diverse recommendations (Monforte & Úbeda-Colomer, 2021; Velardo & Elliott, 2021). For example, Monforte and Úbeda-Colomer suggested that it is important for the interviewers to keep a constant dialogue between interviews in order to attune with one another or – as often phrased in dialogical inquiry – to 'fusion horizons of understanding'

Table 1. The Participants.

Dyad	Name	Pronouns	Expertise	Years of experience
1	Sean	He/Him	Sean is the funder of a leisure company that works with social care coordinators and workers to help disabled people get active using direct payments.	>20
	Bob	He/Him	Bob works in a local council to promote inclusive sport and PA for disabled people. Bob was born with a physical impairment, which means that he has more than 30 years of lived experience.	>20
2	Sue	She/Her	Sue is a world-leading professor of education, and the principal carer of a person with intellectual disability.	>20
	Tim	He/Him	Tim is the president of an international disabled sport association that helps thousands of disabled people enjoy being active.	<20
3	Eva	She/Her	Eva is a PA champion. She works for the UK government and she is the CEO of a health promotion initiative.	>20
	Ceri	She/Her	Ceri is the head of disability in a public sector organisation. She leads several projects to increase the PA levels of disabled people.	<10
4	Rafa	He/Him	Rafa is the director of a nation-wide charity that promotes inclusive PA through community engagement programmes.	>20
	Navi	She/Her	Navi is a social worker involved in an adult social care team. She is interested in how can social workers to promote PA among disabled people and other population. She is also a CPD promoter.	<10
5	Ben	He/Him	Ben is a regional locality manager of a charity for adult social care in the UK.	>20
	Fiona	She/Her	Fiona is a PA champion. She is a community manager in a leisure charity where she focuses on promoting recreational and health-enhancing PA.	>20

(Frank, 2011). Consistent with this suggestion, Javier and Chris interchanged emails on a regular basis and met via Zoom before and after each interview to exchange ideas and broad each other's perceptions about the study.

The constant exchange between the two interviewers not only helped in developing the data collection process but also impacted on upcoming tasks such as the analysis. That became obvious when, one week after the last interview, we met to discuss potential issues of power and authority that could arise during the analytical process. This discussion was guided by some questions inspired by criteria for judging the quality of co-produced research (Smith et al., 2022), such as: Did non-academic researchers feel that their contributions were genuinely engaged with and made a difference to the decisions that were made? To what extent did they believe their personal skills and insights contributed to the research and were valued? Was power shared between academic and non-academic researchers? In engaging with these questions, Chris expressed:

> I had my own assumptions and bias, you know, there is an academic in the room… there is an immediate feeling of, historically, throughout my own education, that an academic is always somebody that knows more than me. But when we talk about co-production, as we conducted each interview, my perception of the power has changed. It has levelled out to the point now where I think, you know, we got a really good levelled balanced relationship in terms of academic-non-academic, or just two people.

Certainly, that power differentials are not perceived does not mean that they do not exist – concepts such as symbolic violence (Bourdieu, 1998) help us understand that. Simply put, symbolic violence is an imperceptible but effective form of violence that is exercised upon a person with his or her complicity. Its effectiveness lies in its misrecognition: people subjected to symbolic violence may be subjected to unequal power relationships but not recognise them as such. Put in context, this means that perceptions of power balance from Chris should not be considered an evidence of actual power balance, since inequities in power may remain invisible for him. Having said that, co-production is about trusting, not invalidating, people's perceptions. Disregarding or invalidating Chris' image of an equal partnership would also be a form of symbolic violence. So, what is to be done? From our perspective (Smith et al., 2022), the soundest way out is to maintain honest conversations regarding how co-researchers 'are working together, how they respond to conflicting views, and how their assumptions, power, and lived experiences influence the conversations'. Consistent with this perspective, Javier and Chris agreed to keep exchanging challenging questions about their positionality during the whole analytical process.

Dialogical Analysis

Wells et al.'s (2021) proposed seven dialogical inquiry steps to conduct a 'receptive, open-ended process of

meaning-making' among a team of three persons or more. However, Shaesta could not join the analysis stage either as her personal issues persisted. This left us with two analysts and therefore with the need of finding or crafting another analytical process. Eventually, Javier found a model detailed in Hermans (2006) but originally formulated by Marková (1987) and Linell and Marková (1993). Although the model serves the purpose of researching the dialogical self between different self-positions (as opposed to different people), the three steps of the model were applicable to our dialogical relationship. Adapted to our context, the steps read as follows:

> Step 1: A to B. One co-researcher directs a statement to the other co-researcher. For example, co-researcher A may state: 'This is how I see it' or, 'This is my interpretation of what participants were discussing'
> Step 2: B to A. Co-researcher B responds to co-researcher A's statement. For example: 'I have another way of seeing it' or, 'I see your point, but my interpretation is slightly different' or 'focuses on a different issue'.
> Step 3: Co-researcher A modifies to a lesser or greater extent his or her initial statement: 'Now I see it differently' or 'Your point made me think in another way' or 'your view supports mine but adds to it'. Here, the point is not to change the initial statement, but rather to remain open to be influenced by the other's point of view.

Javier introduced the model to *SecondAuthor*, who was keen to try it out. Both agreed to avoid what qualitative scholars call proceduralism, which means treating the steps like a baking recipe that researchers follow faithfully to ensure a successful product. They also agreed to immerse in the interviews and took notes independently prior to using the model. To support note taking, they engaged in the following analytical tasks.

First, they registered what Mitchell and Clark (2021) called 'data earworms'. This concept refers to the repetition of participants' quotes in one's thinking, like when a line of a given song gets stuck in one's head. Data earworms can be a single catch phrase from a participant, or a variation of the same phrase uttered by different participants, for example. The second task entailed questioning data. For example, one key question was: What does the interview data say to the previous Delphi data? The third task consisted of identifying key messages that could inform the programme design straightforwardly. The last analytical task involved recognising instances in which one expert's voice could be heard in the voice of another expert. In dialogical inquiry, this phenomenon is called resonance (Frank, 2011). Through resonance, Frye (1982) noted, 'a particular statement in a particular context acquires a universal significance'. Resonance was explored in relation to each dyad, between different dyads, and between dyads and other voices outside the interviews (e.g. as part of the academic literature and in policymaking contexts). Following from this process, the co-researchers met via Zoom to share and discuss their findings and interpretations. In such discussions, they actively tried to avoid the consensus fallacy, which refers to the idea that an interpretation is valid when it can be followed by all the researchers. As Smith and McGannon (2018) argued, the chances of agreement among researchers rise when interpretations are superficial and thin. This does not mean that agreement should be avoided at all costs. Doing so might be as misleading as forcing agreement. As such, the point was to dialogue around both agreement and disagreement, in order to challenge each other's interpretations and avoid settling for the lowest common denominator. The three-step dialogical model highlighted earlier proved to be a useful tool in this respect.

The co-researchers recorded and studied the analysis sessions that took place over Zoom and opened a document that both could access to comment and respond to each other. That is how, together, slowly, they wrote and re-wrote the results, until a complete draft was produced. This draft was discussed with members of the co-production group. Shaesta and Brett were too part of this feedback. Finally, member reflections were used (Smith & McGannon, 2018). In particular, four participants gave us their feedback, which helped us adjusting concrete parts of the manuscript.

Results

The data afforded by the interviews helped us enhance the knowledge base built through the Delphi study in relevant ways. Below, we present a selection of empirical findings that illustrate how.

Contents to Include in the Education and Training Programme Prototype

In the Delphi study, experts did not reach consensus to include the social model of disability in the programme. This was heavily problematised in the interviews. The social model is a framework that conceptualises disability as 'the disadvantage or restriction of activity caused by a social organisation that does not take into account people who have impairments and excludes them from community life' (Haegele & Hodge, 2016, p. 197). During the analysis of interview data, 'the social model needs to be

there' was a data earworm for us. The importance of not only including but privileging this content is illustrated in the following choral quote which include textual cites from all the interviews:

> I'm liking all the ticks (☑), but there's some really huge things here. So, the social model and health inequalities is the one that really gets me. This should absolutely be over the consensus threshold. I can't believe it's not there. I think it's really hard to understand things like barriers if you dion't actually understand social model. If there is ignorance about health inequalities for people with learning disabilities, then there's even more reason it should be there. Social model up front. It underpins everything.

In a similar fashion, some experts found personal budgets way more important than highlighted in the Delphi. For example, Ben said: 'if you look at the care act, physical activity is linked to the assessment, and the assessments are linked to personal budgets, so it seems difficult to understand how it doesn't get consensus'. Following discussion about this result, several experts suggested that both the social model and personal budgets might not have reached consensus due to the Delphi participants' assumption that SWs would already know about these contents. In this sense, Tim suggested that a 'checking should be done beforehand to make sure that the assumed knowledge is there'. Sean contended: even if students know about this, it is important to teach about how the social model is embedded in practice and how personal budgets can be use specifically to help disabled do PA.

Looking at Figure 1, the absence of a tick (☑) next to 'being active at home' also called experts' attention. They highlighted four reasons why this content should be incorporated in the programme. The first is contingent: currently, the Covid19 pandemic raises concerns over the safety of being active outdoors. As Naivi said: 'People are still anxious about going out'. The second refers to the environmental barriers that disabled people face: because there are so many barriers including lack of transport and inaccessible gyms, it is more practical for some to stay home. The third is that doing exercise at home is safe and cost-effective. The fourth is that many disabled would benefit to be active at home before going outside. Eva used her lived experience of disability as a case in point; doing PA at home prepared her to take pleasure in activity outdoors. The collection of at home workouts provided by Get Yourself Active on their website was highlighted as a useful resource for signposting. Other resources to include in the training resources were recommended in the interviews, such as the content from Richmond group of charities, We are Undefeatable and the Social Care Pack.

Learning Methods and Considerations for Teaching the Training Programme Contents

The Delphi study positioned interactive discussions as the most important method to deliver training the programme. This was echoed in the interviews. However, what was considered here was the question of who should be involved in the cited interactive discussions. The experts argued that people with lived experience and not just students should be involved. 'That's going to be the most powerful tool in teaching SWs', asserted Bob. His dyad agreed: 'I would hope that things like What PA means to disabled people is delivered and led by people with lived experience'; and added: 'Non-disabled people talking to non-disabled people doesn't challenge assumptions'. In line with these reflections, the item 'invited talks and blogs' was reassessed as much more important as in the Delphi results. For example, Fiona commented that invited talks and blogs can be helpful to gather a variety of voices and 'opening up the interactive discussions'.

Another method that can help open up discussions and 'get examples of how people deal with things' (Tim) is case studies. Like in the Delphi, this method was regarded indispensable, but three messages were added to knowledge when interviews were conducted. First, case studies should be presented in a way that is digestible for SWs, as they can find a booklet full of detailed case studies overwhelming (Bob). Second, case studies should not merely present cases of success, but show as well how things can go wrong (Sean). Finally, storytelling should be used as it is an effective way of presenting case studies and 'bring them to life, so that they have an emotional impact on SWs' (Ceri). Bob shared an example. First, students would be presented with an example of the physical activity trap, such as this video: https://www.youtube.com/watch?v=JWpTxvtg744. Then they would be asked: What can a social worker do to change this? Bob recognised that this kind of question is difficult to answer, and yet unavoidable. Asking uncomfortable questions throughout the programme, stated Sue, is imperative.

Finally, the experts drew their attention to the item named 'scenario-based learning'. This item was defined in the Delphi in terms of giving SWs the chance to visit the scenarios where disabled people do PA and observe how they do it. All experts gave positive arguments for why this method reached consensus, except one, Sue. She raised an important caveat:

> If the social worker wants to come and observe me having my gym session, I wouldn't be fine with that (…) They could learn by asking me (…) Disabled people are constantly observed by other people. If physical activity is for fun… it's another space where someone is going to come and look at you. I'd be like: no, thank you.

We mentioned this caveat in the interviews that followed the one involving Sue. This includes the interview involving Eva. Before hearing about Sue's words, Eva sustained that scenario-based learning could have a 'massive positive impact'. After hearing the caveat, Eva added that that gaining consent would indeed be essential if this learning method is to be employed. The above resembles the three steps in the dialogical model that Javier and Chris used throughout the analysis. Eva said something, Sue's response was introduced, and then Eva added to her initial statement to recognise Sue's caveat.

Barriers that Can Compromise the Success of the Teaching Programme (and How to Address Them)

In the Delphi study, experts agreed that diverse barriers needed to be considered, but they did not have the chance of discussing how these barriers can impact the programme, and how they might be overcome. The interview gave them this opportunity. First, the experts pointed out that many of the barriers that achieved consensus in the Delphi could be addressed *before* the training programme content is introduced. Their propositions can be summarised in two related tactics. The first is presenting a strong rationale for why the training content matters for people taking the course. That would help tackling barriers such as lack of understanding and, by association, lack of interest and commitment. As Bob argued, 'If social work students understand [the programme rationale] better, they would be more interested'.

The second tactic is about appeasing SWs. Before learning how to promote PA, SWs must feel assured that the programme will not be asking them to shift their focus from wellbeing, but the opposite. They need to *appreciate* that PA is a means to take care of people's social, mental and physical wellbeing. Then, SWs need to be made aware that they are not alone. They are not being asked to get disabled people active on their own and with the lack of resources they often limit them. They are seen and should see themselves as a part of a wider gear which includes other messengers, including occupational therapists and physiotherapists. Experts suggested that mentioning the word 'multiagency' would be useful to communicate this point, as SWs are familar with it. Equally significant is to avoid coercing SWs into PA promotion and, instead, to share affirmative messages like: promoting PA 'will actually make your working day more enjoyable, more productive, easier. You can have exciting, fruitful conversations with people about making positive changes in their life' (Sean). Moreover, SWs should also be convinced that the training and the future work delivering PA messages 'will not be hard work for them' (Rafa). They are not expected to act as physicians, coaches, and psychologists. A caveat should accompany this message: embedding PA as part of everyday conversation as a social worker will not be automatic. It will take time, practice and reflection. Therefore, the training leaders 'need to tell SWs that they will be allowed to try and fail and try again'. All experts emphasised the importance of this point.

In addition, experts suggested that many of the barriers privileged in the Delphi can be tackled *through* delivering the training content. These include lack of understanding, interest, commitment and confidence, but also the stereotyped views that SWs may have on disability (e.g. the perception that disabled person are too fragile to do PA). For Sue, challenging potential assumptions or myths about disability during the training is essential. It would help address other barriers highlighted in the Delphi, including risk aversion. The experts directly connected with PA insisted that it is safe for disabled people to do PA. To gain awareness about that, SWs need to be aware of the evidence stating that PA benefits outweigh risks for disabled people and people living with long term conditions (Reid et al., 2022). More importantly, said the experts, SWs need to listen to what disabled people say they can and cannot do. In this respect, bad communication skills can be a dangerous barrier, which in turn means that 'communication skills is a vital content of the programme' (Tim)

In the same way the programme needs to challenge assumptions about disability, it must do the same with PA. This can be done through core contents such as 'Definition and types of PA'. When delivering this content, the experts suggested, it is important to stress that PA is much more than sports and competition. It is about moving the body in everyday contexts, and it might involve 'open the front door and do some gardening' (Fiona), 'dancing in the kitchen' (Eva) or 'doing some cultural activities with others' (Sean and Ben). Overall, experts recommended telling SWs that PA can be to feel hostile to people, but also kind to them, and that reviewing assumptions of what is PA can help them find the kindness in it. This is especially so when considering that some SWs might have had negative PA experiences in the past, which fed into them and removed them from all contexts of PA.

Finally, the experts commented on the barriers for long-term success that do not lay on the feet of SWs alone. They maintained that, even though it is key that SWs and HCPs work together, both workforces often have an uncooperative attitude. Bob commented that HCPs and SWs 'do not have honest discussions because everyone feels that they are going to be told: you're wrong'. Likewise, Naivi affirmed that SWs 'do struggle working with HCPs. Not all the time we are in the same boat'. Optimistically, Eva suggested that PA can help address this tension and 'be the space in which HCPs and social

care professionals get together'. For this to be possible, Ben argued that curriculums should converge: 'the more joint teaching we can do, the better'. That curriculums are different might be problematic 'because we know the hierarchy of professions, and social care is not at the top'. (Sue). In view of these points, addressing power imbalances between SWs and HCPs appears to be the first necessary step. In this respect, it would be important to 'identify the things they have in common. Identify shared goals and aspirations. Then there's room to accept the differences there. You don't flag them up. You don't highlight the differences before you highlight the commonalities'. (Sean). To conclude this discussion, dyads highlighted the importance of researching how HCPs and SWs work together now, and how education could help them work better in the future. 'It's something we will have to think about' is another data earworm that has stayed with us.

Secondly, experts suggested that employers, senior managers and national organisations such as Social Work England need to endorse and back the training programme to ensure its progress. As Ben said, 'If it does not come from the top, then it's not going to be used on the ground level'. In practice, this means recognising the work and giving SWs' incentives to promote PA, but also 'being more flexible to give SWs time to try out new things' (Rafa).

Concluding Discussion

The curiosity-driven qualitative research presented in this paper followed a previous Delphi study. As highlighted, the Delphi study was conducted in order to design the contours of a training programme prototype. This paper has provided us with additional layers of knowledge on experts' opinions that could not be obtained through the Delphi method. Moreover, it has allowed us to rectify seemingly clear expert agreements on what the MSW training programme prototype should include, and what needs to be done to achieve long-term impact. We have used the new qualitative evidence to refine the initial iteration of the programme prototype. Sections have been added to our programme summary, and the structure of our teaching resources have evolved. Overall, a much more nuanced output has been developed that was considered more relevant, useful and useable.

Importantly, though, this research has not resulted in a final output. On the one hand, a dialogical philosophy does not tolerate finalising claims. A finalising claim says the last word about what something is or can become, preventing it from changing and evolving over time (Frank, 2005). By contrast, dialogical inquiry 'aims at increasing people's possibilities for hearing themselves and others. It seeks to expand people's sense of responsibility (a Bakhtinian pun on response) in how they might respond to what is heard' (Frank, 2012, p. 37). In this sense, the results of this research are not meant to establish a definitive design for the training programme. That is why we have been calling it training programme prototype. The design of the training programme that we have created drawing on the literature, the Delphi study, and now this interview study, remains open to more voices. This includes the voices of people with lived experience, like those who experience disability. To witness such voices, knowledge cafés have been recently conducted. The knowledge café, or what is also called World Café, is a research activity that allows having unstructured conversations with and learn from marginalised voices (Netherway, et al., forthcoming). The 86 people with lived experience who have participated in the MSW knowledge cafés engaged with the prototype iteration derived from this research, sometimes reinforcing its components, sometimes challenging them. After the cafés, some elements have stayed and are part of the new iteration. Others have been amended or expanded, and a few have been removed. The latest iteration of the programme prototype is now being used to teach social work undergraduate students and SWs in continual professional development training. Staying with dialogical inquiry, observations of the teaching and interview-based conversations with students and lecturers about their experiences of participating in the programme testing will inform the succeeding prototype iteration.

Besides generating empirical insights to advance the MSW project, this article has provided contributions that may be of interest to different audiences. These audiences include researchers and practitioners interested in co-production, and health and social care education. For instance, this research has illustrated how co-produced, dyadic and data-prompted interviews can be conducted, and how a co-produced analytical process might look like in action. Furthermore, it has presented original knowledge on what kind of considerations revolve around PA promotion training for SWs, and in doing so, it has helped us understand the contemporary condition of both PA promotion and social work. The process may also be useful for others to help know how to create an evidence-based training programme for other professionals, such as occupational therapists, nurses and physiotherapists. However, the most significant contributions of this article are discussed below.

In the first place, this research has showed that dialogical inquiry and co-production are a good fit. This is (at least) because of three interrelated reasons. Firstly, constant dialogue is a necessary condition for the ethical and practical success of co-production. Secondly, dialogue, or at least how dialogue is idealised in dialogical inquiry (e.g. Frank, 2005), refuses hierarchies between people as well

as the 'tyranny of the last word' (Levinas, 1998, p. 141) – which is conventionally uttered by the researcher. Thirdly, dialogical inquiry offers ways of doing analysis that are reasonably accessible for non-academics. Certainly, the ideas and language of dialogical analysis are sophisticated, and can become as hard to reach as any other complex form of qualitative analysis. We could even call dialogism 'high theory'. But, as Strom (2018) argued, some exclusionary iterations of high theory can and should be interrupted. Indeed, some core elements of dialogical analysis such as the identification of resonances can be made accessible without losing all their substance. In the future, it would be worth formalising the dialogical foundations of co-production. Although excellent scholarship is being done to theorise co-production which mentions the idea of dialogue, this task is yet to be done.

In the second place, the research has called on us to question whether a Delphi study alone can be the basis of any educational programme, curriculum or policy agenda. Although there are good reasons why consensus-building methods such as the Delphi are privileged in policy research, the present study has revealed that the pursuit of consensus is likely to invest a superficial agreement with righteousness, brush minority views under the carpet, fail to collect concrete recommendations, and miss the heuristic potential of conflict and relational thinking. In light of that, using qualitative methods after a Delphi study can be very important – not only to recognise dissent (Shrier, 2021) but also to tackle it properly. Yet it is unlikely that the anecdotal use of qualitative techniques allows exploring conflict in depth. For example, from a qualitative stance it is inadequate to conduct short interviews and a content analysis, whereby data are coded and analysed numerically. Although this analysis might be a good addition within Delphi studies (e.g. Krijtenburg-Lewerissa et al., 2019), it is unlikely to capture the complexity and nuance of expert knowledge. Against this, it is critical to engage with what Braun and Clarke (2013) call 'Big Q qualitative research'. This refers to research that applies qualitative methods within a qualitative paradigm, rather than a positivist one. Big Q qualitative research thus avoids converting qualitative data through a quantitative framework, proceduralism and taking things at face value. It asks questions through a qualitative lens, including about why things may be that way and how they could be otherwise. Vindications for Big Q qualitative research and co-production pile up. Here, we have added a modest example that can be used to support such vindications. We hope it is useful and used.

Acknowledgments

We thank the advisory board members of Moving Social Work as well as our partners of the Moving Social Work co-production collective for shaping the development of this paper and the project as a whole. More details about this collective can be found here https://www.getyourselfactive.org/resources/social-work/ and via Twitter @MovingSW

Author Contributions

All authors contributed to the manuscript substantially and approved the final version.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research is funded by the National Institute for Health and Care Research (NIHR) [Applied Research Collaboration North East and North Cumbria (NIHR200173)] and Sport England.

Data Availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

Activity Alliance. (2022). *Activity alliance annual disability and activity survey (June 2022)*. https://www.activityalliance.org.uk/how-we-help/research/7236-activity-alliance-annual-disability-and-activity-survey-june-2022

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using zoom videoconferencing for qualitative data collection: Perceptions and experiences of researchers and participants. *International Journal of Qualitative Methods*, *18*, 1–8. https://doi.org/10.1177/1609406919874596

Bechofer, F., Elliott, B., & McCrone, D. (1984). Safety in numbers: On the use of multiple interviewers. *Sociology*, *18*(1), 97–100. https://doi.org/10.1177/0038038584018001009

Bourdieu, P. (1998). *Practical reason: On the theory of action*. Stanford University Press

Brannan, M., Bernardotto, M., Clarke, N., & Varney, J. (2019). Moving healthcare professionals–a whole system approach to embed physical activity in clinical practice. *BMC Medical Education*, *19*(1), 1–7. https://doi.org/10.1186/s12909-019-1517-y

Braun, V., & Clarke, V. (2013). *Successful qualitative research: A practical guide for beginners*. Sage

Caldwell, K. (2014). Dyadic interviewing: A technique valuing interdependence in interviews with individuals with

intellectual disabilities. *Qualitative Research*, *14*(4), 488–507. https://doi.org/10.1177/1468794113490718

Clark, A. M., & Sousa, B. J. (2020). A manifesto for better research failure. *International Journal of Qualitative Methods*, *19*, 1609406920973858.

Fouda, A. Y. (2020). Introducing the zoom interview: Tips for job hunting during the coronavirus pandemic. *Nature*, *582*(7811), 299–301. https://doi.org/10.1038/d41586-020-01618-9

Frank, A. W. (2005). What is dialogical research, and why should we do it? *Qualitative Health Research*, *15*(7), 964–974. https://doi.org/10.1177/1049732305279078

Frank, A.W. (2011). Practicing dialogical narrative analysis. In J. A. Holstein & J. F. Gubrium (Eds.), *Varieties of narrative analysis* (pp. 33–52). Sage Publications

Frank, A. W. (2012). Practicing dialogical narrative analysis. In J. Holstein & J. Gubrium (Eds.), *Varieties of narrative analysis* (pp. 33–52). London: SAGE.

Frye, N. (1982). *The great code: The Bible and literature*. San Diego, CA: Harcourt Brace Jovanovich, Publishers.

Haegele, J. A., & Hodge, S. (2016). Disability discourse: Overview and critiques of the medical and social models. *Quest*, *68*(2), 193–206. https://doi.org/10.1080/00336297.2016.1143849

Hermans, H. J. (2006). Moving through three paradigms, yet remaining the same thinker. *Counselling Psychology Quarterly*, *19*(01), 5–25. https://doi.org/10.1080/09515070600589735

Hirschhorn, F. (2019). Reflections on the application of the Delphi method: Lessons from a case in public transport research. *International Journal of Social Research Methodology*, *22*(3), 309–322. https://doi.org/10.1080/13645579.2018.1543841

Jaarsma, E. A., Haslett, D., & Smith, B. (2019). Improving communication of information about physical activity opportunities for people with disabilities. *Adapted Physical Activity Quarterly*, *36*(2), 185–201. https://doi.org/10.1123/apaq.2018-0020

Krijtenburg-Lewerissa, K., Pol, H. J., Brinkman, A., & Van Joolingen, W. R. (2019). Key topics for quantum mechanics at secondary schools: A Delphi study into expert opinions. *International Journal of Science Education*, *41*(3), 349–366. https://doi.org/10.1080/09500693.2018.1550273

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. F. (2015). Data-prompted interviews: Using individual ecological data to stimulate narratives and explore meanings. *Health Psychology*, *34*(12), 1191–1194. https://doi.org/10.1037/hea0000234

Leonard, M., & McKnight, M. (2015). Look and tell: Using photo-elicitation methods with teenagers. *Children's Geographies*, *13*(6), 629–642. https://doi.org/10.1080/14733285.2014.887812

Levinas, E. (1998). *Collected philosophical papers*. Duquesne University Press

Liddiard, K., Runswick-Cole, K., Goodley, D., Whitney, S., Vogelmann, E., & Watts, L. (2019). I was excited by the idea of a project that focuses on those unasked questions" Co producing disability research with disabled young people. *Children & Society*, *33*(2), 154–167. https://doi.org/10.1111/chso.12308

Linell, P., & Marková, I. (1993). Acts in discourse: From monological speech acts to dialogical inter-acts. *Journal for the Theory of Social Behaviour*, *23*(2), 173–195. https://doi.org/10.1111/j.1468-5914.1993.tb00236.x

Malterud, K., Siersma, V. K., & Guassora, A. D. (2016). Sample size in qualitative interview studies: Guided by information power. *Qualitative Health Research*, *26*(13), 1753–1760. https://doi.org/10.1177/1049732315617444

Marková, I. (1987). On the interaction of opposites in psychological processes. *Journal for the Theory of Social Behaviour*, *17*(3), 279–299. https://doi.org/10.1111/j.1468-5914.1987.tb00100.x

Mascarinas, A, & Blauwet, C (2018). Policy and advocacy initiatives to promote the benefits of sports participation for individuals with disability. In AJ De Luigi (Ed.), *Adaptive Sports Medicine* (p. 371e384). Cham: Springer. DOI:10.1007/978-3-319-56568-2_30. https://dx.doi.org/

Mitchell, K. M., & Clark, A. M. (2021). Enhance your qualitative analysis with writing: Four principles of writing as inquiry. *International Journal of Qualitative Methods*, *20*(1), 1–5. https://doi.org/10.1177/16094069211057997

Monforte, J., Smith, M., & Smith, B. (2022). Designing a programme to train social workers on how to promote physical activity for disabled people: A Delphi study in the UK. *Health & Social Care in the Community*. DOI:10.1111/hsc.13724.

Monforte, J., & Úbeda-Colomer, J. (2021). Tinkering with the two-to-one interview: Reflections on the use of two interviewers in qualitative constructionist inquiry. *Methods in Psychology*, *5*, 100082. https://doi.org/10.1016/j.metip.2021.100082

Morgan, D. L., Ataie, J., Carder, P., & Hoffman, K. (2013). Introducing dyadic interviews as a method for collecting qualitative data. *Qualitative Health Research*, *23*(9), 1276–1284. https://doi.org/10.1177/1049732313501889

Netherway, J., Smith, B., & Monforte, J. (2021). Training healthcare professionals on how to promote physical activity in the UK: A scoping review of current trends and future opportunities. *International Journal of Environmental Research and Public Health*, *18*(13), 6701.

Netherway, J., Smith, B., & Monforte, J. (forthcoming). Falling into conversations that matter: the use of knowledge cafés within Equitable and Experientially-informed research.

Oliffe, J. L., Kelly, M. T., Gonzalez Montaner, G., & Yu Ko, W. F. (2021). Zoom interviews: Benefits and concessions. *International Journal of Qualitative Methods*, *20*, 1–8. https://doi.org/10.1177/16094069211053522

Reeves, G., & Jauch, L. R. (1978). Curriculum development through Delphi. *Research in Higher Education*, *8*(2), 157–168. https://doi.org/10.1007/bf00992116

Reid, H., Ridout, A. J., Tomaz, S. A., Kelly, P., & Jones, N. (2022). Benefits outweigh the risks: a consensus statement on the risks of physical activity for people living with long-term conditions. *British journal of sports medicine*, *56*(8), 427–438.

Shrier, I. (2021). Consensus statements that fail to recognise dissent are flawed by design: A narrative review with 10 suggested improvements. *British Journal of Sports Medicine*, *55*(10), 545–549. https://doi.org/10.1136/bjsports-2020-102545

Smith, B., Collinson, J. A., Phoenix, C., Brown, D., & Sparkes, A. (2009). Dialogue, monologue, and boundary crossing within research encounters: A performative narrative analysis. *International journal of sport and exercise psychology*, *7*(3), 342–358.

Smith, B., & McGannon, K. R. (2018). Developing rigor in qualitative research: Problems and opportunities within sport and exercise psychology. *International Review of Sport and Exercise Psychology*, *11*(1), 101–121. https://doi.org/10.1080/1750984x.2017.1317357

Smith, B., & Sparkes, A. (2016). Interviews: Qualitative interviewing in the sport and exercise sciences. In B. Smith & A. Sparkes (Eds.), *Routledge handbook of qualitative research in sport and exercise* (pp. 103–123). Routledge

Smith, B., & Wightman, L. (2019). Promoting physical activity to disabled people: Messengers, messages, guidelines and communication formats. *Disability and Rehabilitation*, *43*(24), 3427–3431. https://doi.org/10.1080/09638288.2019.1679896

Smith, B., Wightman, L., Smith, M., & Monforte, J. (forthcoming). Nine reasons why social workers should promote physical activity for disabled people.

Smith, B., Williams, O., Bone, L., & Collective, T. M. S. W. C. P. (2022). Co-production: A resource to guide co-producing research in the sport, exercise, and health sciences. *Qualitative Research* in Sport, Exercise and Health, 1–29.

Strom, K. J. (2018). That's not very deleuzian": Thoughts on interrupting the exclusionary nature of "high theory. *Educational Philosophy and Theory*, *50*(1), 104–113. https://doi.org/10.1080/00131857.2017.1339340

Velardo, S., & Elliott, S. (2021). Co-interviewing in qualitative social research: Prospects, merits and considerations. *International Journal of Qualitative Methods*, *20*, 1–7. https://doi.org/10.1177/16094069211054920

Vishnubala, D., & Pringle, A. (2021). Working with healthcare professionals to promote physical activity. *Perspectives in Public Health*, *141*(2), 111–113. https://doi.org/10.1177/1757913920978253

Wattanapisit, A., Petchuay, P., Wattanapisit, S., & Tuangratananon, T. (2019). Developing a training programme in physical activity counselling for undergraduate medical curricula: A nationwide Delphi study. *BMJ Open*, *9*(8), e030425. https://doi.org/10.1136/bmjopen-2019-030425

Wells, R., Barker, S., Boydell, K., Buus, N., Rhodes, P., & River, J. (2021). Dialogical inquiry: Multivocality and the interpretation of text. *Qualitative Research*, *21*(4), 498–514. https://doi.org/10.1177/1468794120934409