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AI-Enabled Physical Activity Intervention Strategies for Children and Adolescents: A Scoping Review

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Zhao, JL; Shang, ZY; Huang, JD; He, ZK.

Corresponding author:
Junling Zhao

junling@pku.edu.cn

Author Affiliation:
School of Public Health & China Center for Health Development Studies, Peking University, Beijing, China.

ADMINISTRATIVE INFORMATION

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INTRODUCTION

Review question / Objective The overarching objective of this scoping review is to map the nature, range, and characteristics of artificial intelligence (AI)–enabled intervention strategies used to promote physical activity (PA) or reduce sedentary behaviour in children and adolescents, and to identify gaps in the current evidence base.

The review question, structured using the Population–Concept–Context (PCC) framework, is: What AI-enabled intervention strategies have been used to promote physical activity or reduce sedentary behaviour in children and adolescents aged 6–18 years, and what are their characteristics with respect to the type of AI approach, intervention format, target population, outcomes, and study design?

Specifically, the review seeks to: (1) characterise the AI techniques applied (e.g., machine learning, deep learning, computer vision, reinforcement learning, and generative AI / large language models); (2) describe the intervention formats and modes of delivery (e.g., exergames, virtual or augmented reality, conversational agents, robotic coaches, and app-based feedback); (3) summarise the target populations and PA-related outcomes assessed; (4) map the study designs and the maturity of the evidence; and (5) identify knowledge gaps to inform future research.

Background Insufficient physical activity and excessive sedentary behaviour during childhood and adolescence are major global public-health concerns, associated with adverse effects on physical fitness, cardiometabolic health, weight status, and psychosocial well-being. The World Health Organization recommends that children and adolescents accumulate at least 60 minutes of moderate-to-vigorous physical activity daily, yet a large proportion worldwide fail to meet this threshold, and sedentary screen-based behaviour continues to rise.

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Conventional PA promotion strategies—such as school-based programmes and structured exercise—face persistent challenges in engagement, personalisation, scalability, and long-term adherence, and may not reach populations with specific needs, such as children with obesity or neurodevelopmental conditions. In parallel, rapid advances in artificial intelligence since 2018, including deep learning, computer vision, reinforcement learning, and, more recently, generative AI and large language models, have created new opportunities to deliver individualised, adaptive, and interactive interventions. AI-enabled technologies have been integrated into diverse delivery platforms, including exergames, virtual and augmented reality systems, conversational agents (chatbots), robotic coaches, and wearable-linked mobile applications, with the potential to enhance motivation, provide real-time feedback, and tailor activity to the individual user.

Existing reviews have largely examined single technology modalities—such as exergames, wearable activity trackers, or digital interventions for obesity—or have focused on effectiveness within narrowly defined designs. To date, no review has comprehensively mapped the broader and rapidly evolving landscape of AI-enabled PA interventions specifically for children and adolescents across the full range of AI techniques, delivery formats, populations, and outcomes. Given the emergent and methodologically heterogeneous nature of this field, a scoping review is the most appropriate approach to chart the existing evidence and to identify conceptual and methodological gaps.

Rationale This review addresses a timely and under-synthesised topic. Although AI-enabled approaches to physical activity promotion in young people are proliferating, the evidence is dispersed across biomedical, behavioural, engineering, and computing literature, and is characterised by substantial heterogeneity in AI techniques, intervention formats, study populations, outcome measures, and study designs—ranging from randomised controlled trials to single-arm feasibility studies and early-stage system-development or proof-of-concept reports.

A scoping review, rather than a systematic review, was selected for several reasons. First, the primary aim is to map the breadth, nature, and characteristics of the available evidence and to clarify key concepts, rather than to estimate the effect of a clearly defined intervention on a specific outcome. Second, the marked methodological and technological heterogeneity of the field, together with the inclusion of non-trial sources such as system-design and proof-of-concept reports, precludes a meaningful quantitative synthesis or a uniform risk-of-bias assessment. Third, mapping the evidence in this way will identify knowledge gaps, reveal where the evidence is concentrated or sparse, and determine whether a future, more focused systematic review is warranted.

The findings are intended to inform researchers, clinicians, educators, technology developers, and policymakers about the current state, opportunities, and limitations of AI-enabled physical activity interventions for children and adolescents, and to guide the design of higher-quality future studies.

METHODS

Strategy of data synthesis A comprehensive search will be conducted across six electronic databases: PubMed, Web of Science, Scopus, and EMBASE (biomedical and multidisciplinary coverage), together with IEEE Xplore and the ACM Digital Library (engineering and computing coverage, where many AI intervention studies are indexed). The most recent search was executed on 24 May 2026.

The search strategy combines three conceptual blocks using the Boolean operator AND, with synonyms within each block combined using OR, and is adapted to the syntax of each database. Date (2018 onward) and language (English) limits are applied.

Block 1 (Artificial intelligence): “Artificial Intelligence” OR “Machine Learning” OR “Deep Learning” OR “Deep Neural Network” OR “Deep Reinforcement Learning” OR “AI Coach” OR “Computational Intelligence”.

Block 2 (Physical activity / sedentary behaviour): “Physical Activity” OR “Exercise” OR “Sedentary Behavior” OR “Active Play” OR “Physical Activity Monitoring” OR “Screen Time” OR “Resistance Training” OR “Exercise Intervention” OR “Lifestyle Intervention” OR “Sport-based Intervention”.

Block 3 (Children / adolescents): “Child” OR “Children” OR “Adolescent” OR “Youth” OR “Teenager” OR “Pediatric” OR “School-age” OR “Childhood”. Combination: Block 1 AND Block 2 AND Block 3.

A narrative synthesis will be undertaken. The charted data will be grouped and summarised according to the type of AI approach, the

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intervention format and mode of delivery, the target population, the type of PA-related outcome, and the study design and maturity of the evidence. Results will be presented using tables and descriptive narrative, supplemented where appropriate by an evidence-and-gap map.

Eligibility criteria Inclusion criteria. Participants: children and adolescents aged 6–18 years; where mixed ages are reported, the principal focus must be on this age range. Concept: the intervention incorporates at least one AI-enabled component, defined as the use of machine learning, deep learning, computer vision, natural language processing, reinforcement learning, artificial neural networks, recommender or generative AI systems (including large language models), or AI-driven wearable sensing; and reports at least one outcome directly related to physical activity promotion or sedentary behaviour reduction (e.g., step count, exercise duration, physical activity level, energy expenditure, or screen time). Context: any setting (home, school, clinical, or community) and any country. Publication: published in English, from 1 January 2018 onward.

Exclusion criteria. E1, ineligible population (outside 6–18 years with no disaggregated data for the target range); E2, no AI-enabled component (e.g., conventional or sensor-only interventions without an AI algorithm); E3, irrelevant outcome (no PA or sedentary outcome—e.g., only rehabilitation/motor function, cognition, mood, or nutrition); E4, ineligible publication type (reviews, meta-analyses, protocols without results, editorials, commentaries, single-case reports, or conference abstracts without an available full text); E5, non-English publication; E6, published before 2018.

Source of evidence screening and selection All records retrieved from the six databases will be imported into Rayyan, where duplicate records will be identified and removed. Study selection will proceed in two sequential stages. First, titles and abstracts will be screened independently by two reviewers against the predefined eligibility criteria, with reviewers blinded to one another's decisions. Second, the full texts of all potentially relevant records will be retrieved and independently assessed for eligibility; for each excluded full text, the primary reason will be recorded using the standardised exclusion codes (E1–E6). Records for which a full text cannot be obtained will be documented as reports not retrieved. Prior to each stage, a calibration exercise will be conducted on a sample of records to refine the application of the criteria. Disagreements will be resolved through discussion and consensus, with a third reviewer consulted when necessary. The full selection process will be reported using a PRISMA-ScR flow diagram.

Data management Bibliographic records will be managed and de-duplicated in Rayyan, which will also be used to document title/abstract and full-text screening decisions and reasons for exclusion. A standardised data-charting form will be developed in a spreadsheet application (Microsoft Excel) and piloted on a subset of included studies before full use. Charted data, screening logs, and the final dataset will be stored securely by the review team, with version control maintained throughout, to ensure transparency and reproducibility.

Reporting results / Analysis of the evidence The review will be reported in accordance with the PRISMA-ScR checklist. The selection process will be presented in a PRISMA-ScR flow diagram. A descriptive numerical summary (e.g., number of studies, year and country of publication, AI approaches, intervention formats, and study designs) will be combined with a qualitative narrative synthesis. Charted data will be organised thematically by AI approach, intervention format, target population, PA-related outcome, and study design/evidence maturity, and knowledge gaps will be identified.

Presentation of the results Results will be presented through a combination of tables, figures, and a descriptive narrative. A flow diagram will document the study selection process, and the characteristics of the included studies will be summarised in tabular form. Where appropriate, additional tables or figures may be used to map the evidence according to the review's key dimensions and to highlight areas of concentration and gaps.

Language restriction The search will be restricted to articles published in English.

Country(ies) involved China.

Keywords artificial intelligence; machine learning; physical activity; sedentary behaviour; children; adolescents; exergame; scoping review.

Dissemination plans The findings will be disseminated through publication in a peer-reviewed international journal and may be presented at relevant scientific conferences. The results are expected to inform researchers, clinicians, educators, and technology developers working on physical activity promotion in young

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people, and to guide the design of future, more focused studies in this field.

Contributions of each author

Author 1 - Junling Zhao - Conceptualised and designed the review, developed the search strategy, performed study screening and data charting, and drafted the manuscript.
Email: junling@pku.edu.cn
Author 2 - Zhaoyang Shang - Performed title/abstract and full-text screening and data charting, and contributed to manuscript revision.
Email: 1282645751@qq.com
Author 3 - Jiandong Huang - Performed study screening and data charting, verified extracted data, and contributed to manuscript revision.
Email: 2143751508@qq.com
Author 4 - Zhongkai He - Supervised the review, resolved screening disagreements, and contributed to manuscript revision.
Email: hzk@pku.edu.cn

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