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## A Youth-centred Participatory Action approach towards co-created implementation of socially and physically activating environmental interventions in Africa and Europe: The YoPA project study protocol

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**A Youth-centred Participatory Action approach towards co-created implementation of socially and physically activating environmental interventions in Africa and Europe: The YoPA project study protocol.**

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## Abstract

### *Introduction*

The majority of adolescents do not meet guidelines for healthy behaviours, posing major risks for developing multiple non-communicable diseases. Unhealthy lifestyles seem more prevalent in urban than rural areas, with the neighbourhood environment as a mediating pathway. How to develop and implement sustainable and effective interventions focused on adolescent health and wellbeing in urban vulnerable life situations is a key challenge. This paper describes the protocol of a Youth-centred Participatory Action (YoPA) project aiming to tailor, implement, and evaluate social and physical environmental interventions using an evidence-informed youth-centred co-creation approach.

### *Methods and Analysis*

In diverse urban environments in Denmark, the Netherlands, Nigeria, and South Africa, we will engage adolescents (12-19 years) growing up in vulnerable life situations and other key stakeholders (e.g., policy makers, urban planners, community leaders) in local co-creation communities. Together with academic researchers and local stakeholders, adolescents will take a leading role in mapping the local system; tailoring; implementing and evaluating interventions during participatory meetings over the course of three years. YoPA applies a participatory mixed methods design guided by our newly developed SUPER-AIM framework assessing: (i) the local Systems, (ii) User perspectives, (iii) the Participatory co-creation process, (iv) Effects, v) Reach, (vi) Adoption, (vii) Implementation, and (viii) Maintenance of interventions, in an integrated manner. Through a realist evaluation YoPA will explore why and how specific outcomes were reached (or not) in each setting.

### *Ethics and dissemination*

This study received approval from the Ethics committees in Denmark, the Netherlands, Nigeria, and South Africa and will be disseminated via various collaborative dissemination activities targeting multiple scientific and wider audiences. We envision that our YoPA co-creation approach will serve as a guide for participation of adolescents in vulnerable life situations in implementation of health promotion and urban planning in Europe, Africa and globally.

### *Registration details*

ClinicalTrials.gov, NCT06181162.

<https://clinicaltrials.gov/study/NCT06181162?titles=YoPA&rank=1>

### Strengths and limitations

- By introducing teen-centred evidence-informed co-creation - combining a participatory and complex systems approach – YoPA proposes an alternative approach to the complex challenges of physical inactivity and health inequalities;
- YoPA contributes to theory-building and evidence-base on why and how environmental interventions work (or not) by applying a realist evaluation in diverse, multi-country contexts;
- The combination of the flexible co-creation approach with a rigorous evaluation framework and of scientific evidence with systematically produced local knowledge are particularly novel;
- YoPA fills research gaps in health behaviours and non-communicable diseases within Sub-Saharan Africa and the involvement of adolescents in shaping their physical and social environments;
- The complexity of the public health problem and context-specific approach prohibit a randomised controlled trial design. Instead, in YoPA we focus on identifying working mechanisms and detailed documentation using a mixed methods design.

## Introduction

Insufficient physical activity is associated with many non-communicable diseases (NCDs) and responsible for >5 million deaths worldwide each year.<sup>1</sup> Public health guidelines recommend at least 60 minutes/day moderate-to-vigorous physical activity for youth.<sup>2</sup> An alarming large number of adolescents do not meet these guidelines: at global level, 78% of boys and 85% of girls between the age of 12-18 years.<sup>3</sup> Girls are generally less active than boys<sup>3</sup> and European adolescents with migrant or ethnic minority backgrounds are generally less active than adolescents from the majority population.<sup>4</sup> As a result, many adolescents have an increased risk of developing physical inactivity related NCDs, both physical (e.g. obesity, diabetes) and mental (e.g. reduced wellbeing, anxiety, depression).<sup>5-7</sup> Moreover, recreational activities are an effective coping strategy for many and have a positive effect on reducing stress, especially when physical activity is combined with social support.<sup>8</sup> The periods of lockdown due to the COVID-19 pandemic exacerbated inequities, and in Europe the percentage of adolescents meeting physical activity recommendations decreased to 9.3% among 9-18-year-olds.<sup>9</sup> Periods of lockdown were particularly challenging for the most marginalized groups due to urban overcrowding, lack of public open space and lower levels of access to outdoor activities.

Besides the abundant evidence for the benefits of regular participation in physical activity, over the past decade, excessive sedentary behaviour, specifically recreational screen-based behaviour and shortened sleep have gained increased attention as risk factors for adolescents' health and wellbeing.<sup>10-12</sup> Thus, a healthier composition of movement behaviours (i.e. physical activity, sedentary behaviour and sleep) throughout the 24-hours of the day has important physical and mental health benefits.<sup>12, 13</sup> Moreover, movement behaviours and their underlying mechanisms interact and might result in a vicious circle of unhealthy behaviours negatively influencing each other.<sup>14</sup> Physical activity can also be a powerful tool for promoting health equity through community empowerment, mutual social support ensuring affordable access to sport and recreation services.<sup>15</sup>

Recognising the importance and urgency of reducing global levels of insufficient physical activity, WHO (World Health Organization) member states endorsed a global action plan on physical activity (GAPPA)<sup>16</sup> and agreed to a 15% relative reduction in insufficient physical activity among adolescents by 2030. The International Society of Physical Activity and Health (ISPAH) formulated eight investments that work for physical activity,<sup>17</sup> which are

1 supported by robust evidence of effectiveness and have worldwide applicability.<sup>18</sup> Recommended environmental  
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3 and policy approaches include creation and improvement of access to places for physical activity with  
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5 informational outreach activities, community-scale and street-scale urban design and land use, a pro-active  
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7 transport policy and practice, and community-wide participatory policies and planning.<sup>19</sup> Despite these global  
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9 efforts, most of the evidence on the health benefits of and interventions targeting physical activity is from high-  
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11 income countries,<sup>20</sup> or what are increasingly referred to as 'Minority World' countries<sup>21</sup> (as in those countries  
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13 combined the minority of the world's population lives). This terminology highlights the absence of representation  
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15 in research in this field from 'Majority World' countries. This is particularly relevant for Africa, which accounts for  
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17 less than 1% of global research output even though it makes up 12.5% of the world's population.<sup>22</sup> For example, in  
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19 the field of child development, research from countries in which the majority of the world's population lives is  
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21 unacceptably underrepresented in most academic journals.<sup>23</sup>

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27 Many interventions targeting adolescents have had disappointing impact, plausibly because they were  
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29 implemented top-down, adult-driven, and insufficiently tailored to the specific context<sup>24</sup> and thus not addressing  
30  
31 the real wishes and needs of adolescents. For example, the beneficial long-term effects of regular physical activity  
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33 on reducing morbidity and health care costs are highly relevant for health professionals and policy makers, while  
34  
35 for adolescents the more immediate benefits on wellbeing, directly or indirectly through mutual social support,  
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37 and having fun are of relevance. Health professionals increasingly call for greater engagement of young people in  
38  
39 the measurement of adolescent health issues as well as the development of appropriate targeted interventions to  
40  
41 promote their health.<sup>25</sup> In programmes that do engage young people, those included are often already confident,  
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43 articulate, and natural leaders.<sup>26</sup> Instead, engagement of youth growing up in vulnerable life situations (e.g.,  
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45 ethnic minorities, living in socially and economically underprivileged neighbourhoods, those with lower  
46  
47 educational levels and managing many uncertainties) in implementation of preventive interventions would have  
48  
49 greater impact on closing equity gaps in health and wellbeing. Therefore, in this paper we introduce the novel  
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51 design and protocol of the EU-funded Youth-centred Participatory Action project.

### 52 53 54 55 56 57 58 59 *The Youth-centred Participatory Action (YoPA) project*

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Considering the complexity of improving healthy movement behaviours and reducing health inequalities in

1 adolescents, we initiated the Youth-centred Participatory Action (YoPA) project. The overall aim of YoPA is to  
2  
3 optimally tailor, implement, and evaluate social and physical environmental interventions using an evidence-  
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5 informed co-creation approach, for structural improvement in the lifestyle of adolescents (12-18 years) in urban  
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7 vulnerable life situations in two European and two African cities. YoPA focuses on improving the physical and built  
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9 environment as well as the social environment considering the importance of friends' and peers' influence, and  
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11 social networks for both physical activity and wellbeing.<sup>27, 28</sup> Co-creation is a participatory approach of creative  
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13 and interactive problem-solving among diverse stakeholders with a shared goal and a shared decision-making  
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15 process, from collaborative problem identification and solution generation to implementation and evaluation.<sup>29</sup>  
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17 Through co-creation geared towards adolescent empowerment, we aim to enhance personal and collective  
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19 agency, and in turn, perceptions of autonomy, which have a direct effect on improving health outcomes.<sup>30</sup> YoPA  
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21 aims to contribute to physical activity security which implies that all people, at all times, should have physical and  
22  
23 economic access to sufficient, safe, and enjoyable physical activity to meet not only their health needs, but also to  
24  
25 promote social connectedness and wellbeing, for an active and healthy life.<sup>20</sup> In YoPA we aim to tackle the  
26  
27 following four challenges by creating and experimenting with a youth-centred participatory action approach in  
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29 four different countries.  
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36 *Challenge 1: Lifestyles and health inequalities in adolescents continue to worsen.* It is crucial to promote healthy  
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38 movement behaviours in adolescence for multiple reasons: i) most adolescents fail to meet the three movement  
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40 behaviour guidelines;<sup>31</sup> ii) the trend for decreasing physical activity starts in adolescence;<sup>32, 33</sup> iii) screen time  
41  
42 increases throughout adolescence;<sup>33</sup> iv) lifestyle habits, including physical activity and screen time<sup>34, 35</sup> track from  
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44 adolescence into adulthood; v) several NCDs have their origins in childhood and adolescence and persist into  
45  
46 adulthood<sup>36, 37</sup> thus effective interventions in adolescence can have lifelong and intergenerational health  
47  
48 implications; vi) adolescence is a crucial and vulnerable life transition where adolescents acquire emotional and  
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50 cognitive abilities for independence. How one navigates this transition depends on available opportunities and  
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52 resources (e.g., family finances to allow school attendance); various systems (e.g., transportation, social welfare)  
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54 and broader societal norms (e.g. gender). Adolescents in vulnerable life situations such as living in socio-economic  
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56 underprivileged areas, minority groups and from low educational and income levels, have less opportunities, and  
57  
58 are more at risk for unhealthy lifestyles and worse health outcomes than their mainstream peers.<sup>38</sup> Living in  
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1 socially disadvantaged areas doubles adolescents' risk of engaging in low levels of moderate-to-vigorous physical  
2  
3 activity.<sup>39</sup>  
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7 *Challenge 2: Increasing population density in urban areas limits space for sports and outdoor play.* Since 2007,  
8  
9 most of the world's population lives in urban areas with major differences in socio-economic and cultural  
10  
11 backgrounds and health.<sup>40</sup> The way cities are built, and public space is designed impacts many of our conscious  
12  
13 and unconscious behavioural choices, acknowledged in ISPAH investment #3 'active urban design'. An  
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15 international study in 14 cities on five different continents showed that adults who lived in the most activity-  
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17 friendly neighbourhoods engaged in 68-89 minutes more physical activity per week than those living in the least  
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19 activity-friendly neighbourhoods. Across vastly different cities spread over ten countries on five continents,  
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21 people living in neighbourhoods with a higher residential density, a more connected street-network, a good  
22  
23 public transportation network and more parks, were more active than residents living in other neighbourhoods.<sup>41</sup>  
24  
25 Active urban design also positively impacts two other ISPAH investments; #6 equitable access to sport and  
26  
27 recreation facilities and amenities, such as parks and urban green spaces, promoting recreational physical activity;  
28  
29 and #2 active transport through more destinations, shorter distances, and better walking, cycling and public  
30  
31 transportation infrastructure, thereby generating a potential tipping point for promoting physical activity.<sup>42</sup> The  
32  
33 importance of urban design as well as public and green open spaces in providing a positive, enabling environment  
34  
35 for physical activity is well-known.<sup>41, 43, 44</sup> However, the increasing population density in urban areas leads to an  
36  
37 increased pressure on the public space and in Majority countries to an increase in informal settlements and the  
38  
39 global privatisation of public space,<sup>45, 46</sup> limiting space for sports and outdoor play.<sup>47</sup> Scientific evidence supports  
40  
41 that the built environment has the potential to affect the long-term health of adolescents by increasing their daily  
42  
43 physical activity through a combination of attractive recreational facilities (e.g., sport pitches, green spaces,  
44  
45 amenities like fresh drinking water).<sup>48, 49</sup> Nonetheless, current urban environments serve adults and young  
46  
47 children better than adolescent.<sup>50</sup> Nonetheless, youth have different access to power than the professionals who  
48  
49 plan the public spaces of their neighbourhood. Especially girls' access to public space adapted to their specific  
50  
51 needs could be improved.<sup>51</sup> To increase effectiveness of socio-environmental interventions, there is a need for  
52  
53 studies that consider the perceptions different intersectional groups of adolescents (e.g., boys and girls with  
54  
55 varying socio-cultural backgrounds) in designing an attractive environment or public space.<sup>52</sup>  
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3 *Challenge 3: Traditional individual-level behavioural interventions are less sustainable.* Physical inactivity is a  
4 complex public health problem with multiple interacting influences and feedback loops embedded in social,  
5 cultural, and physical systems.<sup>53</sup> Such complex problems require multiple, up and downstream, embedded  
6 population-level actions that favourably contribute to reshaping nested systems.<sup>54</sup> Effective approaches to  
7 tackling physical inactivity will thus require multiple concurrent strategies and actions to be implemented across  
8 settings and sectors. However, to date, physical activity interventions have primarily focused on isolated causes  
9 and linear relationships with individual-level health outcomes rather than a systems approach that considers the  
10 links, feedback loops and interactions among elements within the bigger picture.<sup>55</sup> For example, most physical  
11 activity interventions have primarily relied on educational and information-based programmes targeting the  
12 individual with little consideration of the relational and social (e.g., peers, role models, gatekeepers) and physical  
13 environments (e.g., accessibility of parks, walkability, adequate lighting, safety) that have a major enabling or  
14 hindering influence on health behaviours.

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32 *Challenge 4: Top-down implemented, one-size-fits-all interventions are ineffective.* Health research frequently  
33 addresses questions and outcomes that are of limited relevance to health care practitioners, patients, and other  
34 end-users, resulting in considerable research waste.<sup>56</sup> Hence, most top-down, adult-driven, standardized  
35 interventions have had limited adoption and impact.<sup>24</sup> Citizen participation in the form of youth-centred,  
36 evidence-informed co-creation of interventions tailored to local contexts helps to prevent misalignment of  
37 priorities between researchers and stakeholders on the one hand and misalignment of interventions with local  
38 contexts on the other. Engaging adolescents as critical agents of social and political change is necessary for  
39 building inclusive democratic societies, which can result in more effective and youth-friendly health promotion.<sup>57</sup>  
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<sup>58</sup> Currently, adolescents increasingly participate in public health research; however, participation is generally  
limited to consultation and adolescents are rarely involved in the decision-making process, which is essential to  
becoming empowered and gain personal and collective agency to take action to improve their life situation.<sup>59-62</sup>  
Several studies on youth participation in policy making have demonstrated that young people are sharp analysts  
of their settings and creative producers of ideas for planning, but authorities are reluctant to expand their top-  
down, expert-based mode of urban planning and health policy making to include young people.<sup>63, 64</sup>

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3 Below, we present the protocol of the YoPA project including the design, theoretical and evaluation framework.  
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## 7 **Methods and analysis**

### 10 *Design*

11  
12 YoPA combines the flexible and adaptive participatory action research with a rigorous practical protocol and  
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14 evaluation framework as well as scientific evidence with systematically produced local knowledge, i.e. knowledge  
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16 that is rooted in experience in a particular social context. Figure 1 presents the five phases of the YoPA approach,  
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18 where engagement of stakeholders and evaluation continue throughout the project. We use a participatory,<sup>65</sup>  
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20 mixed-methods<sup>66</sup>, comparative approach<sup>67, 68</sup> to comprehensively examine a broad range of evaluation questions  
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22 such as whether, how and why interventions contribute to system change; how this evidence can be generalised  
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24 and subsequently adapted to specific contexts, intended and unintended consequences of implemented  
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26 interventions; as well as potential working mechanisms and interactions with the local context. Using our novel  
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28 SUPER-AIM Framework (Systems, User perspectives, Participatory co-creation process, Effects, Reach, Adoption,  
29  
30 Implementation, and Maintenance) (see Table 1), we will evaluate both the participatory co-creation process as  
31  
32 well as the process and outcomes of implementing holistic, systemic interventions in the four study sites: Aalborg  
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34 in Denmark, Amsterdam in the Netherlands, Osogbo in Nigeria and Soweto in South Africa.  
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50 **Figure 1: YoPA youth-centred co-creation approach visualising the engagement of adolescent-researchers,**  
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52 **community adolescents and adult stakeholders.**

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54 IPT = Initial Program Theory  
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### 58 *Theories and paradigms*

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60 The central paradigm in YoPA is Participatory Action Research: a collaborative, iterative, often open-ended and

1 unpredictable approach, which prioritizes the expertise of those experiencing a social issue and uses systematic  
2 research methodologies to generate new insights.<sup>65</sup> In YoPA we use the six building blocks for designing a  
3 Participatory Action Research project proposed by Cornish et. al.:<sup>65</sup> i) building relationships, ii) establishing  
4 working practices, iii) establishing a common understanding of the issue, iv) observing, gathering and generating  
5 materials, v) collaborative data analysis, and vi) planning and taking action. A key benefit of Participatory Action  
6 Research is empowerment by enabling participants to have a voice and contribute to knowledge production.<sup>69, 70</sup>  
7 Empowerment theory is a conceptual framework for understanding the enhancement of positive youth  
8 development by engaging youth in developing confidence, skills, and behavioural strategies to achieve self-  
9 identified goals.<sup>71, 72</sup> Empowerment includes three components: 1) intrapersonal, including beliefs regarding  
10 control and confidence; 2) interactional, including critical awareness of driving forces and understanding of the  
11 actions and resources needed for the desired change; and 3) behavioural, referring to actions to make the desired  
12 changes.<sup>71</sup> A second paradigm in YoPA is a systems-approach that considers the links, feedback loops and  
13 interactions among elements within the bigger picture.<sup>55</sup> We start with studying and understanding the local  
14 context. Next, we aim to develop and implement interventions, which we consider as a complex of actions that  
15 favourably contribute to reshaping the system dynamics.<sup>14</sup>

### 36 *The YoPA co-creation protocol*

37 We will start with collaboratively developing one overall YoPA co-creation protocol together with the local  
38 researchers from all four study sites. The YoPA co-creation protocol aims at high-quality co-creation i) based on  
39 state-of-the-art science- and practice-based evidence and theory; ii) tailored to the local context, including the  
40 local needs and preferences of adolescents; iii) acceptable and feasible for local stakeholders responsible for  
41 implementation. This protocol ensures a systematic, evidence- and theory-based application of co-creation  
42 leaving space for adaptation to each local context. The overall co-creation protocol will include building an  
43 infrastructure for continuous capacity building for adolescents, as well as local stakeholders to stimulate  
44 participatory thinking, active engagement, equal collaboration, and training in research and other relevant skills.  
45 This protocol will describe how to apply youth-centred co-creation including recruitment and all methods for  
46 capacity building and peer research. We will organise training for local facilitators of the youth-centred co-  
47 creation process, as well as for key stakeholders to stimulate their active contribution to the co-creation process.

1 Academic researchers bring in their state-of-the-art scientific knowledge and experience with developing  
2 evidence-based interventions while adolescent-researchers bring in their lived experience. In YoPA we aim to  
3 develop academic and adolescent-researchers' collective agency, by building their capacities for collaboration,  
4 peer-research and intervention development. Collaborating with other key stakeholders from multiple sectors in  
5 the system will gain a deeper understanding of the complex system and thereby contribute to more holistic and  
6 contextually relevant interventions.  
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### 16 *ENGAGING local YoPA communities (Public involvement)*

17 We will engage four local co-creation communities, two communities in Minority countries (Denmark and the  
18 Netherlands) and two in Majority countries (Nigeria and South Africa). In each community, a dynamic group of 15-  
19 20 adolescents will be recruited to participate as co-researchers in local co-creation groups facilitated by an  
20 academic researcher. Recruitment will take place through diverse channels and settings including schools, local  
21 community centres, youth clubs, religious meeting places and other relevant settings where adolescents with  
22 diverse backgrounds meet. We will use a purposive sampling method tailored to each local context (e.g., social  
23 media, flyers) in collaboration with local NGOs and other community stakeholders. By ensuring safe spaces, skilled  
24 facilitators and capacity building, adolescents in local co-creation groups will be encouraged to actively engage  
25 and contribute to the co-creation process. We will conduct stakeholder analyses to identify and recruit other key  
26 stakeholders (e.g., existing community-based organisations and local authorities with a shared agenda), who will  
27 be invited to actively contribute to the co-creation process by joining meetings of the local co-creation groups.  
28 The co-creation process will take place during regular participatory meetings with adolescents facilitated by an  
29 academic researcher over the course of three years. To maximise chances of sustained commitment we will  
30 collaborate with local community groups organised around health advocacy, sports, music, or social activity. We  
31 will emphasise social inclusion by involving adolescents of different genders and backgrounds.  
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### 54 *MAPPING the local context*

55 To ensure YoPA will address questions and outcomes that are most relevant to the local communities, thereby  
56 promoting uptake and sustainability of the interventions, we will start with mapping the local context by an audit  
57 and environmental scan of selected communities to identify local needs and priorities using various state-of-the-  
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1 art participatory methods e.g., photovoice,<sup>73</sup> community mapping,<sup>74</sup> and neighbourhood walks.<sup>75</sup> To explore the  
2 local communities at multiple levels, i.e., including linkages, relationships, feedback loops and interactions, we will  
3 use systems methods such as group model building<sup>76</sup> and social network analysis.<sup>77</sup> We will use Causal Loop  
4 Diagrams as a tool to explore the multiple, interacting feedback loops operating in the existing local system. Such  
5 Causal Loop Diagrams create a dynamic, holistic view of the existing system, including intended and unintended  
6 potential consequences, and the ways in which interventions in one setting, such as home or school, might be  
7 influenced by the interactions with other settings, such as macroeconomic and urban systems e.g., public space.<sup>14,</sup>  
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<sup>78</sup> In bringing together key stakeholders (locally, nationally, or internationally) to understand the root causes of unhealthy movement behaviours, a systems approach enables each stakeholder to see where they fit within a bigger picture.<sup>17</sup> To ensure results align with the perspectives of the wider community, emerging findings will be shared with community representatives for them to critically examine and contribute. For this step we may use structured interview matrix<sup>79</sup> – a community-based research method that allows large groups (up to 40 participants) to discuss directions for future developments and priorities in an iterative, structured, and transparent process – and multi-criteria decision-making matrices,<sup>80</sup> to weigh all collected data in a transparent way. Each local system map will include an agreed set of priorities for holistic, systemic interventions in each local community.

#### *SELECTION, TAILORING AND IMPLEMENTING evidence-informed interventions*

Based on the local system maps, the best matching evidence-based interventions will be selected from i) local youth-led knowledge ii) ISPAH's 8 investments that work for physical activity; and iii) literature reviews conducted by the academic researchers, iv) other relevant (local) literature and databases including evidence-based interventions. For each of the selected interventions, we will develop an intervention theory to help identify key working mechanisms, salient context conditions, and relevant additional outcomes. The intervention theories will be grounded in existing evidence and empirically tested in the local contexts. The selected interventions will be aligned with local priorities and existing strategic plans where possible, based on the local system maps and meetings with key stakeholders, to obtain support and ensure feasibility, sustainability, and resources for the implementation. Key considerations for our settings are safety and crime (especially for adolescent girls), limited infrastructure and resources, and transport challenges.

### *EVALUATE interventions using the SUPER-AIM framework*

The YoPA evaluation will take a systems perspective, aiming to evaluate a range of outcomes, associated processes, and their dynamic interrelationships using interrupted time series methods as one of the strongest quasi-experimental research designs.<sup>81</sup> Table 1 describes the specific outcomes, samples, and proposed methods for each component of our SUPER-AIM framework. Together with the local co-creation communities, we will select and/or modify the most appropriate methods that allow the collection of quantitative and qualitative data at all system levels, including measures of the process and outcomes of the co-creation and implementation of interventions. Process data will be collected continuously from the start of the co-creation process. Outcome data will be collected before and 6 months after implementation of interventions as well 6-12 months later depending on the local situation. For the outcome evaluation, we aim to recruit 200-250 adolescents in each local community. Training of (adolescent) data collectors for collecting data in the four communities will follow the 'train-the-trainer' principle: one meeting will be organised to train the researchers responsible for data collection in their country, who will subsequently train local (adolescent) data collectors. As there is a lack of evidence on the application of youth-centred co-creation in vulnerable settings in both Majority and Minority countries, we aim to better understand the mechanisms underlying co-creation through personal and collective agency in each of the settings with the help of realist evaluation.<sup>82</sup> Next to evaluating the outcomes of interventions, realist evaluation aims to understand why and how specific outcomes were reached in each setting and thus contributes to building the theory base on why interventions work (or not), and for whom, in a range of settings. Collaborating and sharing experiences across the four co-creation sites through online meetings, exchanges and joint analyses may help to generalize findings.

### *Analyses*

Data collected by adolescent-researchers throughout the co-creation process will be analysed using the best available and accessible techniques with options for facilitated co-researcher involvement. The selected methods should be engaging to the co-researchers, suited to answering their research questions and supported by a skilled academic researcher. Following data cleaning and data processing, we will analyse the outcomes of the implemented interventions, as well as the dynamics underlying these, combining and comparing data from the

1 four study sites. We will conduct analyses of a combination of quantitative (e.g., sensor-based behavioural data)  
2 as well as qualitative (e.g., interviews and user-generated data) data.<sup>83</sup> Quantitative data will be analysed using  
3 appropriate techniques (e.g., multilevel modelling appropriate for individual-level data nested within  
4 communities). Qualitative data will be summarised and subsequently analysed using open and axial coding by two  
5 independent researchers. Intersectionality references the critical insight that race, class, gender, sexuality,  
6 ethnicity, nation, ability, and age operate not as unitary, mutually exclusive entities, but as reciprocally  
7 constructing phenomena that in turn shape complex social and health inequalities.<sup>84</sup> In both quantitative and  
8 qualitative analyses, we will apply different kinds of intersectional analyses including relevant categories such as  
9 gender, age, education and ethnicity.

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23 In the social network analysis, we will focus on the relationships among relevant 'actors' when mapping the local  
24 setting including persons, organisations, and locations to understand the interrelations and impacts of factors at  
25 different levels – from individual-level factors to environments and policies. We will use this knowledge to identify  
26 leverage points for interventions. We will integrate realist evaluation<sup>82</sup> in the process evaluation to better  
27 understand which mechanisms contributed to the observed outcomes, e.g. how the achievement of individual  
28 and collective agency leads to empowerment, and under which conditions. Additionally, we will provide a tested  
29 and refined intervention theory on the application of youth-centred co-creation in vulnerable settings, focusing  
30 on social mechanisms potentially to be triggered (trust, reciprocity, neighbourhood solidarity, personal and  
31 collective agency, leadership) in a range of context conditions (typology of settings: socially cohesive long time  
32 residing migrant communities, less cohesive transient migrant communities, diverse communities, partially  
33 gentrified etc.). We will develop a plausible causal explanation, focusing also on counteracting or unintended  
34 consequences. These findings will be further synthesised into a refined intervention theory that can be used for  
35 future similar interventions and can be tested in other settings. To analyse the costs of implementation, we will  
36 use micro costing reflecting actual resource use and economic costs by collecting data on resources utilized and  
37 the unit costs of those resources following guidelines and checklists for conducting and reporting micro-costing  
38 studies.<sup>85</sup>

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*[Place Table 1 here]*



### **Ethics and dissemination**

Ethical considerations are fundamental throughout the YoPA project. In YoPA we will encourage an emphasis on inclusive practices, mutual respect, continuous dialogue and reflexivity, shared decision-making and collaborative action. Each adolescent participating in the youth-centred co-creation or any aspect of the evaluation, and where relevant also one of their parents, will sign informed consent before participating in the study, verifying that they understood the involvement and agree to data collection. We will develop attractive, age-adapted and easy-to-understand information (brochures, videos) explaining the purpose of involvement, the nature of data collection, the potential burden (e.g., time investment), the right to access their own data, how data will be processed and protected, and how confidentiality will be maintained. Where possible we will make datasets generated and/or analysed during the YoPA project available in the Open Science Framework repository. Not all data can be made public in order to protect participants' confidentiality. Participation is entirely voluntary, and participants can choose to withdraw at any time without consequences. The Research Ethics committees of the four local institutions approved the protocol for the YoPA project: Amsterdam UMC Medical Ethical Committee, the Netherlands (2023.0670), the Redeemer's University, Nigeria (2023.060), the University of Southern Denmark Research Ethics Committee, Denmark (Case no 23/47839, REC ID 408), the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, South-Africa (reference: M230721).

To enhance the communication, dissemination, and impact of YoPA, we have developed a comprehensive plan (Figure 2) that includes a well-defined strategy, clear objectives with measurable key results, and various tools designed to amplify the project's impact. Effective communication and (community) dialogue is crucial for raising public awareness about the importance of healthy movement behaviours in preventing NCDs and promoting youth-centred co-creation of intervention customization and implementation. This will enhance the visibility of the YoPA project among various stakeholders e.g. through the project website (<https://www.yopa-project.eu/>). Collaborative dissemination activities target scientific, stakeholder, policymaker, and a wider audience aiming to promote youth-centred co-creation for healthy movement behaviours and NCD prevention tailored to local communities. YoPA is committed to continued project results through a sustainable dissemination and impact strategy. Additionally, we aim to build capacities among local partners and universities for ongoing local co-

1 creation research and community collaboration. We will make all educational and training materials, practical  
2 protocols, and successful local intervention examples available in the YoPA toolbox. The YoPA approach will be  
3 shared through a licensed train-the-trainer program for effective dissemination through diverse channels. By  
4 actively engaging stakeholders in training sessions, we aim to promote the benefits of co-creation and inspire  
5 more effective action towards promoting health across society.  
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## 18 **Figure 2. YoPA communication, dissemination, and impact plan**

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### 23 **Discussion**

24 YoPA will contribute to health equity by specifically focussing on improving the social and physical environment of  
25 adolescents in urban vulnerable life situations. Evaluating the effectiveness of such socio-environmental  
26 interventions across heterogeneous local contexts, co-creation communities and interventions is challenging as  
27 these will result in different 'intervention theories' or scenarios, on how systems-oriented interventions are  
28 expected to work in their respective contexts. Describing and testing plausible mechanisms of how interventions  
29 are expected to work at multiple levels and for a range of actors (in nested systems), is important for  
30 strengthening robust causal inference but also for credibility towards policy and practice.<sup>99</sup> Traditional designs  
31 and analysis methods are not appropriate for studying complex systems as they lack the ability to measure and  
32 understand contextual including socio-ecological effects as well as the dynamic properties of complex adaptive  
33 systems,<sup>77</sup> including unintended effects on other parts of the system.<sup>100</sup> Therefore, we introduce our novel SUPER-  
34 AIM framework, incorporating crucial data explaining if, how, why and in which settings the implemented  
35 interventions will favourably contribute to reshaping local systems.  
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55 A better understanding of how culture and structure impacts the co-creation process and interventions  
56 implemented in the four selected communities in YoPA benefits knowledge exchange between the different  
57 settings. Furthermore, YoPA goes beyond addressing a research gap in physical activity and health research in Sub  
58 Sahara Africa; it takes an approach to considering context in a robust and meaningful way that fully accounts for  
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1 competing priorities in African settings.<sup>20</sup> Currently, there is a lack of systematic and practical protocols guiding  
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3 the application of co-creation for tailoring evidence-informed interventions to specific contexts, and subsequently  
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5 evaluating them together with adolescents and other key stakeholders. To fill this gap, we will develop a YoPA  
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7 toolbox, making all materials and training on the youth-centred co-creation for tailoring and implementation of  
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9 evidence-informed interventions available through the YoPA website ([yopa-project.eu](http://yopa-project.eu)), both during its  
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11 development and its final form. Once results from the process, outcome and realist evaluations start to come in,  
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13 more formalised guidelines for the use of the toolbox, as well as policy recommendations for the implementation  
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15 of similar co-creation processes will be developed and become part of the toolbox, targeted at researchers, public  
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17 health and urban planning practitioners, local authorities, policy makers, grassroots/community based  
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19 organisations and citizens. By establishing an infrastructure for youth-centred co-creation including capacity  
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21 building, mentoring, and with active engagement of adolescent health advocates and leaders, YoPA aims to  
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23 nurture sustainable implementation of adolescent-responsive preventive interventions tailored to the local  
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25 context, improving their agency, 24-hour movement behaviours and wellbeing, with the purpose of halting the  
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27 rise in NCDs and associated health care costs. We envision that our YoPA youth-centred co-creation approach will  
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29 serve as a guide for participation of adolescents in vulnerable life situations in implementation of health  
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31 promotion in Europe, Africa and globally.  
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### 39 **Authors' contributions**

40  
41 MC has led the writing and editing of this paper, coordinates the overall YoPA project, and is the project lead for  
42  
43 YoPA in Amsterdam. LK contributed to the design of the YoPA project, commented on drafts and is co-project lead  
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45 for YoPA in Amsterdam. ALO contributed to the design of the YoPA project, commented on drafts, leads the  
46  
47 mapping of the local systems, and is the project lead for YoPA in Osogbo. CED contributed to the design of the  
48  
49 YoPA project, commented on drafts, leads the evaluation of YoPA, and is the project lead for YoPA in Soweto. CSP  
50  
51 and JS contributed to the design of the YoPA project, commented on drafts, and are co-project leads for YoPA in  
52  
53 Aalborg. AP and MS commented on drafts, and lead the YoPA communication, dissemination and impact strategy.  
54  
55 SVB contributed to the design of the YoPA project, commented on drafts and leads the realist evaluation. TA  
56  
57 contributed to the design of the YoPA project, commented on drafts, leads the tailoring and implementing of co-  
58  
59 created interventions and ethics and is co-project lead for YoPA in Amsterdam. All authors read and approved the  
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## 14 **Competing interests**

16 The authors declare they have no competing interests.  
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## 22 **References**

- 23 1. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219-29.
- 24 2. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-62.
- 25 3. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child Adolesc Health*. 2020;4(1):23-35.
- 26 4. Brug J, van Stralen MM, Chinapaw MJ, De Bourdeaudhuij I, Lien N, Bere E, et al. Differences in weight status and energy-balance related behaviours according to ethnic background among adolescents in seven countries in Europe: the ENERGY-project. *Pediatr Obes*. 2012;7(5):399-411.
- 27 5. van Sluijs EMF, Ekelund U, Crochemore-Silva I, Guthold R, Ha A, Lubans D, et al. Physical activity behaviours in adolescence: current evidence and opportunities for intervention. *Lancet*. 2021;398(10298):429-42.
- 28 6. Akseer N, Mehta S, Wigle J, Chera R, Brickman ZJ, Al-Gashm S, et al. Non-communicable diseases among adolescents: current status, determinants, interventions and policies. *BMC Public Health*. 2020;20(1):1908.
- 29 7. Rodriguez-Ayllon M, Cadenas-Sanchez C, Estevez-Lopez F, Munoz NE, Mora-Gonzalez J, Migueles JH, et al. Role of Physical Activity and Sedentary Behavior in the Mental Health of Preschoolers, Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Med*. 2019;49(9):1383-410.
- 30 8. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med*. 2011;45(11):886-95.
- 31 9. Kovacs VA, Brandes M, Suesse T, Blagus R, Whiting S, Wickramasinghe K, Okely AD. Are we underestimating the impact of COVID-19 on children's physical activity in Europe? - a study of 24,302 children. *Eur J Public Health*. 2022.
- 32 10. Hjorth MF, Chaput JP, Damsgaard CT, Dalskov SM, Andersen R, Astrup A, et al. Low physical activity level and short sleep duration are associated with an increased cardio-metabolic risk profile: a longitudinal study in 8-11 year old Danish children. *PLoS One*. 2014;9(8):e104677.
- 33 11. Chastin SF, Palarea-Albaladejo J, Dontje ML, Skelton DA. Combined Effects of Time Spent in Physical Activity, Sedentary Behaviors and Sleep on Obesity and Cardio-Metabolic Health Markers: A Novel Compositional Data Analysis Approach. *PLoS One*. 2015;10(10):e0139984.
- 34 12. Rollo S, Antsygina O, Tremblay MS. The whole day matters: Understanding 24-hour movement guideline adherence and relationships with health indicators across the lifespan. *J Sport Health Sci*. 2020;9(6):493-510.
- 35 13. Roenneberg T. Chronobiology: the human sleep project. *Nature*. 2013;498(7455):427-8.
- 36 14. Waterlander WE, Singh A, Altenburg T, Dijkstra C, Luna Pinzon A, Anselma M, et al. Understanding obesity-related behaviors in youth from a systems dynamics perspective: The use of causal loop diagrams. *Obes Rev*. 2021;22(7):e13185.

- 1 15. Laverack G. Improving health outcomes through community empowerment: a review of the literature. *J Health*
- 2 *Popul Nutr.* 2006;24(1):113-20.
- 3 16. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a
- 4 healthier world: World Health Organization; 2019.
- 5 17. Milton K, Cavill N, Chalkley A, Foster C, Gomersall S, Hagstromer M, et al. Eight Investments That Work for
- 6 Physical Activity. *J Phys Act Health.* 2021;18(6):625-30.
- 7 18. Organization WH. Tackling NCDs: 'best buys' and other recommended interventions for the prevention and
- 8 control of noncommunicable diseases. <https://apps.who.int/iris/handle/10665/259232>. . 2017.
- 9 19. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, et al. Evidence-based intervention in
- 10 physical activity: lessons from around the world. *Lancet.* 2012;380(9838):272-81.
- 11 20. Lambert EV, Kolbe-Alexander T, Adlakha D, Oyeyemi A, Anokye NK, Goenka S, et al. Making the case for
- 12 'physical activity security': the 2020 WHO guidelines on physical activity and sedentary behaviour from a
- 13 Global South perspective. *Br J Sports Med.* 2020;54(24):1447-8.
- 14 21. Khan T, Abimbola S, Kyobutungi C, Pai M. How we classify countries and people and why it matters. *BMJ*
- 15 *Global Health.* 2022;7:e009704.
- 16 22. Marincola E, Kariuki T. Quality Research in Africa and Why It Is Important. *Acs Omega.* 2020;5(38):24155-7.
- 17 23. Draper CE, Barnett LM, Cook CJ, Cuartas JA, Howard SJ, McCoy DC, et al. Publishing child development
- 18 research from around the world: An unfair playing field resulting in most of the world's child population under-
- 19 represented in research. *Infant Child Dev.* 2022.
- 20 24. Gibbs A, Campbell C, Maimane S, Nair Y. Mismatches between youth aspirations and participatory
- 21 HIV/AIDS programmes in South Africa. *Afr J AIDS Res.* 2010;9(2):153-63.
- 22 25. Sawyer SM, Afifi RA, Bearinger LH, Blakemore SJ, Dick B, Ezech AC, Patton GC. Adolescence: a foundation for
- 23 future health. *Lancet.* 2012;379(9826):1630-40.
- 24 26. Villa-Torres L, Svanemyr J. Ensuring youth's right to participation and promotion of youth leadership in the
- 25 development of sexual and reproductive health policies and programs. *J Adolesc Health.* 2015;56(1 Suppl):S51-
- 26 7.
- 27 27. Maturo CC, Cunningham SA. Influence of friends on children's physical activity: a review. *Am J Public Health.*
- 28 2013;103(7):e23-38.
- 29 28. Lamblin M, Murawski C, Whittle S, Fornito A. Social connectedness, mental health and the adolescent brain.
- 30 *Neurosci Biobehav Rev.* 2017;80:57-68.
- 31 29. Vargas C, Whelan J, Brimblecombe J, Allender S. Co-creation, co-design, co-production for public health - a
- 32 perspective on definition and distinctions. *Public Health Res Pract.* 2022;32(2).
- 33 30. Wallerstein N. Powerlessness, empowerment, and health: implications for health promotion programs. *Am J*
- 34 *Health Promot.* 1992;6(3):197-205.
- 35 31. Tapia-Serrano MA, Sevil-Serrano J, Sanchez-Miguel PA, Lopez-Gil JF, Tremblay MS, Garcia-Hermoso A.
- 36 Prevalence of meeting 24-Hour Movement Guidelines from pre-school to adolescence: A systematic review
- 37 and meta-analysis including 387,437 participants and 23 countries. *J Sport Health Sci.* 2022.
- 38 32. Kalman M, Inchley J, Sigmundova D, Iannotti RJ, Tynjala JA, Hamrik Z, et al. Secular trends in moderate-to-
- 39 vigorous physical activity in 32 countries from 2002 to 2010: a cross-national perspective. *Eur J Public Health.*
- 40 2015;25 Suppl 2:37-40.
- 41 33. Marques A, Loureiro N, Avelar-Rosa B, Naia A, Matos MG. Adolescents' healthy lifestyle. *J Pediatr (Rio J).*
- 42 2020;96(2):217-24.
- 43 34. Jones RA, Hinkley T, Okely AD, Salmon J. Tracking physical activity and sedentary behavior in childhood: a
- 44 systematic review. *Am J Prev Med.* 2013;44(6):651-8.
- 45 35. Telama R, Yang X, Leskinen E, Kankaanpaa A, Hirvensalo M, Tammelin T, et al. Tracking of physical activity from
- 46 early childhood through youth into adulthood. *Med Sci Sports Exerc.* 2014;46(5):955-62.
- 47 36. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into
- 48 adulthood: a systematic review of the literature. *Obes Rev.* 2008;9(5):474-88.
- 49 37. Yan Y, Hou D, Zhao X, Liu J, Cheng H, Wang Y, Mi J. Childhood Adiposity and Nonalcoholic Fatty Liver Disease in
- 50 Adulthood. *Pediatrics.* 2017;139(4).
- 51 38. Patton GC, Sawyer SM, Santelli JS, Ross DA, Afifi R, Allen NB, et al. Our future: a Lancet commission on
- 52 adolescent health and wellbeing. *Lancet.* 2016;387(10036):2423-78.
- 53 39. Heath GW, Bilderback J. Grow Healthy Together: Effects of Policy and Environmental Interventions on Physical
- 54 Activity Among Urban Children and Youth. *Journal of Physical Activity & Health.* 2019;16(2):172-6.
- 55 40. Oosterlynck S, Verschraegen G, Kempen R. Divercities: Understanding super-diversity in deprived and mixed
- 56
- 57
- 58
- 59
- 60



- neighbourhoods2018. 1-250 p.
41. Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet*. 2016;387(10034):2207-17.
  42. Wijntuin P, Koster M. Dutch-Moroccan Girls Navigating Public Space: Wandering as an Everyday Spatial Practice. *Space Cult*. 2019;22(3):280-93.
  43. Giles-Corti B, Broomhall MH, Knuiman M, Collins C, Douglas K, Ng K, et al. Increasing walking: how important is distance to, attractiveness, and size of public open space? *Am J Prev Med*. 2005;28(2 Suppl 2):169-76.
  44. Giles-Corti B, Vernez-Moudon A, Reis R, Turrell G, Dannenberg AL, Badland H, et al. City planning and population health: a global challenge. *Lancet*. 2016;388(10062):2912-24.
  45. Agyemang F. Privatization of Public Spaces and Its Impact on the Socio-Political and Spatial Landscapes of the Cape Town Central City Improvement District (CCCID). Available at SSRN 3153812. 2017.
  46. Ware C. A Tale of Two Cities: Public Space Development in Nigeria2021. Available from: <https://worldlandscapearchitect.com/a-tale-of-two-cities-public-space-development-in-nigeria/>.
  47. Xu F, Li J, Liang Y, Wang Z, Hong X, Ware RS, et al. Associations of residential density with adolescents' physical activity in a rapidly urbanizing area of Mainland China. *Journal of Urban Health*. 2010;87(1):44-53.
  48. Sallis JF, Glanz K. The role of built environments in physical activity, eating, and obesity in childhood. *Future Child*. 2006;16(1):89-108.
  49. Giles-Corti B, Kelty SF, Zubrick SR, Villanueva KP. Encouraging walking for transport and physical activity in children and adolescents: how important is the built environment? *Sports Med*. 2009;39(12):995-1009.
  50. WHO. Global Accelerated Action for the Health of Adolescents (AA-HA!): guidance to support country implementation. Geneva; 2017.
  51. Jalalkamali A, Doratli N. Public Space Behaviors and Intentions: The Role of Gender through the Window of Culture, Case of Kerman. *Behav Sci (Basel)*. 2022;12(10).
  52. Van Hecke L, Verhoeven H, Clarys P, Van Dyck D, Van de Weghe N, Baert T, et al. Factors related with public open space use among adolescents: a study using GPS and accelerometers. *International journal of health geographics*. 2018;17(1):3.
  53. Rutter H, Cavill N, Bauman A, Bull F. Systems approaches to global and national physical activity plans. *Bull World Health Organ*. 2019;97(2):162-5.
  54. Rutter H, Savona N, Glonti K, Bibby J, Cummins S, Finegood DT, et al. The need for a complex systems model of evidence for public health. *Lancet*. 2017;390(10112):2602-4.
  55. Popkin BM, Duffey K, Gordon-Larsen P. Environmental influences on food choice, physical activity and energy balance. *Physiology & behavior*. 2005;86(5):603-13.
  56. Ioannidis JP. Why Most Clinical Research Is Not Useful. *PLoS Med*. 2016;13(6):e1002049.
  57. World Health Organization. Engaging young people for health and sustainable development: strategic opportunities for the World Health Organization and partners. 2018.
  58. World Health Organization. Health for the world's adolescents: a second chance in the second decade: summary. World Health Organization; 2014.
  59. Frerichs L, Ataga O, Corbie-Smith G, Tessler Lindau S. Child and youth participatory interventions for addressing lifestyle-related childhood obesity: a systematic review. *Obes Rev*. 2016;17(12):1276-86.
  60. Larsson I, Staland-Nyman C, Svedberg P, Nygren JM, Carlsson IM. Children and young people's participation in developing interventions in health and well-being: a scoping review. *BMC Health Serv Res*. 2018;18(1):507.
  61. Anyon Y, Bender K, Kennedy H, Dechants J. A Systematic Review of Youth Participatory Action Research (YPAR) in the United States: Methodologies, Youth Outcomes, and Future Directions. *Health Educ Behav*. 2018;45(6):865-78.
  62. Shamrova DP, Cummings CE. Participatory action research (PAR) with children and youth: An integrative review of methodology and PAR outcomes for participants, organizations, and communities. *Children and Youth Services Review*. 2017;81:400-12.
  63. Horelli L, Kaaja M. Opportunities and constraints of "Internet-assisted urban planning" with young people. *Journal of Environmental Psychology*. 2002;22(1-2):191-200.
  64. Frank KI. The potential of youth participation in planning. *Journal of Planning Literature*. 2006;20(4):351-71.
  65. Cornish F, Breton N, Moreno-Tabarez U, Delgado J, Rua M, Aikins AD, Hodgetts D. Participatory action research. *Nat Rev Method Prime*. 2023;3(1).
  66. Schoonenboom J, Johnson RB. How to Construct a Mixed Methods Research Design. *Kolner Z Soziol Soz*. 2017;69:107-31.
  67. Bartlett L, Vavrus F. Rethinking case study research: A comparative approach: Taylor & Francis; 2016.

- 1 68. Beach D, Pedersen RB. Causal case study methods: Foundations and guidelines for comparing, matching, and  
2 tracing: University of Michigan Press; 2016.
- 3 69. (ICPHR) ICfPHR. Position Paper 5: Empowerment and Participatory Health Research. Baltimore 2021.
- 4 70. Wallerstein N. Empowerment to reduce health disparities. *Scand J Public Health*. 2002;30(3):72-7.
- 5 71. Zimmerman MA. Psychological empowerment: issues and illustrations. *Am J Community Psychol*.  
6 1995;23(5):581-99.
- 7 72. Zimmerman MA. Empowerment theory: Psychological, organizational and community levels of analysis.  
8 *Handbook of community psychology*: Springer; 2000. p. 43-63.
- 9 73. Wang C. Youth Participation in Photovoice as a Strategy for Community Change *Journal of Community  
10 Practice*. 2006;14(1-2):147-61.
- 11 74. Amsden J, VanWynsberghe R. Community mapping as a research tool with youth. *Action Research*.  
12 2005;3(4):357-81.
- 13 75. Carpiano RM. Come take a walk with me: the "go-along" interview as a novel method for studying the  
14 implications of place for health and well-being. *Health Place*. 2009;15(1):263-72.
- 15 76. Vennix JA, Akkermans HA, Rouwette EA. Group model-building to facilitate organizational change: an  
16 exploratory study. *System Dynamics Review: The Journal of the System Dynamics Society*. 1996;12(1):39-58.
- 17 77. Luke DA, Stamatakis KA. Systems science methods in public health: dynamics, networks, and agents. *Annual  
18 review of public health*. 2012;33:357-76.
- 19 78. Hendricks G, Savona N, Aguiar A, Alaba O, Booley S, Malczyk S, et al. Adolescents' Perspectives on the Drivers  
20 of Obesity Using a Group Model Building Approach: A South African Perspective. *Int J Environ Res Public  
21 Health*. 2022;19(4).
- 22 79. O'Sullivan TL, Corneil W, Kuziemsy CE, Toal-Sullivan D. Use of the Structured Interview Matrix to Enhance  
23 Community Resilience Through Collaboration and Inclusive Engagement. *Systems Research and Behavioral  
24 Science*. 2015;32(6):616-28.
- 25 80. Harputlugil T, Prins M, Gültekin AT, Topçu YI. Conceptual framework for potential implementations of multi  
26 criteria decision making (MCDM) methods for design quality assessment. 2011.
- 27 81. Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health  
28 interventions: a tutorial. *Int J Epidemiol*. 2017;46(1):348-55.
- 29 82. Pawson R, Tilley N. An introduction to scientific realist evaluation. *Evaluation for the 21st century: A  
30 handbook*. Thousand Oaks, CA, US: Sage Publications, Inc; 1997. p. 405-18.
- 31 83. Prins RG, Panter J, Heinen E, Griffin SJ, Ogilvie DB. Causal pathways linking environmental change with health  
32 behaviour change: Natural experimental study of new transport infrastructure and cycling to work. *Preventive  
33 Medicine*. 2016;87:175-82.
- 34 84. Collins PH. Intersectionality's Definitional Dilemmas. *Annu Rev Sociol*. 2015;41:1-20.
- 35 85. Ruger JP, Reiff M. A Checklist for the Conduct, Reporting, and Appraisal of Microcosting Studies in Health Care:  
36 Protocol Development. *JMIR Res Protoc*. 2016;5(4):e195.
- 37 86. Gerritsen S, Harre S, Rees D, Renker-Darby A, Bartos AE, Waterlander WE, Swinburn B. Community Group  
38 Model Building as a Method for Engaging Participants and Mobilising Action in Public Health. *Int J Environ Res  
39 Public Health*. 2020;17(10).
- 40 87. Luke DA, Harris JK. Network analysis in public health: history, methods, and applications. *Annu Rev Public  
41 Health*. 2007;28:69-93.
- 42 88. Emery M, Higgins L, Chazdon S, Hansen D. Using Ripple Effect Mapping to Evaluate Program Impact: Choosing  
43 or Combining the Methods That Work Best for You. *Journal of Extension*. 2015;53(2).
- 44 89. Chazdon S, Emery M, Hansen D, Higgins L, Sero R. A field guide to ripple effects mapping: University of  
45 Minnesota Libraries Publishing; 2017.
- 46 90. Feick R, Robertson C. A multi-scale approach to exploring urban places in geotagged photographs. *Computers,  
47 Environment and Urban Systems*. 2015;53:96-109.
- 48 91. Pawlowski CS, Andersen HB, Troelsen J, Schipperijn J. Children's Physical Activity Behavior during School  
49 Recess: A Pilot Study Using GPS, Accelerometer, Participant Observation, and Go-Along Interview. *PLoS One*.  
50 2016;11(2):e0148786.
- 51 92. Pawlowski CS, Schmidt T, Nielsen JV, Troelsen J, Schipperijn J. Will the children use it?—A RE-AIM evaluation of a  
52 local public open space intervention involving children from a deprived neighbourhood. *Eval Program Plann*.  
53 2019;77:101706.
- 54 93. Hofland ACL, Devilee J, van Kempen E, den Broeder L. Resident participation in neighbourhood audit tools - a  
55 scoping review. *Eur J Public Health*. 2018;28(1):23-9.

- 1 94. McKenzie TL. System for observing play and leisure activity in youth (SOPLAY). Retrieved August. 2002;1:2006.
- 2 95. McKenzie T, Cohen D. System for observing play and recreation in communities (SOPARC). Center for
- 3 Population Health and Health Disparities (ed) RAND. 2006.
- 4 96. Manzano A. The craft of interviewing in realist evaluation. *Evaluation*. 2016;22(3):342-60.
- 5 97. Kern ML, Benson L, Steinberg EA, Steinberg L. The EPOCH Measure of Adolescent Well-Being. *Psychol Assess*.
- 6 2016;28(5):586-97.
- 7 98. Zimmerman LA, Li M, Moreau C, Wilopo S, Blum R. Measuring agency as a dimension of empowerment among
- 8 young adolescents globally; findings from the Global Early Adolescent Study. *SSM Popul Health*.
- 9 2019;8:100454.
- 10 99. Reis RS, Salvo D, Ogilvie D, Lambert EV, Goenka S, Brownson RC, Lancet Physical Activity Series 2 Executive C.
- 11 Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get
- 12 people moving. *Lancet*. 2016;388(10051):1337-48.
- 13 100. Mittelmark MB. Unintended effects in settings-based health promotion. *Scand J Public Health*. 2014;42(15
- 14 Suppl):17-24.
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**Table 1: The YoPA SUPER-AIM evaluation framework**

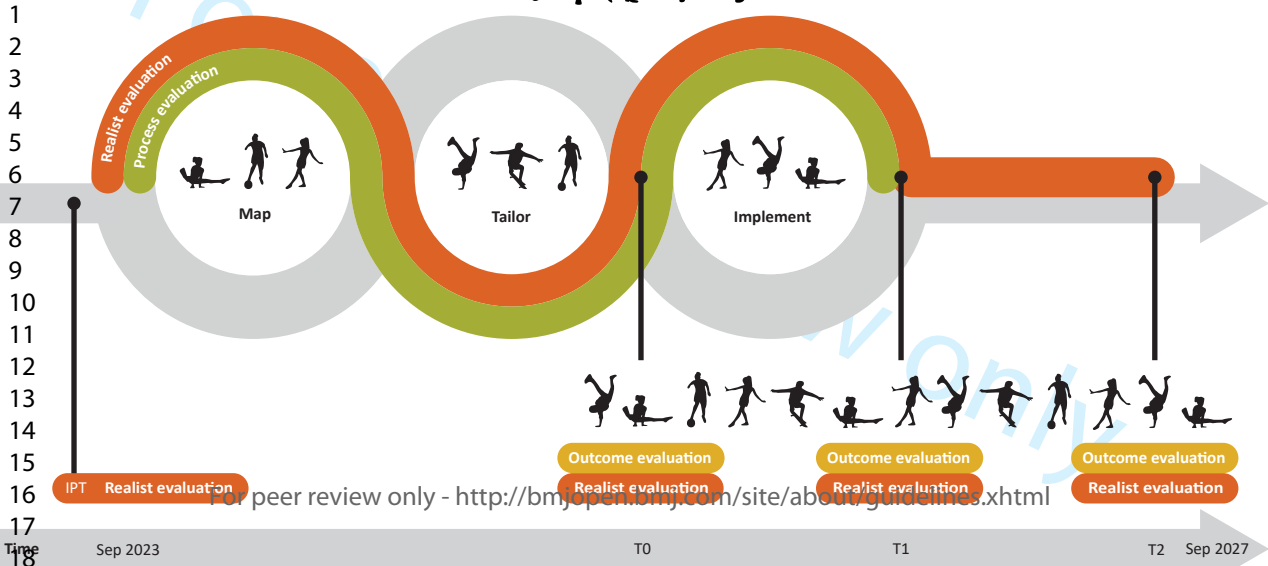
Component & Definition	Outcome	Methods
<p><b>Systems</b> - Identification of the drivers of unhealthy movement behaviours at multiple levels of the system including linkages, relationships, feedback loops and interactions among system parts</p>	<p>1. Maps of the local system and its stakeholders, displaying knowledge gaps, leverage points for interventions, and insights 2. Overview of both intended and emergent outcomes of interventions across various levels, interactions with the local context, and adaptation of interventions</p>	<p>1. Developing local system maps based on e.g., Group Model Building,<sup>86</sup> Social Network Analysis<sup>87</sup> 2. Ripple Effects Mapping:<sup>88, 89</sup> in several group sessions, different key stakeholders participate to provide their perspective on the outcomes (appreciative inquiry) and collaboratively explore the contribution of the implemented interventions to these outcomes in mind maps. This provides practice-based knowledge about effective principles as well as the broader impact of the interventions.</p>
<p><b>User perspectives</b> - Identification of the user perspective on implemented interventions for example on the attractiveness and acceptability.</p>	<p>Accessibility, acceptability, and adaptations of interventions e.g., perceived physical activity friendliness, perceived inclusiveness of interventions, perceived safety, and fear of crime; satisfaction with interventions and use of interventions.</p>	<p>Participant observation and in-depth formal and informal interviews with adolescents e.g., using photo-diaries,<sup>90</sup> go-along interviews,<sup>91, 92</sup> neighbourhood audit,<sup>93</sup> focus group interviews<sup>94, 95</sup>.</p>
<p><b>Participatory co-creation process</b> - Identification of important barriers and facilitators of the participatory co-creation process</p>	<p>1. Adolescents' motivations to participate in the project 2. Satisfaction with the co-creation process among involved stakeholders* 3. Mechanisms underlying co-creation</p>	<p>1. Participatory observations, focus group interviews, reflection scheme after each co-creation meeting 2. Online satisfaction measurement, focus group interviews 3. In-depth focus group interviews<sup>96</sup> with project team; realist Context-Mechanism-Outcome causal analysis</p>
<p><b>Effects</b> - Identification of desired outcomes among the adolescents. If necessary, measures of locally defined impact will be added to examine factors of greatest interest to local stakeholders.</p>	<p>1. Wellbeing 2. Personal and collective agency 3. 24 hr movement behaviours (physical activity, sedentary behaviour, sleep)</p>	<p>1. EPOCH measure of adolescent well-being<sup>97</sup> 2. GEAS survey freedom of movement, voice, behavioural control, and decision making<sup>98</sup> 3. Accelerometers, self-report, and systematic observation (adapted SOPLAY<sup>94</sup>/SOPARC<sup>95</sup>)</p>
<p><b>Reach</b> - adolescents whose behaviours and wellbeing we aim to benefit: 1) co-creation participants; 2) users of interventions; 3) adolescent citizens in the selected communities</p>	<p>Characteristics of adolescents</p>	<p>1. Focus group interviews with co-creation participants 2. Systematic observations of intervention users 3. Existing databases (e.g., from municipality) and survey data adolescent citizens in the selected communities</p>
<p><b>Adoption</b> - Identification of engagement and commitment with 1) Implemented interventions; 2) Teen centred co-creation</p>	<p>Engagement and commitment of relevant stakeholders*</p>	<p>Focus group interviews</p>
<p><b>Implementation</b> - Identification of</p>	<p>1. Satisfaction with implementation of youth-centred</p>	<p>1. Participatory observations and focus group interviews</p>

<p>1 adaptations, potential barriers and 2 facilitators of implementation 3 4 5 6 7</p>	<p>co-creation among involved stakeholders* 2. Number, type and quality of implemented interventions 3. Satisfaction with implementation of interventions among involved stakeholders* 4. Costs of intervention implementation</p>	<p>2. Calculation of the resources needed to implement the interventions using micro-costing.<sup>85</sup></p>
<p>8 <b>Maintenance</b> - Identification of sustained 9 use of 1) Implemented interventions; 2) 10 Teen centred co-creation 11</p>	<p>1. Sustained use of interventions 2. Sustained use of youth-centred co-creation in the communities</p>	<p>1. Systematic observation (e.g., adapted SOPLAY<sup>94</sup>/SOPARC<sup>95</sup>) 2. Focus group interviews</p>

\* Involved stakeholders: e.g., adolescents, public health professionals, urban planners/designers, policy makers

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Adult stakeholders

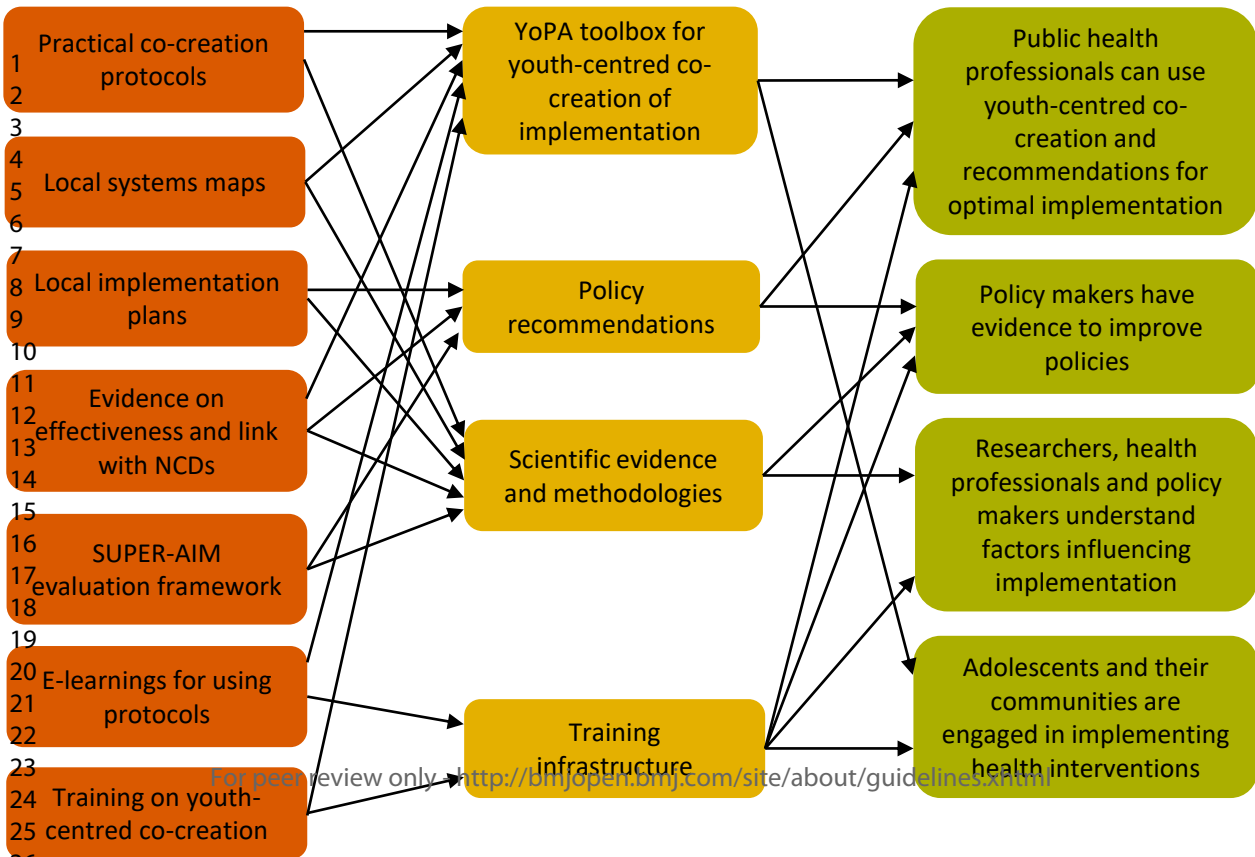


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## YoPA results

## Collated Results

## Expected outcomes



**GUIDED – a guideline for reporting for intervention development studies.**

## Supplementary File 1: Blank Checklist

Item description	Explanation	Page in manuscript where item is located	Other*
1. Report the context for which the intervention was developed.	Understanding the context in which an intervention was developed informs readers about the suitability and transferability of the intervention to the context in which they are considering evaluating, adapting or using the intervention. Context here can include place, organisational and wider socio-political factors that may influence the development and/or delivery of the intervention (15).	8-10	
2. Report the purpose of the intervention development process.	Clearly describing the purpose of the intervention specifies what it sets out to achieve. The purpose may be informed by research priorities, for example those identified in systematic reviews, evidence gaps set out in practice guidance such as The National Institute for Health and Care Excellence or specific prioritisation exercises such as those undertaken with patients and practitioners through the James Lind Alliance.	8-10	
3. Report the target population for the intervention development process.	The target population is the population that will potentially benefit from the intervention – this may include patients, clinicians, and/or members of the public. If the target population is clearly described then readers will be able to understand the relevance of the intervention to their own research or practice. Health inequalities, gender and ethnicity are features of the target population that may be relevant to intervention development processes.	10-11	
4. Report how any published intervention development approach contributed to the development process	Many formal intervention development approaches exist and are used to guide the intervention development process (e.g. 6Squid (16) or The Person Based Approach to Intervention Development (17)). Where a formal intervention development approach is used, it is helpful to describe the process that was followed, including any deviations. More general approaches to intervention development also exist and have been categorised as follows (3):- Target Population-centred intervention development; evidence and theory-based intervention development; partnership intervention development; implementation-based intervention development; efficacy-based intervention development; step or phased-based intervention development; and intervention-specific intervention development (3). These approaches do not always have specific guidance that describe their use. Nevertheless, it is helpful to give a rich description of how any published approach was operationalised	8	
5. Report how evidence from different sources informed the intervention development process.	Intervention development is often based on published evidence and/or primary data that has been collected to inform the intervention development process. It is useful to describe and reference all forms of evidence and data that have informed the development of the intervention because evidence bases can change rapidly, and to explain the manner in which the evidence and/or data was used. Understanding what evidence was and was not available at the time of intervention development can help readers to assess transferability to their current situation.	8-12	
6. Report how/if published theory informed the intervention development process.	Reporting whether and how theory informed the intervention development process aids the reader's understanding of the theoretical rationale that underpins the intervention. Though not mentioned in the e-Delphi or consensus meeting, it became increasingly apparent through the development of our guidance that this theory item could relate to either existing published theory or programme theory	9	
7. Report any use of components from an existing intervention in the current intervention development process.	Some interventions are developed with components that have been adopted from existing interventions. Clearly identifying components that have been adopted or adapted and acknowledging their original source helps the reader to understand and distinguish between the novel and adopted components of the new intervention.	6	
8. Report any guiding principles, people or factors that were prioritised when making decisions during the intervention development process.	Reporting any guiding principles that governed the development of the application helps the reader to understand the authors' reasoning behind the decisions that were made. These could include the examples of particular populations who views are being considered when designing the intervention, the modality that is viewed as being most appropriate, design features considered important for the target population, or the potential for the intervention to be scaled up.	8-12	

Item description	Explanation	Page in manuscript where item is located	Other*
9. Report how stakeholders contributed to the intervention development process.	Potential stakeholders can include patient and community representatives, local and national policy makers, health care providers and those paying for or commissioning health care. Each of these groups may influence the intervention development process in different ways. Specifying how differing groups of stakeholders contributed to the intervention development process helps the reader to understand how stakeholders were involved and the degree of influence they had on the overall process. Further detail on how to integrate stakeholder contributions within intervention reporting are available (19).	8-12	
10. Report how the intervention changed in content and format from the start of the intervention development process.	Intervention development is frequently an iterative process. The conclusion of the initial phase of intervention development does not necessarily mean that all uncertainties have been addressed. It is helpful to list remaining uncertainties such as the intervention intensity, mode of delivery, materials, procedures, or type of location that the intervention is most suitable for. This can guide other researchers to potential future areas of research and practitioners about uncertainties relevant to their healthcare context.	n.a.	
11. Report any changes to interventions required or likely to be required for subgroups.	Specifying any changes that the intervention development team perceive are required for the intervention to be delivered or tailored to specific sub groups enables readers to understand the applicability of the intervention to their target population or context. These changes could include changes to personnel delivering the intervention, to the content of the intervention, or to the mode of delivery of the intervention.	12	
12. Report important uncertainties at the end of the intervention development process.	Intervention development is frequently an iterative process. The conclusion of the initial phase of intervention development does not necessarily mean that all uncertainties have been addressed. It is helpful to list remaining uncertainties such as the intervention intensity, mode of delivery, materials, procedures, or type of location that the intervention is most suitable for. This can guide other researchers to potential future areas of research and practitioners about uncertainties relevant to their healthcare context.	11-12	
13. Follow TIDieR guidance when describing the developed intervention.	Interventions have been poorly reported for a number of years. In response to this, internationally recognized guidance has been published to support the high quality reporting of health care? interventions <sup>5</sup> and public health interventions <sup>14</sup> . This guidance should therefore be followed when describing a developed intervention.	n.a.	
14. Report the intervention development process in an open access format.	Unless reports of intervention development are available people considering using an intervention cannot understand the process that was undertaken and make a judgement about its appropriateness to their context. It also limits cumulative learning about intervention development methodology and observed consequences at later evaluation, translation and implementation stages. Reporting intervention development in an open access (Gold or Green) publishing format increases the accessibility and visibility of intervention development research and makes it more likely to be read and used. Potential platforms for open access publication of intervention development include open access journal publications, freely accessible funder reports or a study web-page that details the intervention development process.	15 & 17	

\*e.g. if item is reported elsewhere, then the location of this information can be stated here.

# BMJ Open

## A Youth-centred Participatory Action approach towards co-created implementation of socially and physically activating environmental interventions in Africa and Europe: the YoPA project study protocol

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<b>Primary Subject Heading</b>:	Public health
Secondary Subject Heading:	Public health, Epidemiology, Mental health, Paediatrics, Research methods
Keywords:	Adolescents < Adolescent, Community-Based Participatory Research, Behavior, Health Equity

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1 **A Youth-centred Participatory Action approach towards co-created implementation of socially and physically**  
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**Abstract****Introduction**

The majority of adolescents do not meet guidelines for healthy behaviours, posing major risks for developing multiple non-communicable diseases. Unhealthy lifestyles seem more prevalent in urban than rural areas, with the neighbourhood environment as a mediating pathway. How to develop and implement sustainable and effective interventions focused on adolescent health and wellbeing in urban vulnerable life situations is a key challenge. This paper describes the protocol of a Youth-centred Participatory Action (YoPA) project aiming to tailor, implement, and evaluate social and physical environmental interventions.

**Methods and analysis**

In diverse urban environments in Denmark, the Netherlands, Nigeria, and South Africa, we will engage a dynamic group of 15-20 adolescents (12-19 years) growing up in vulnerable life situations and other key stakeholders (e.g., policy makers, urban planners, community leaders) in local co-creation communities. Together with academic researchers and local stakeholders, adolescents will take a leading role in mapping the local system; tailoring; implementing and evaluating interventions during participatory meetings over the course of three years. YoPA applies a participatory mixed methods design guided by a novel SUPER-AIM framework assessing: (i) the local Systems, (ii) User perspectives, (iii) the Participatory co-creation process, (iv) Effects, v) Reach, (vi) Adoption, (vii) Implementation, and (viii) Maintenance of interventions. Through a realist evaluation YoPA will explore why and how specific outcomes were reached (or not) in each setting (n=800-1000 adolescents in total).

**Ethics and dissemination**

This study received approval from the Ethics committees in Denmark, the Netherlands, Nigeria, and South Africa and will be disseminated via various collaborative dissemination activities targeting multiple audiences. We will obtain informed consent from all participants. We envision that our YoPA co-creation approach will serve as a guide for participation of adolescents in vulnerable life situations in implementation of health promotion and urban planning in Europe, Africa and globally.

**Study registration**

ClinicalTrials.gov, NCT06181162.

## Strengths and limitations of this study

- By introducing teen-centred evidence-informed co-creation—combining a participatory and complex systems approach—YoPA proposes a novel approach to the complex challenges of physical inactivity and health inequalities.
- YoPA contributes to theory-building and the evidence base on why and how environmental interventions work (or not) by applying a realist evaluation in diverse, multi-country contexts.
- YoPA fills research gaps in health behaviours and non-communicable diseases within sub-Saharan Africa and the involvement of adolescents in shaping their physical and social environments.
- The complexity of the public health problem and context-specific approach prohibit a randomised controlled trial design.
- Developing actions that change the system is highly ambitious and the involved stakeholders may not have the ability to fully implement the required structural changes within the timeframe of the project.

## INTRODUCTION

Insufficient physical activity is associated with many non-communicable diseases (NCDs) and responsible for >5 million deaths worldwide each year.(1) Public health guidelines recommend at least 60 minutes/day moderate-to-vigorous physical activity for youth.(2) An alarming large number of adolescents do not meet these guidelines: at global level, 78% of boys and 85% of girls between the age of 12-18 years.(3) Girls are generally less active than boys(3) and European adolescents with migrant or ethnic minority backgrounds are generally less active than adolescents from the majority population.(4) As a result, many adolescents have an increased risk of developing physical inactivity related NCDs, both physical (e.g. obesity, diabetes) and mental (e.g. reduced wellbeing, anxiety, depression).(5-7) Moreover, recreational activities are an effective coping strategy for many and have a positive effect on reducing stress, especially when physical activity is combined with social support.(8) The periods of lockdown due to the COVID-19 pandemic exacerbated inequities, and in Europe the percentage of adolescents meeting physical activity recommendations decreased to 9.3% among 9-18-year-olds.(9) Periods of lockdown were particularly challenging for the most marginalized groups due to urban overcrowding, lack of public open space and lower levels of access to outdoor activities.

Besides the abundant evidence for the benefits of regular participation in physical activity, over the past decade, excessive sedentary behaviour, specifically recreational screen-based behaviour and shortened sleep have gained increased attention as risk factors for adolescents' health and wellbeing.(10-12) Thus, a healthier composition of movement behaviours (i.e. physical activity, sedentary behaviour and sleep) throughout the 24-hours of the day has important physical and mental health benefits.(12, 13) Moreover, movement behaviours and their underlying mechanisms interact and might result in a vicious circle of unhealthy behaviours negatively influencing each other.(14) Physical activity can also be a powerful tool for promoting health equity through community empowerment, mutual social support ensuring affordable access to sport and recreation services.(15)

Recognising the importance and urgency of reducing global levels of insufficient physical activity, WHO (World Health Organization) member states endorsed a global action plan on physical activity (GAPPA)(16) and agreed to a 15% relative reduction in insufficient physical activity among adolescents by 2030. The International Society of Physical Activity and Health (ISPAH) formulated eight investments that work for physical activity,(17) which are

1 supported by robust evidence of effectiveness and have worldwide applicability.(18) Recommended  
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3 environmental and policy approaches include creation and improvement of access to places for physical activity  
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5 with informational outreach activities, community-scale and street-scale urban design and land use, a pro-active  
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7 transport policy and practice, and community-wide participatory policies and planning.(19) Despite these global  
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9 efforts, most of the evidence on the health benefits of and interventions targeting physical activity is from high-  
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11 income countries,(20) or what are increasingly referred to as 'Minority World' countries(21) (as in those countries  
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13 combined the minority of the world's population lives). This terminology highlights the absence of representation  
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15 in research in this field from 'Majority World' countries. This is particularly relevant for Africa, which accounts for  
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17 less than 1% of global research output even though it makes up 12.5% of the world's population.(22) For example,  
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19 in the field of child development, research from countries in which the majority of the world's population lives is  
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21 unacceptably underrepresented in most academic journals.(23)  
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27 Many interventions targeting adolescents have had disappointing impact, plausibly because they were  
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29 implemented top-down, adult-driven, and insufficiently tailored to the specific context(24) and thus not  
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31 addressing the real wishes and needs of adolescents. For example, the beneficial long-term effects of regular  
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33 physical activity on reducing morbidity and health care costs are highly relevant for health professionals and  
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35 policy makers, while for adolescents the more immediate benefits on wellbeing, directly or indirectly through  
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37 mutual social support, and having fun are of relevance. Health professionals increasingly call for greater  
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39 engagement of young people in the measurement of adolescent health issues as well as the development of  
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41 appropriate targeted interventions to promote their health.(25) In programmes that do engage young people,  
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43 those included are often already confident, articulate, and natural leaders.(26) Instead, engagement of youth  
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45 growing up in vulnerable life situations (e.g., ethnic minorities, living in socially and economically underprivileged  
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47 neighbourhoods, those with lower educational levels and managing many uncertainties) in implementation of  
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49 preventive interventions would have greater impact on closing equity gaps in health and wellbeing. Therefore, in  
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51 this paper we introduce the novel design and protocol of the EU-funded Youth-centred Participatory Action  
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*The Youth-centred Participatory Action (YoPA) project*

1 Considering the complexity of improving healthy movement behaviours and reducing health inequalities in  
2 adolescents, we initiated the Youth-centred Participatory Action (YoPA) project. The overall aim of YoPA is to  
3 optimally tailor, implement, and evaluate social and physical environmental interventions using an evidence-  
4 informed co-creation approach, for structural improvement in the lifestyle of adolescents (12-18 years) in urban  
5 vulnerable life situations in two European and two African cities. YoPA focuses on improving the physical and built  
6 environment as well as the social environment considering the importance of friends' and peers' influence, and  
7 social networks for both physical activity and wellbeing.(27, 28) Co-creation is a participatory approach of creative  
8 and interactive problem-solving among diverse stakeholders with a shared goal and a shared decision-making  
9 process, from collaborative problem identification and solution generation to implementation and evaluation.(29)  
10 Through co-creation geared towards adolescent empowerment, we aim to enhance personal and collective  
11 agency, and in turn, perceptions of autonomy, which have a direct effect on improving health outcomes.(30) YoPA  
12 aims to contribute to physical activity security which implies that all people, at all times, should have physical and  
13 economic access to sufficient, safe, and enjoyable physical activity to meet not only their health needs, but also to  
14 promote social connectedness and wellbeing, for an active and healthy life.(20) In YoPA we aim to tackle the  
15 following four challenges by creating and experimenting with a youth-centred participatory action approach in  
16 four different countries.

### 38 *Challenge 1: Lifestyles and health inequalities in adolescents continue to worsen*

39 It is crucial to promote healthy movement behaviours in adolescence for multiple reasons: i) most adolescents fail  
40 to meet the three movement behaviour guidelines;(31) ii) the trend for decreasing physical activity starts in  
41 adolescence;(32, 33) iii) screen time increases throughout adolescence;(33) iv) lifestyle habits, including physical  
42 activity and screen time(34, 35) track from adolescence into adulthood; v) several NCDs have their origins in  
43 childhood and adolescence and persist into adulthood(36, 37) thus effective interventions in adolescence can  
44 have lifelong and intergenerational health implications; vi) adolescence is a crucial and vulnerable life transition  
45 where adolescents acquire emotional and cognitive abilities for independence. How one navigates this transition  
46 depends on available opportunities and resources (e.g., family finances to allow school attendance); various  
47 systems (e.g., transportation, social welfare) and broader societal norms (e.g. gender). Adolescents in vulnerable  
48 life situations such as living in socio-economic underprivileged areas, minority groups and from low educational  
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1 and income levels, have less opportunities, and are more at risk for unhealthy lifestyles and worse health  
2  
3 outcomes than their mainstream peers.(38) Living in socially disadvantaged areas doubles adolescents' risk of  
4  
5 engaging in low levels of moderate-to-vigorous physical activity.(39)  
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### 10 *Challenge 2: Increasing population density in urban areas limits space for sports and outdoor play*

11 Since 2007, most of the world's population lives in urban areas with major differences in socio-economic and  
12  
13 cultural backgrounds and health.(40) The way cities are built, and public space is designed impacts many of our  
14  
15 conscious and unconscious behavioural choices, acknowledged in ISPAH investment #3 'active urban design'. An  
16  
17 international study in 14 cities on five different continents showed that adults who lived in the most activity-  
18  
19 friendly neighbourhoods engaged in 68-89 minutes more physical activity per week than those living in the least  
20  
21 activity-friendly neighbourhoods. Across vastly different cities spread over ten countries on five continents,  
22  
23 people living in neighbourhoods with a higher residential density, a more connected street-network, a good  
24  
25 public transportation network and more parks, were more active than residents living in other  
26  
27 neighbourhoods.(41) Active urban design also positively impacts two other ISPAH investments; #6 equitable  
28  
29 access to sport and recreation facilities and amenities, such as parks and urban green spaces, promoting  
30  
31 recreational physical activity; and #2 active transport through more destinations, shorter distances, and better  
32  
33 walking, cycling and public transportation infrastructure, thereby generating a potential tipping point for  
34  
35 promoting physical activity.(42) The importance of urban design as well as public and green open spaces in  
36  
37 providing a positive, enabling environment for physical activity is well-known.(41, 43, 44) However, the increasing  
38  
39 population density in urban areas leads to an increased pressure on the public space and in Majority countries to  
40  
41 an increase in informal settlements and the global privatisation of public space,(45, 46) limiting space for sports  
42  
43 and outdoor play.(47) Scientific evidence supports that the built environment has the potential to affect the long-  
44  
45 term health of adolescents by increasing their daily physical activity through a combination of attractive  
46  
47 recreational facilities (e.g., sport pitches, green spaces, amenities like fresh drinking water).(48, 49) Nonetheless,  
48  
49 current urban environments serve adults and young children better than adolescent.(50) Nonetheless, youth have  
50  
51 different access to power than the professionals who plan the public spaces of their neighbourhood. Especially  
52  
53 girls' access to public space adapted to their specific needs could be improved.(51) To increase effectiveness of  
54  
55 socio-environmental interventions, there is a need for studies that consider the perceptions different  
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1 intersectional groups of adolescents (e.g., boys and girls with varying socio-cultural backgrounds) in designing an  
2 attractive environment or public space.(52)

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7 *Challenge 3: Traditional individual-level behavioural interventions are less sustainable*

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9 Physical inactivity is a complex public health problem with multiple interacting influences and feedback loops  
10 embedded in social, cultural, and physical systems.(53) Such complex problems require multiple, up and  
11 downstream, embedded population-level actions that favourably contribute to reshaping nested systems.(54)  
12 Effective approaches to tackling physical inactivity will thus require multiple concurrent strategies and actions to  
13 be implemented across settings and sectors. However, to date, physical activity interventions have primarily  
14 focused on isolated causes and linear relationships with individual-level health outcomes rather than a systems  
15 approach that considers the links, feedback loops and interactions among elements within the bigger picture.(55)  
16 For example, most physical activity interventions have primarily relied on educational and information-based  
17 programmes targeting the individual with little consideration of the relational and social (e.g., peers, role models,  
18 gatekeepers) and physical environments (e.g., accessibility of parks, walkability, adequate lighting, safety) that  
19 have a major enabling or hindering influence on health behaviours.  
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36 *Challenge 4: Top-down implemented, one-size-fits-all interventions are ineffective*

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38 Health research frequently addresses questions and outcomes that are of limited relevance to health care  
39 practitioners, patients, and other end-users, resulting in considerable research waste.(56) Hence, most top-down,  
40 adult-driven, standardized interventions have had limited adoption and impact.(24) Citizen participation in the  
41 form of youth-centred, evidence-informed co-creation of interventions tailored to local contexts helps to prevent  
42 misalignment of priorities between researchers and stakeholders on the one hand and misalignment of  
43 interventions with local contexts on the other. Engaging adolescents as critical agents of social and political  
44 change is necessary for building inclusive democratic societies, which can result in more effective and youth-  
45 friendly health promotion.(57, 58) Currently, adolescents increasingly participate in public health research;  
46 however, participation is generally limited to consultation and adolescents are rarely involved in the decision-  
47 making process, which is essential to becoming empowered and gain personal and collective agency to take  
48 action to improve their life situation.(59-62) Several studies on youth participation in policy making have  
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1 demonstrated that young people are sharp analysts of their settings and creative producers of ideas for planning,  
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3 but authorities are reluctant to expand their top-down, expert-based mode of urban planning and health policy  
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5 making to include young people.(63, 64)  
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10 Here, we present the protocol of the YoPA project including the design, theoretical and evaluation framework.  
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## 14 **METHODS AND ANALYSIS**

### 17 *Design*

18  
19 YoPA combines the flexible and adaptive participatory action research with a rigorous practical protocol and  
20  
21 evaluation framework as well as scientific evidence with systematically produced local knowledge, i.e. knowledge  
22  
23 that is rooted in experience in a particular social context. Figure 1 presents the five phases of the YoPA approach,  
24  
25 where engagement of stakeholders and evaluation continue throughout the project. We use a participatory,(65)  
26  
27 mixed-methods(66), comparative approach(67, 68) to comprehensively examine a broad range of evaluation  
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29 questions such as whether, how and why interventions contribute to system change; how this evidence can be  
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31 generalised and subsequently adapted to specific contexts, intended and unintended consequences of  
32  
33 implemented interventions; as well as potential working mechanisms and interactions with the local context.  
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35 Using our novel SUPER-AIM Framework (Systems, User perspectives, Participatory co-creation process, Effects,  
36  
37 Reach, Adoption, Implementation, and Maintenance) (see Table 1), we will evaluate both the participatory co-  
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39 creation process as well as the process and outcomes of implementing holistic, systemic interventions in the four  
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41 study sites: Aalborg in Denmark, Amsterdam in the Netherlands, Osogbo in Nigeria and Soweto in South Africa.  
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Table 1. The YoPA SUPER-AIM evaluation framework

Component & Definition	Outcome	Methods
<b>Systems</b> - Identification of the drivers of unhealthy movement behaviours at multiple levels of the system including linkages, relationships, feedback loops and interactions among system parts	<ol style="list-style-type: none"> <li>1. Maps of the local system and its stakeholders, displaying knowledge gaps, leverage points for interventions, and insights</li> <li>2. Overview of both intended and emergent outcomes of interventions across various levels, interactions with the local context, and adaptation of interventions</li> </ol>	<ol style="list-style-type: none"> <li>1. Developing local system maps based on e.g., Group Model Building,(69) Social Network Analysis(70)</li> <li>2. Ripple Effects Mapping:(71, 72) in several group sessions, different key stakeholders participate to provide their perspective on the outcomes (appreciative inquiry) and collaboratively explore the contribution of the implemented interventions to these outcomes in mind maps. This provides practice-based knowledge about effective principles as well as the broader impact of the interventions.</li> </ol>
<b>User perspectives</b> - Identification of the user perspective on implemented interventions for example on the attractiveness and acceptability.	Accessibility, acceptability, and adaptations of interventions e.g., perceived physical activity friendliness, perceived inclusiveness of interventions, perceived safety, and fear of crime; satisfaction with interventions and use of interventions.	Participant observation and in-depth formal and informal interviews with adolescents e.g., using photo-diaries,(73) go-along interviews,(74, 75) neighbourhood audit,(76) focus group interviews(77, 78).
<b>Participatory co-creation process</b> - Identification of important barriers and facilitators of the participatory co-creation process	<ol style="list-style-type: none"> <li>1. Adolescents' motivations to participate in the project</li> <li>2. Satisfaction with the co-creation process among involved stakeholders*</li> <li>3. Mechanisms underlying co-creation</li> </ol>	<ol style="list-style-type: none"> <li>1. Participatory observations, focus group interviews, reflection scheme after each co-creation meeting</li> <li>2. Online satisfaction measurement, focus group interviews</li> <li>3. In-depth focus group interviews(79) with project team; realist Context-Mechanism-Outcome causal analysis</li> </ol>
<b>Effects</b> - Identification of desired outcomes among the adolescents. If necessary, measures of locally defined impact will be added to examine factors of greatest interest to local stakeholders.	<ol style="list-style-type: none"> <li>1. Wellbeing</li> <li>2. Personal and collective agency</li> <li>3. 24 hr movement behaviours (physical activity, sedentary behaviour, sleep)</li> </ol>	<ol style="list-style-type: none"> <li>1. EPOCH measure of adolescent well-being(80)</li> <li>2. GEAS survey freedom of movement, voice, behavioural control, and decision making(81)</li> <li>3. Accelerometers, self-report, and systematic observation (adapted SOPLAY(77)/SOPARC(78))</li> </ol>
<b>Reach</b> - adolescents whose behaviours and wellbeing we aim to benefit: 1) co-creation participants; 2) users of interventions; 3) adolescent citizens in the selected communities	Characteristics of adolescents	<ol style="list-style-type: none"> <li>1. Focus group interviews with co-creation participants</li> <li>2. Systematic observations of intervention users</li> <li>3. Existing databases (e.g., from municipality) and survey data adolescent citizens in the selected communities</li> </ol>
<b>Adoption</b> - Identification of engagement and commitment with 1) Implemented interventions; 2) Teen centred co-creation	Engagement and commitment of relevant stakeholders*	Focus group interviews
<b>Implementation</b> - Identification of	1. Satisfaction with implementation of youth-	1. Participatory observations and focus group interviews

<p>1 adaptations, potential barriers and 2 facilitators of implementation 3 4 5 6 7 8</p>	<p>centred co-creation among involved stakeholders* 2. Number, type and quality of implemented interventions 3. Satisfaction with implementation of interventions among involved stakeholders* 4. Costs of intervention implementation</p>	<p>2. Calculation of the resources needed to implement the interventions using micro-costing.(82)</p>
<p>9 <b>Maintenance</b> - Identification of sustained 10 use of 1) Implemented interventions; 2) 11 Teen centred co-creation 12</p>	<p>1. Sustained use of interventions 2. Sustained use of youth-centred co-creation in the communities</p>	<p>1. Systematic observation (e.g., adapted SOPLAY(77)/SOPARC(78)) 2. Focus group interviews</p>

13 \* Involved stakeholders: e.g., adolescents, public health professionals, urban planners/designers, policy makers  
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### *Theories and paradigms*

The central paradigm in YoPA is Participatory Action Research: a collaborative, iterative, often open-ended and unpredictable approach, which prioritizes the expertise of those experiencing a social issue and uses systematic research methodologies to generate new insights.<sup>(65)</sup> In YoPA we use the six building blocks for designing a Participatory Action Research project proposed by Cornish et. al.:<sup>(65)</sup> i) building relationships, ii) establishing working practices, iii) establishing a common understanding of the issue, iv) observing, gathering and generating materials, v) collaborative data analysis, and vi) planning and taking action. A key benefit of Participatory Action Research is empowerment by enabling participants to have a voice and contribute to knowledge production.<sup>(83, 84)</sup> Empowerment theory is a conceptual framework for understanding the enhancement of positive youth development by engaging youth in developing confidence, skills, and behavioural strategies to achieve self-identified goals.<sup>(85, 86)</sup> Empowerment includes three components: 1) intrapersonal, including beliefs regarding control and confidence; 2) interactional, including critical awareness of driving forces and understanding of the actions and resources needed for the desired change; and 3) behavioural, referring to actions to make the desired changes.<sup>(85)</sup> A second paradigm in YoPA is a systems-approach that considers the links, feedback loops and interactions among elements within the bigger picture.<sup>(55)</sup> We start with studying and understanding the local context. Next, we aim to develop and implement interventions, which we consider as a complex of actions that favourably contribute to reshaping the system dynamics.<sup>(14)</sup>

### *The YoPA co-creation protocol*

We will start with collaboratively developing one overall YoPA co-creation protocol together with the local researchers from all four study sites. The YoPA co-creation protocol aims at high-quality co-creation i) based on state-of-the-art science- and practice-based evidence and theory; ii) tailored to the local context, including the local needs and preferences of adolescents; iii) acceptable and feasible for local stakeholders responsible for implementation. This protocol ensures a systematic, evidence- and theory-based application of co-creation leaving space for adaptation to each local context. The overall co-creation protocol will include building an infrastructure for continuous capacity building for adolescents, as well as local stakeholders to stimulate participatory thinking, active engagement, equal collaboration, and training in research and other relevant skills. This protocol will describe how to apply youth-centred co-creation including recruitment and all methods for

1 capacity building and peer research. We will organise training for local facilitators of the youth-centred co-  
2 creation process, as well as for key stakeholders to stimulate their active contribution to the co-creation process.  
3  
4 Academic researchers bring in their state-of-the-art scientific knowledge and experience with developing  
5 evidence-based interventions while adolescent-researchers bring in their lived experience. In YoPA we aim to  
6  
7 develop academic and adolescent-researchers' collective agency, by building their capacities for collaboration,  
8  
9 peer-research and intervention development. Collaborating with other key stakeholders from multiple sectors in  
10  
11 the system will gain a deeper understanding of the complex system and thereby contribute to more holistic and  
12  
13 contextually relevant interventions.  
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### 21 *ENGAGING local YoPA communities*

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23 We will engage four local co-creation communities, two communities in Minority countries (Denmark and the  
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25 Netherlands) and two in Majority countries (Nigeria and South Africa). In each community, a dynamic group of 15-  
26  
27 20 adolescents will be recruited to participate as co-researchers in local co-creation groups facilitated by an  
28  
29 academic researcher. Recruitment will take place through diverse channels and settings including schools, local  
30  
31 community centres, youth clubs, religious meeting places and other relevant settings where adolescents with  
32  
33 diverse backgrounds meet. We will use a purposive sampling method tailored to each local context (e.g., social  
34  
35 media, flyers) in collaboration with local NGOs and other community stakeholders. By ensuring safe spaces, skilled  
36  
37 facilitators and capacity building, adolescents in local co-creation groups will be encouraged to actively engage  
38  
39 and contribute to the co-creation process. We will conduct stakeholder analyses to identify and recruit other key  
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41 stakeholders (e.g., existing community-based organisations and local authorities with a shared agenda), who will  
42  
43 be invited to actively contribute to the co-creation process by joining meetings of the local co-creation groups.  
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45  
46 The co-creation process will take place during regular participatory meetings with adolescents facilitated by an  
47  
48 academic researcher over the course of three years. To maximise chances of sustained commitment we will  
49  
50 collaborate with local community groups organised around health advocacy, sports, music, or social activity. We  
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52 will emphasise social inclusion by involving adolescents of different genders and backgrounds.  
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### 59 *MAPPING the local context*

60 To ensure YoPA will address questions and outcomes that are most relevant to the local communities, thereby

1 promoting uptake and sustainability of the interventions, we will start with mapping the local context by an audit  
2  
3 and environmental scan of selected communities to identify local needs and priorities using various state-of-the-  
4  
5 art participatory methods e.g., photovoice,(87) community mapping,(88) and neighbourhood walks.(89) To  
6  
7 explore the local communities at multiple levels, i.e., including linkages, relationships, feedback loops and  
8  
9 interactions, we will use systems methods such as group model building(90) and social network analysis.(91) We  
10  
11 will use Causal Loop Diagrams as a tool to explore the multiple, interacting feedback loops operating in the  
12  
13 existing local system. Such Causal Loop Diagrams create a dynamic, holistic view of the existing system, including  
14  
15 intended and unintended potential consequences, and the ways in which interventions in one setting, such as  
16  
17 home or school, might be influenced by the interactions with other settings, such as macroeconomic and urban  
18  
19 systems e.g., public space.(14, 92) In bringing together key stakeholders (locally, nationally, or internationally) to  
20  
21 understand the root causes of unhealthy movement behaviours, a systems approach enables each stakeholder to  
22  
23 see where they fit within a bigger picture.(17) To ensure results align with the perspectives of the wider  
24  
25 community, emerging findings will be shared with community representatives for them to critically examine and  
26  
27 contribute. For this step we may use structured interview matrix(93) – a community-based research method that  
28  
29 allows large groups (up to 40 participants) to discuss directions for future developments and priorities in an  
30  
31 iterative, structured, and transparent process – and multi-criteria decision-making matrices,(94) to weigh all  
32  
33 collected data in a transparent way. Each local system map will include an agreed set of priorities for holistic,  
34  
35 systemic interventions in each local community.  
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#### 43 *SELECTION, TAILORING AND IMPLEMENTING evidence-informed interventions*

44  
45 Based on the local system maps, the best matching evidence-based interventions will be selected from i) local  
46  
47 youth-led knowledge ii) ISPAH's 8 investments that work for physical activity; and iii) literature reviews conducted  
48  
49 by the academic researchers, iv) other relevant (local) literature and databases including evidence-based  
50  
51 interventions. For each of the selected interventions, we will develop an intervention theory to help identify key  
52  
53 working mechanisms, salient context conditions, and relevant additional outcomes. The intervention theories will  
54  
55 be grounded in existing evidence and empirically tested in the local contexts. The selected interventions will be  
56  
57 aligned with local priorities and existing strategic plans where possible, based on the local system maps and  
58  
59 meetings with key stakeholders, to obtain support and ensure feasibility, sustainability, and resources for the  
60

1 implementation. Key considerations for our settings are safety and crime (especially for adolescent girls), limited  
2  
3 infrastructure and resources, and transport challenges.  
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#### 7 *EVALUATE interventions using the SUPER-AIM framework*

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9 The YoPA evaluation will take a systems perspective, aiming to evaluate a range of outcomes, associated  
10  
11 processes, and their dynamic interrelationships using interrupted time series methods as one of the strongest  
12  
13 quasi-experimental research designs.(95) Table 1 describes the specific outcomes, samples, and proposed  
14  
15 methods for each component of our SUPER-AIM framework. Together with the local co-creation communities, we  
16  
17 will select and/or modify the most appropriate methods that allow the collection of quantitative and qualitative  
18  
19 data at all system levels, including measures of the process and outcomes of the co-creation and implementation  
20  
21 of interventions. Process data will be collected continuously from the start of the co-creation process. Outcome  
22  
23 data will be collected before and 6 months after implementation of interventions as well 6-12 months later  
24  
25 depending on the local situation. For the outcome evaluation, we aim to recruit 200-250 adolescents in each local  
26  
27 community. Training of (adolescent) data collectors for collecting data in the four communities will follow the  
28  
29 'train-the-trainer' principle: one meeting will be organised to train the researchers responsible for data collection  
30  
31 in their country, who will subsequently train local (adolescent) data collectors. As there is a lack of evidence on  
32  
33 the application of youth-centred co-creation in vulnerable settings in both Majority and Minority countries, we  
34  
35 aim to better understand the mechanisms underlying co-creation through personal and collective agency in each  
36  
37 of the settings with the help of realist evaluation.(96) Next to evaluating the outcomes of interventions, realist  
38  
39 evaluation aims to understand why and how specific outcomes were reached in each setting and thus contributes  
40  
41 to building the theory base on why interventions work (or not), and for whom, in a range of settings.  
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43 Collaborating and sharing experiences across the four co-creation sites through online meetings, exchanges and  
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45 joint analyses may help to generalize findings.  
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#### 54 *Analyses*

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56 Data collected by adolescent-researchers throughout the co-creation process will be analysed using the best  
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58 available and accessible techniques with options for facilitated co-researcher involvement. The selected methods  
59  
60 should be engaging to the co-researchers, suited to answering their research questions and supported by a skilled

1 academic researcher. Following data cleaning and data processing, we will analyse the outcomes of the  
2  
3 implemented interventions, as well as the dynamics underlying these, combining and comparing data from the  
4  
5 four study sites. We will conduct analyses of a combination of quantitative (e.g., sensor-based behavioural data)  
6  
7 as well as qualitative (e.g., interviews and user-generated data) data.(97) Quantitative data will be analysed using  
8  
9 appropriate techniques (e.g., multilevel modelling appropriate for individual-level data nested within  
10  
11 communities). Qualitative data will be summarised and subsequently analysed using open and axial coding by two  
12  
13 independent researchers. Intersectionality references the critical insight that race, class, gender, sexuality,  
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15 ethnicity, nation, ability, and age operate not as unitary, mutually exclusive entities, but as reciprocally  
16  
17 constructing phenomena that in turn shape complex social and health inequalities.(98) In both quantitative and  
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19 qualitative analyses, we will apply different kinds of intersectional analyses including relevant categories such as  
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21 gender, age, education and ethnicity.  
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28 In the social network analysis, we will focus on the relationships among relevant 'actors' when mapping the local  
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30 setting including persons, organisations, and locations to understand the interrelations and impacts of factors at  
31  
32 different levels – from individual-level factors to environments and policies. We will use this knowledge to identify  
33  
34 leverage points for interventions. We will integrate realist evaluation(96) in the process evaluation to better  
35  
36 understand which mechanisms contributed to the observed outcomes, e.g. how the achievement of individual  
37  
38 and collective agency leads to empowerment, and under which conditions. Additionally, we will provide a tested  
39  
40 and refined intervention theory on the application of youth-centred co-creation in vulnerable settings, focusing  
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42 on social mechanisms potentially to be triggered (trust, reciprocity, neighbourhood solidarity, personal and  
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44 collective agency, leadership) in a range of context conditions (typology of settings: socially cohesive long time  
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46 residing migrant communities, less cohesive transient migrant communities, diverse communities, partially  
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48 gentrified etc.). We will develop a plausible causal explanation, focusing also on counteracting or unintended  
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50 consequences. These findings will be further synthesised into a refined intervention theory that can be used for  
51  
52 future similar interventions and can be tested in other settings. To analyse the costs of implementation, we will  
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54 use micro costing reflecting actual resource use and economic costs by collecting data on resources utilized and  
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56 the unit costs of those resources following guidelines and checklists for conducting and reporting micro-costing  
57  
58 studies.(82)  
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## *Patient and public involvement*

Involvement of youth and other relevant stakeholders is a key element of the YoPA project. Together with academic researchers and local stakeholders, adolescents will take a leading role in the co-creation process running over the course of three years (see also *ENGAGING local YoPA communities* above). Recruitment of adolescents for the local co-creation communities started in October 2023 in Denmark and in January 2024 in all other countries. Data collection will continue until December 2026.

## **ETHICS AND DISSEMINATION**

Ethical considerations are fundamental throughout the YoPA project. In YoPA we will encourage an emphasis on inclusive practices, mutual respect, continuous dialogue and reflexivity, shared decision-making and collaborative action. Each adolescent participating in the youth-centred co-creation or any aspect of the evaluation, and where relevant also one of their parents, will sign informed consent before participating in the study, verifying that they understood the involvement and agree to data collection. We will develop attractive, age-adapted and easy-to-understand information (brochures, videos) explaining the purpose of involvement, the nature of data collection, the potential burden (e.g., time investment), the right to access their own data, how data will be processed and protected, and how confidentiality will be maintained. Where possible we will make datasets generated and/or analysed during the YoPA project available in the Open Science Framework repository. Not all data can be made public in order to protect participants' confidentiality. Participation is entirely voluntary, and participants can choose to withdraw at any time without consequences. The Research Ethics committees of the four local institutions approved the protocol for the YoPA project: Amsterdam UMC Medical Ethical Committee, Netherlands (2023.0670), the Redeemer's University, Nigeria (2023.060), the University of Southern Denmark Research Ethics Committee, Denmark (Case no 23/47839, REC ID 408), the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, South-Africa (reference: M230721).

To enhance the communication, dissemination, and impact of YoPA, we have developed a comprehensive plan (Figure 2) that includes a well-defined strategy, clear objectives with measurable key results, and various tools designed to amplify the project's impact. Effective communication and (community) dialogue is crucial for raising

1 public awareness about the importance of healthy movement behaviours in preventing NCDs and promoting  
2 youth-centred co-creation of intervention customization and implementation. This will enhance the visibility of  
3 the YoPA project among various stakeholders e.g. through the project website (<https://www.yopa-project.eu/>).  
4 Collaborative dissemination activities target scientific, stakeholder, policymaker, and a wider audience aiming to  
5 promote youth-centred co-creation for healthy movement behaviours and NCD prevention tailored to local  
6 communities. YoPA is committed to continued project results through a sustainable dissemination and impact  
7 strategy. Additionally, we aim to build capacities among local partners and universities for ongoing local co-  
8 creation research and community collaboration. We will make all educational and training materials, practical  
9 protocols, and successful local intervention examples available in the YoPA toolbox. The YoPA approach will be  
10 shared through a licensed train-the-trainer program for effective dissemination through diverse channels. By  
11 actively engaging stakeholders in training sessions, we aim to promote the benefits of co-creation and inspire  
12 more effective action towards promoting health across society.

## 30 DISCUSSION

31 YoPA will contribute to health equity by specifically focussing on improving the social and physical environment of  
32 adolescents in urban vulnerable life situations. Evaluating the effectiveness of such socio-environmental  
33 interventions across heterogeneous local contexts, co-creation communities and interventions is challenging as  
34 these will result in different 'intervention theories' or scenarios, on how systems-oriented interventions are  
35 expected to work in their respective contexts. Describing and testing plausible mechanisms of how interventions  
36 are expected to work at multiple levels and for a range of actors (in nested systems), is important for  
37 strengthening robust causal inference but also for credibility towards policy and practice.<sup>(99)</sup> Traditional designs  
38 and analysis methods are not appropriate for studying complex systems as they lack the ability to measure and  
39 understand contextual including socio-ecological effects as well as the dynamic properties of complex adaptive  
40 systems,<sup>(91)</sup> including unintended effects on other parts of the system.<sup>(100)</sup> Therefore, we introduce our novel  
41 SUPER-AIM framework, incorporating crucial data explaining if, how, why and in which settings the implemented  
42 interventions will favourably contribute to reshaping local systems.

A better understanding of how culture and structure impacts the co-creation process and interventions

1 implemented in the four selected communities in YoPA benefits knowledge exchange between the different  
2 settings. Furthermore, YoPA goes beyond addressing a research gap in physical activity and health research in  
3 sub-Saharan Africa; it takes an approach to considering context in a robust and meaningful way that fully accounts  
4 for competing priorities in African settings.(20) Currently, there is a lack of systematic and practical protocols  
5 guiding the application of co-creation for tailoring evidence-informed interventions to specific contexts, and  
6 subsequently evaluating them together with adolescents and other key stakeholders. To fill this gap, we will  
7 develop a YoPA toolbox, making all materials and training on the youth-centred co-creation for tailoring and  
8 implementation of evidence-informed interventions available through the YoPA website ([yopa-project.eu](http://yopa-project.eu)), both  
9 during its development and its final form. Once results from the process, outcome and realist evaluations start to  
10 come in, more formalised guidelines for the use of the toolbox, as well as policy recommendations for the  
11 implementation of similar co-creation processes will be developed and become part of the toolbox, targeted at  
12 researchers, public health and urban planning practitioners, local authorities, policy makers,  
13 grassroots/community based organisations and citizens.

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32 Limitations of our study could be the lack of a controlled design and the challenge to instigate and measure  
33 sustainable system change as this cannot be externally directed, but occurs as a result of the self-organising  
34 interactions and relationships within the system. The complexity of the public health problem and context-  
35 specific approach prohibit a randomised controlled trial design. Instead, in YoPA we focus on identifying working  
36 mechanisms and detailed documentation using a mixed methods design.

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45 By establishing an infrastructure for youth-centred co-creation including capacity building, mentoring, and with  
46 active engagement of adolescent health advocates and leaders, YoPA aims to nurture sustainable implementation  
47 of adolescent-responsive preventive interventions tailored to the local context, improving their agency, 24-hour  
48 movement behaviours and wellbeing, with the purpose of halting the rise in NCDs and associated health care  
49 costs. We envision that our YoPA youth-centred co-creation approach will serve as a guide for participation of  
50 adolescents in vulnerable life situations in implementation of health promotion in Europe, Africa and globally.  
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## Contributors

MC has led the writing and editing of this paper, coordinates the overall YoPA project, and is the project lead for YoPA in Amsterdam. LK contributed to the design of the YoPA project, commented on drafts and is co-project lead for YoPA in Amsterdam. ALO contributed to the design of the YoPA project, commented on drafts, leads the mapping of the local systems, and is the project lead for YoPA in Osogbo. CED contributed to the design of the YoPA project, commented on drafts, leads the evaluation of YoPA, and is the project lead for YoPA in Soweto. CSP and JS contributed to the design of the YoPA project, commented on drafts, and are co-project leads for YoPA in Aalborg. AP and MS commented on drafts, and lead the YoPA communication, dissemination and impact strategy. SVB contributed to the design of the YoPA project, commented on drafts and leads the realist evaluation. TA contributed to the design of the YoPA project, commented on drafts, leads the tailoring and implementing of co-created interventions and ethics and is co-project lead for YoPA in Amsterdam. All authors read and approved the final manuscript.

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## Competing interests

The authors declare they have no competing interests.

## References

1. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219-29.
2. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*. 2020;54(24):1451-62.
3. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child Adolesc Health*. 2020;4(1):23-35.
4. Brug J, van Stralen MM, Chinapaw MJ, De Bourdeaudhuij I, Lien N, Bere E, et al. Differences in weight status and energy-balance related behaviours according to ethnic background among adolescents in seven countries in Europe: the ENERGY-project. *Pediatr Obes*. 2012;7(5):399-411.
5. van Sluijs EMF, Ekelund U, Crochemore-Silva I, Guthold R, Ha A, Lubans D, et al. Physical activity behaviours in

- adolescence: current evidence and opportunities for intervention. *Lancet*. 2021;398(10298):429-42.
6. Akseer N, Mehta S, Wigle J, Chera R, Brickman ZJ, Al-Gashm S, et al. Non-communicable diseases among adolescents: current status, determinants, interventions and policies. *BMC Public Health*. 2020;20(1):1908.
7. Rodriguez-Ayllon M, Cadenas-Sanchez C, Estevez-Lopez F, Munoz NE, Mora-Gonzalez J, Migueles JH, et al. Role of Physical Activity and Sedentary Behavior in the Mental Health of Preschoolers, Children and Adolescents: A Systematic Review and Meta-Analysis. *Sports Med*. 2019;49(9):1383-410.
8. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med*. 2011;45(11):886-95.
9. Kovacs VA, Brandes M, Suesse T, Blagus R, Whiting S, Wickramasinghe K, Okely AD. Are we underestimating the impact of COVID-19 on children's physical activity in Europe? - a study of 24,302 children. *Eur J Public Health*. 2022.
10. Hjorth MF, Chaput JP, Damsgaard CT, Dalskov SM, Andersen R, Astrup A, et al. Low physical activity level and short sleep duration are associated with an increased cardio-metabolic risk profile: a longitudinal study in 8-11 year old Danish children. *PLoS One*. 2014;9(8):e104677.
11. Chastin SF, Palarea-Albaladejo J, Dontje ML, Skelton DA. Combined Effects of Time Spent in Physical Activity, Sedentary Behaviors and Sleep on Obesity and Cardio-Metabolic Health Markers: A Novel Compositional Data Analysis Approach. *PLoS One*. 2015;10(10):e0139984.
12. Rollo S, Antsygina O, Tremblay MS. The whole day matters: Understanding 24-hour movement guideline adherence and relationships with health indicators across the lifespan. *J Sport Health Sci*. 2020;9(6):493-510.
13. Roenneberg T. Chronobiology: the human sleep project. *Nature*. 2013;498(7455):427-8.
14. Waterlander WE, Singh A, Altenburg T, Dijkstra C, Luna Pinzon A, Anselma M, et al. Understanding obesity-related behaviors in youth from a systems dynamics perspective: The use of causal loop diagrams. *Obes Rev*. 2021;22(7):e13185.
15. Laverack G. Improving health outcomes through community empowerment: a review of the literature. *J Health Popul Nutr*. 2006;24(1):113-20.
16. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world: World Health Organization; 2019.
17. Milton K, Cavill N, Chalkley A, Foster C, Gomersall S, Hagstromer M, et al. Eight Investments That Work for Physical Activity. *J Phys Act Health*. 2021;18(6):625-30.
18. Organization WH. Tackling NCDs: 'best buys' and other recommended interventions for the prevention and control of noncommunicable diseases. <https://apps.who.int/iris/handle/10665/259232>. 2017.
19. Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, et al. Evidence-based intervention in physical activity: lessons from around the world. *Lancet*. 2012;380(9838):272-81.
20. Lambert EV, Kolbe-Alexander T, Adlakha D, Oyeyemi A, Anokye NK, Goenka S, et al. Making the case for 'physical activity security': the 2020 WHO guidelines on physical activity and sedentary behaviour from a Global South perspective. *Br J Sports Med*. 2020;54(24):1447-8.
21. Khan T, Abimbola S, Kyobutungi C, Pai M. How we classify countries and people and why it matters. *BMJ Global Health*. 2022;7:e009704.
22. Marincola E, Kariuki T. Quality Research in Africa and Why It Is Important. *Acs Omega*. 2020;5(38):24155-7.
23. Draper CE, Barnett LM, Cook CJ, Cuartas JA, Howard SJ, McCoy DC, et al. Publishing child development research from around the world: An unfair playing field resulting in most of the world's child population under-represented in research. *Infant Child Dev*. 2022.
24. Gibbs A, Campbell C, Maimane S, Nair Y. Mismatches between youth aspirations and participatory HIV/AIDS programmes in South Africa. *Afr J AIDS Res*. 2010;9(2):153-63.
25. Sawyer SM, Afifi RA, Bearinger LH, Blakemore SJ, Dick B, Ezeh AC, Patton GC. Adolescence: a foundation for future health. *Lancet*. 2012;379(9826):1630-40.
26. Villa-Torres L, Svanemyr J. Ensuring youth's right to participation and promotion of youth leadership in the development of sexual and reproductive health policies and programs. *J Adolesc Health*. 2015;56(1 Suppl):S51-7.
27. Maturo CC, Cunningham SA. Influence of friends on children's physical activity: a review. *Am J Public Health*. 2013;103(7):e23-38.
28. Lamblin M, Murawski C, Whittle S, Fornito A. Social connectedness, mental health and the adolescent brain. *Neurosci Biobehav Rev*. 2017;80:57-68.
29. Vargas C, Whelan J, Brimblecombe J, Allender S. Co-creation, co-design, co-production for public health - a perspective on definition and distinctions. *Public Health Res Pract*. 2022;32(2).
30. Wallerstein N. Powerlessness, empowerment, and health: implications for health promotion programs. *Am J*

- 1 Health Promot. 1992;6(3):197-205.
- 2 31. Tapia-Serrano MA, Sevil-Serrano J, Sanchez-Miguel PA, Lopez-Gil JF, Tremblay MS, Garcia-Hermoso A.
- 3 Prevalence of meeting 24-Hour Movement Guidelines from pre-school to adolescence: A systematic review and
- 4 meta-analysis including 387,437 participants and 23 countries. *J Sport Health Sci.* 2022.
- 5 32. Kalman M, Inchley J, Sigmundova D, Iannotti RJ, Tynjala JA, Hamrik Z, et al. Secular trends in moderate-to-
- 6 vigorous physical activity in 32 countries from 2002 to 2010: a cross-national perspective. *Eur J Public Health.*
- 7 2015;25 Suppl 2:37-40.
- 8 33. Marques A, Loureiro N, Avelar-Rosa B, Naia A, Matos MG. Adolescents' healthy lifestyle. *J Pediatr (Rio J).*
- 9 2020;96(2):217-24.
- 10 34. Jones RA, Hinkley T, Okely AD, Salmon J. Tracking physical activity and sedentary behavior in childhood: a
- 11 systematic review. *Am J Prev Med.* 2013;44(6):651-8.
- 12 35. Telama R, Yang X, Leskinen E, Kankaanpaa A, Hirvensalo M, Tammelin T, et al. Tracking of physical activity
- 13 from early childhood through youth into adulthood. *Med Sci Sports Exerc.* 2014;46(5):955-62.
- 14 36. Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ. Tracking of childhood overweight into
- 15 adulthood: a systematic review of the literature. *Obes Rev.* 2008;9(5):474-88.
- 16 37. Yan Y, Hou D, Zhao X, Liu J, Cheng H, Wang Y, Mi J. Childhood Adiposity and Nonalcoholic Fatty Liver Disease
- 17 in Adulthood. *Pediatrics.* 2017;139(4).
- 18 38. Patton GC, Sawyer SM, Santelli JS, Ross DA, Afifi R, Allen NB, et al. Our future: a Lancet commission on
- 19 adolescent health and wellbeing. *Lancet.* 2016;387(10036):2423-78.
- 20 39. Heath GW, Bilderback J. Grow Healthy Together: Effects of Policy and Environmental Interventions on
- 21 Physical Activity Among Urban Children and Youth. *Journal of Physical Activity & Health.* 2019;16(2):172-6.
- 22 40. Oosterlynck S, Verschraegen G, Kempen R. Divercities: Understanding super-diversity in deprived and mixed
- 23 neighbourhoods2018. 1-250 p.
- 24 41. Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. Physical activity in relation to urban
- 25 environments in 14 cities worldwide: a cross-sectional study. *Lancet.* 2016;387(10034):2207-17.
- 26 42. Wijntuin P, Koster M. Dutch-Moroccan Girls Navigating Public Space: Wandering as an Everyday Spatial
- 27 Practice. *Space Cult.* 2019;22(3):280-93.
- 28 43. Giles-Corti B, Broomhall MH, Knuiaman M, Collins C, Douglas K, Ng K, et al. Increasing walking: how important
- 29 is distance to, attractiveness, and size of public open space? *Am J Prev Med.* 2005;28(2 Suppl 2):169-76.
- 30 44. Giles-Corti B, Vernez-Moudon A, Reis R, Turrell G, Dannenberg AL, Badland H, et al. City planning and
- 31 population health: a global challenge. *Lancet.* 2016;388(10062):2912-24.
- 32 45. Agyemang F. Privatization of Public Spaces and Its Impact on the Socio-Political and Spatial Landscapes of the
- 33 Cape Town Central City Improvement District (CCCID). Available at SSRN 3153812. 2017.
- 34 46. Ware C. A Tale of Two Cities: Public Space Development in Nigeria2021. Available from:
- 35 <https://worldlandscapearchitect.com/a-tale-of-two-cities-public-space-development-in-nigeria/>.
- 36 47. Xu F, Li J, Liang Y, Wang Z, Hong X, Ware RS, et al. Associations of residential density with adolescents'
- 37 physical activity in a rapidly urbanizing area of Mainland China. *Journal of Urban Health.* 2010;87(1):44-53.
- 38 48. Sallis JF, Glanz K. The role of built environments in physical activity, eating, and obesity in childhood. *Future*
- 39 *Child.* 2006;16(1):89-108.
- 40 49. Giles-Corti B, Kelty SF, Zubrick SR, Villanueva KP. Encouraging walking for transport and physical activity in
- 41 children and adolescents: how important is the built environment? *Sports Med.* 2009;39(12):995-1009.
- 42 50. WHO. Global Accelerated Action for the Health of Adolescents (AA-HA!): guidance to support country
- 43 implementation. Geneva; 2017.
- 44 51. Jalalkamali A, Doratli N. Public Space Behaviors and Intentions: The Role of Gender through the Window of
- 45 Culture, Case of Kerman. *Behav Sci (Basel).* 2022;12(10).
- 46 52. Van Hecke L, Verhoeven H, Clarys P, Van Dyck D, Van de Weghe N, Baert T, et al. Factors related with public
- 47 open space use among adolescents: a study using GPS and accelerometers. *International journal of health*
- 48 *geographics.* 2018;17(1):3.
- 49 53. Rutter H, Cavill N, Bauman A, Bull F. Systems approaches to global and national physical activity plans. *Bull*
- 50 *World Health Organ.* 2019;97(2):162-5.
- 51 54. Rutter H, Savona N, Glonti K, Bibby J, Cummins S, Finegood DT, et al. The need for a complex systems model
- 52 of evidence for public health. *Lancet.* 2017;390(10112):2602-4.
- 53 55. Popkin BM, Duffey K, Gordon-Larsen P. Environmental influences on food choice, physical activity and energy
- 54 balance. *Physiology & behavior.* 2005;86(5):603-13.
- 55 56. Ioannidis JP. Why Most Clinical Research Is Not Useful. *PLoS Med.* 2016;13(6):e1002049.



- 1 57. World Health Organization. Engaging young people for health and sustainable development: strategic  
2 opportunities for the World Health Organization and partners. 2018.
- 3 58. World Health Organization. Health for the world's adolescents: a second chance in the second decade:  
4 summary. World Health Organization; 2014.
- 5 59. Frerichs L, Ataga O, Corbie-Smith G, Tessler Lindau S. Child and youth participatory interventions for  
6 addressing lifestyle-related childhood obesity: a systematic review. *Obes Rev*. 2016;17(12):1276-86.
- 7 60. Larsson I, Staland-Nyman C, Svedberg P, Nygren JM, Carlsson IM. Children and young people's participation  
8 in developing interventions in health and well-being: a scoping review. *BMC Health Serv Res*. 2018;18(1):507.
- 9 61. Anyon Y, Bender K, Kennedy H, Dechants J. A Systematic Review of Youth Participatory Action Research  
10 (YPAR) in the United States: Methodologies, Youth Outcomes, and Future Directions. *Health Educ Behav*.  
11 2018;45(6):865-78.
- 12 62. Shamrova DP, Cummings CE. Participatory action research (PAR) with children and youth: An integrative  
13 review of methodology and PAR outcomes for participants, organizations, and communities. *Children and Youth  
14 Services Review*. 2017;81:400-12.
- 15 63. Horelli L, Kaaja M. Opportunities and constraints of "Internet-assisted urban planning" with young people.  
16 *Journal of Environmental Psychology*. 2002;22(1-2):191-200.
- 17 64. Frank KI. The potential of youth participation in planning. *Journal of Planning Literature*. 2006;20(4):351-71.
- 18 65. Cornish F, Breton N, Moreno-Tabarez U, Delgado J, Rua M, Aikins AD, Hodgetts D. Participatory action  
19 research. *Nat Rev Method Prime*. 2023;3(1).
- 20 66. Schoonenboom J, Johnson RB. How to Construct a Mixed Methods Research Design. *Kolner Z Soziol Soz*.  
21 2017;69:107-31.
- 22 67. Bartlett L, Vavrus F. Rethinking case study research: A comparative approach: Taylor & Francis; 2016.
- 23 68. Beach D, Pedersen RB. Causal case study methods: Foundations and guidelines for comparing, matching, and  
24 tracing: University of Michigan Press; 2016.
- 25 69. Gerritsen S, Harre S, Rees D, Renker-Darby A, Bartos AE, Waterlander WE, Swinburn B. Community Group  
26 Model Building as a Method for Engaging Participants and Mobilising Action in Public Health. *Int J Environ Res  
27 Public Health*. 2020;17(10).
- 28 70. Luke DA, Harris JK. Network analysis in public health: history, methods, and applications. *Annu Rev Public  
29 Health*. 2007;28:69-93.
- 30 71. Emery M, Higgins L, Chazdon S, Hansen D. Using Ripple Effect Mapping to Evaluate Program Impact:  
31 Choosing or Combining the Methods That Work Best for You. *Journal of Extension*. 2015;53(2).
- 32 72. Chazdon S, Emery M, Hansen D, Higgins L, Sero R. A field guide to ripple effects mapping: University of  
33 Minnesota Libraries Publishing; 2017.
- 34 73. Feick R, Robertson C. A multi-scale approach to exploring urban places in geotagged photographs.  
35 *Computers, Environment and Urban Systems*. 2015;53:96-109.
- 36 74. Pawlowski CS, Andersen HB, Troelsen J, Schipperijn J. Children's Physical Activity Behavior during School  
37 Recess: A Pilot Study Using GPS, Accelerometer, Participant Observation, and Go-Along Interview. *PLoS One*.  
38 2016;11(2):e0148786.
- 39 75. Pawlowski CS, Schmidt T, Nielsen JV, Troelsen J, Schipperijn J. Will the children use it?-A RE-AIM evaluation of  
40 a local public open space intervention involving children from a deprived neighbourhood. *Eval Program Plann*.  
41 2019;77:101706.
- 42 76. Hofland ACL, Devilee J, van Kempen E, den Broeder L. Resident participation in neighbourhood audit tools - a  
43 scoping review. *Eur J Public Health*. 2018;28(1):23-9.
- 44 77. McKenzie TL. System for observing play and leisure activity in youth (SOPLAY). Retrieved August.  
45 2002;1:2006.
- 46 78. McKenzie T, Cohen D. System for observing play and recreation in communities (SOPARC). Center for  
47 Population Health and Health Disparities (ed) RAND. 2006.
- 48 79. Manzano A. The craft of interviewing in realist evaluation. *Evaluation*. 2016;22(3):342-60.
- 49 80. Kern ML, Benson L, Steinberg EA, Steinberg L. The EPOCH Measure of Adolescent Well-Being. *Psychol Assess*.  
50 2016;28(5):586-97.
- 51 81. Zimmerman LA, Li M, Moreau C, Wilopo S, Blum R. Measuring agency as a dimension of empowerment  
52 among young adolescents globally; findings from the Global Early Adolescent Study. *SSM Popul Health*.  
53 2019;8:100454.
- 54 82. Ruger JP, Reiff M. A Checklist for the Conduct, Reporting, and Appraisal of Microcosting Studies in Health  
55 Care: Protocol Development. *JMIR Res Protoc*. 2016;5(4):e195.

- 1 83. (ICPHR) ICfPHR. Position Paper 5: Empowerment and Participatory Health Research. Baltimore 2021.
- 2 84. Wallerstein N. Empowerment to reduce health disparities. *Scand J Public Health*. 2002;30(3):72-7.
- 3 85. Zimmerman MA. Psychological empowerment: issues and illustrations. *Am J Community Psychol*.
- 4 1995;23(5):581-99.
- 5 86. Zimmerman MA. Empowerment theory: Psychological, organizational and community levels of analysis.
- 6 *Handbook of community psychology*: Springer; 2000. p. 43-63.
- 7 87. Wang C. Youth Participation in Photovoice as a Strategy for Community Change *Journal of Community*
- 8 *Practice*. 2006;14(1-2):147-61.
- 9 88. Amsden J, VanWynsberghe R. Community mapping as a research tool with youth. *Action Research*.
- 10 2005;3(4):357-81.
- 11 89. Carpiano RM. Come take a walk with me: the "go-along" interview as a novel method for studying the
- 12 implications of place for health and well-being. *Health Place*. 2009;15(1):263-72.
- 13 90. Vennix JA, Akkermans HA, Rouwette EA. Group model-building to facilitate organizational change: an
- 14 exploratory study. *System Dynamics Review: The Journal of the System Dynamics Society*. 1996;12(1):39-58.
- 15 91. Luke DA, Stamatakis KA. Systems science methods in public health: dynamics, networks, and agents. *Annual*
- 16 *review of public health*. 2012;33:357-76.
- 17 92. Hendricks G, Savona N, Aguiar A, Alaba O, Booley S, Malczyk S, et al. Adolescents' Perspectives on the Drivers
- 18 of Obesity Using a Group Model Building Approach: A South African Perspective. *Int J Environ Res Public Health*.
- 19 2022;19(4).
- 20 93. O'Sullivan TL, Corneil W, Kuziemyk CE, Toal-Sullivan D. Use of the Structured Interview Matrix to Enhance
- 21 Community Resilience Through Collaboration and Inclusive Engagement. *Systems Research and Behavioral*
- 22 *Science*. 2015;32(6):616-28.
- 23 94. Harputlugil T, Prins M, Gültekin AT, Topçu YI. Conceptual framework for potential implementations of multi
- 24 criteria decision making (MCDM) methods for design quality assessment. 2011.
- 25 95. Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health
- 26 interventions: a tutorial. *Int J Epidemiol*. 2017;46(1):348-55.
- 27 96. Pawson R, Tilley N. An introduction to scientific realist evaluation. *Evaluation for the 21st century: A*
- 28 *handbook*. Thousand Oaks, CA, US: Sage Publications, Inc; 1997. p. 405-18.
- 29 97. Prins RG, Panter J, Heinen E, Griffin SJ, Ogilvie DB. Causal pathways linking environmental change with health
- 30 behaviour change: Natural experimental study of new transport infrastructure and cycling to work. *Preventive*
- 31 *Medicine*. 2016;87:175-82.
- 32 98. Collins PH. Intersectionality's Definitional Dilemmas. *Annu Rev Sociol*. 2015;41:1-20.
- 33 99. Reis RS, Salvo D, Ogilvie D, Lambert EV, Goenka S, Brownson RC, Lancet Physical Activity Series 2 Executive C.
- 34 Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people
- 35 moving. *Lancet*. 2016;388(10051):1337-48.
- 36 100. Mittelmark MB. Unintended effects in settings-based health promotion. *Scand J Public Health*. 2014;42(15
- 37 Suppl):17-24.
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1 **Figure 1.** YoPA youth-centred co-creation approach visualising the engagement of adolescent-researchers,  
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3 community adolescents and adult stakeholders  
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5 IPT = Initial Program Theory.  
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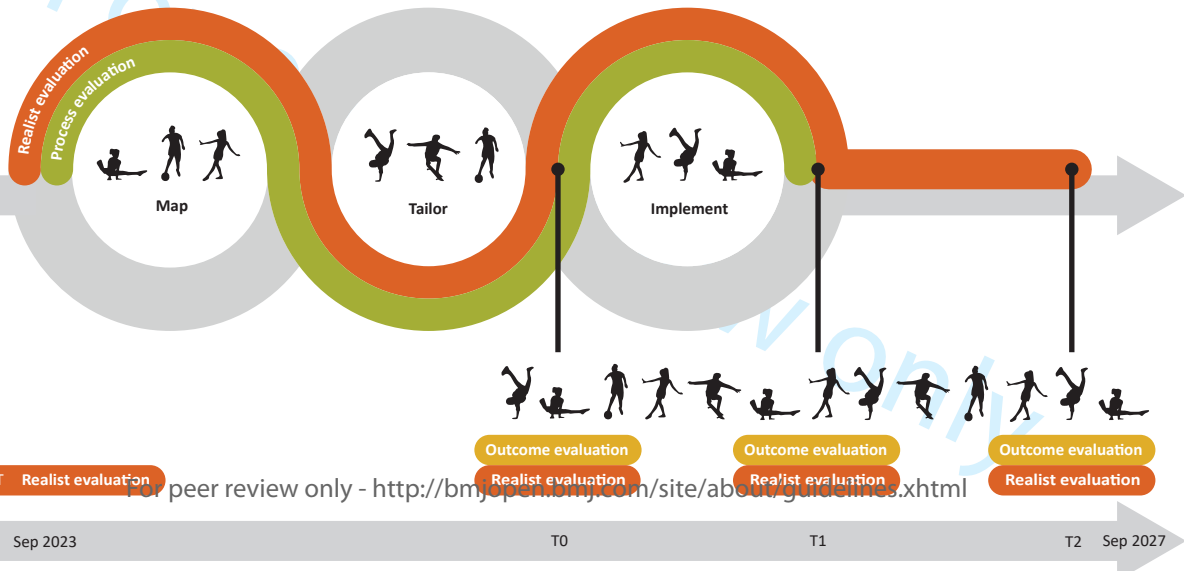
9 **Figure 2.** YoPA communication, dissemination, and impact plan  
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For peer review only

Adult stakeholders



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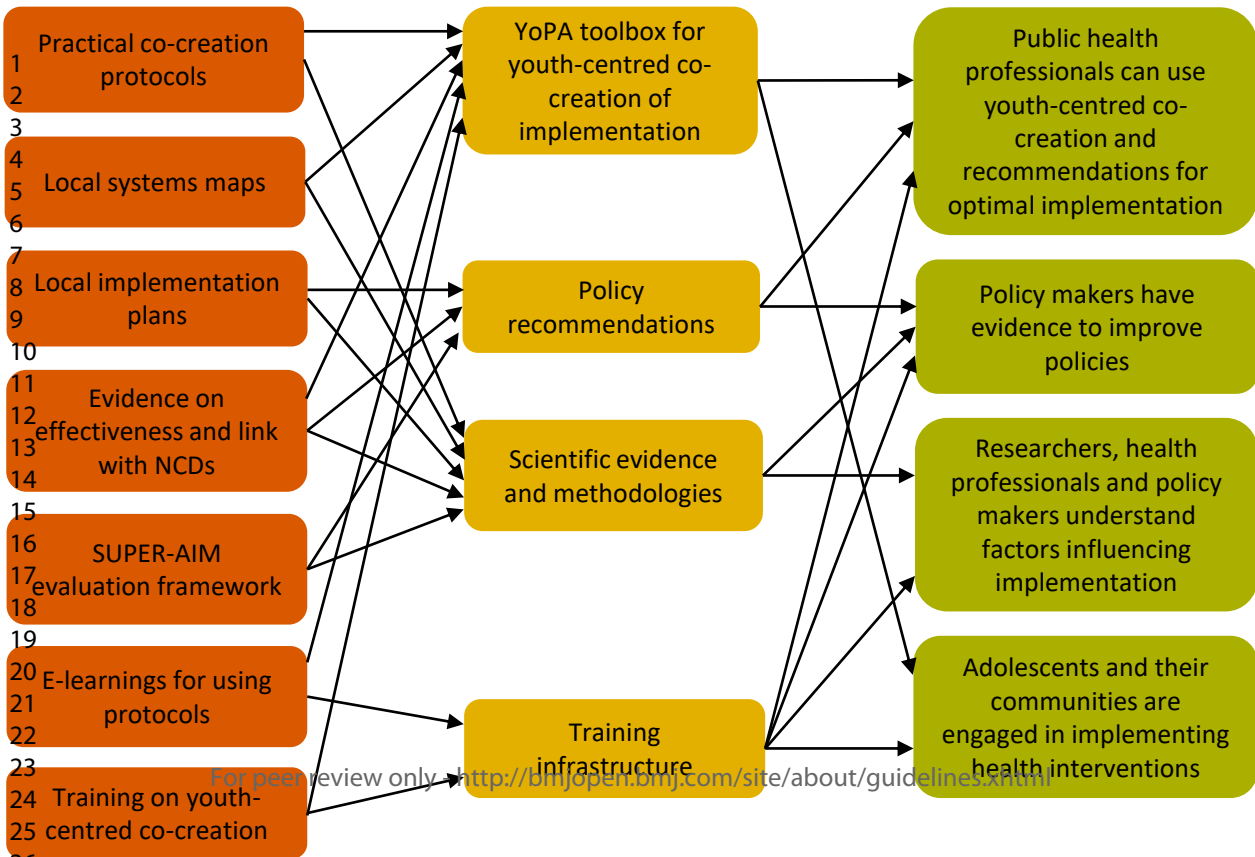


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## YoPA results

## Collated Results

## Expected outcomes



**GUIDED – a guideline for reporting for intervention development studies.**

## Supplementary File 1: Blank Checklist

Item description	Explanation	Page in manuscript where item is located	Other*
1. Report the context for which the intervention was developed.	Understanding the context in which an intervention was developed informs readers about the suitability and transferability of the intervention to the context in which they are considering evaluating, adapting or using the intervention. Context here can include place, organisational and wider socio-political factors that may influence the development and/or delivery of the intervention (15).	8-10	
2. Report the purpose of the intervention development process.	Clearly describing the purpose of the intervention specifies what it sets out to achieve. The purpose may be informed by research priorities, for example those identified in systematic reviews, evidence gaps set out in practice guidance such as The National Institute for Health and Care Excellence or specific prioritisation exercises such as those undertaken with patients and practitioners through the James Lind Alliance.	8-10	
3. Report the target population for the intervention development process.	The target population is the population that will potentially benefit from the intervention – this may include patients, clinicians, and/or members of the public. If the target population is clearly described then readers will be able to understand the relevance of the intervention to their own research or practice. Health inequalities, gender and ethnicity are features of the target population that may be relevant to intervention development processes.	10-11	
4. Report how any published intervention development approach contributed to the development process	Many formal intervention development approaches exist and are used to guide the intervention development process (e.g. 6Squid (16) or The Person Based Approach to Intervention Development (17)). Where a formal intervention development approach is used, it is helpful to describe the process that was followed, including any deviations. More general approaches to intervention development also exist and have been categorised as follows (3):- Target Population-centred intervention development; evidence and theory-based intervention development; partnership intervention development; implementation-based intervention development; efficacy-based intervention development; step or phased-based intervention development; and intervention-specific intervention development (3). These approaches do not always have specific guidance that describe their use. Nevertheless, it is helpful to give a rich description of how any published approach was operationalised	8	
5. Report how evidence from different sources informed the intervention development process.	Intervention development is often based on published evidence and/or primary data that has been collected to inform the intervention development process. It is useful to describe and reference all forms of evidence and data that have informed the development of the intervention because evidence bases can change rapidly, and to explain the manner in which the evidence and/or data was used. Understanding what evidence was and was not available at the time of intervention development can help readers to assess transferability to their current situation.	8-12	
6. Report how/if published theory informed the intervention development process.	Reporting whether and how theory informed the intervention development process aids the reader's understanding of the theoretical rationale that underpins the intervention. Though not mentioned in the e-Delphi or consensus meeting, it became increasingly apparent through the development of our guidance that this theory item could relate to either existing published theory or programme theory	9	
7. Report any use of components from an existing intervention in the current intervention development process.	Some interventions are developed with components that have been adopted from existing interventions. Clearly identifying components that have been adopted or adapted and acknowledging their original source helps the reader to understand and distinguish between the novel and adopted components of the new intervention.	6	
8. Report any guiding principles, people or factors that were prioritised when making decisions during the intervention development process.	Reporting any guiding principles that governed the development of the application helps the reader to understand the authors' reasoning behind the decisions that were made. These could include the examples of particular populations who views are being considered when designing the intervention, the modality that is viewed as being most appropriate, design features considered important for the target population, or the potential for the intervention to be scaled up.	8-12	

Item description	Explanation	Page in manuscript where item is located	Other*
9. Report how stakeholders contributed to the intervention development process.	Potential stakeholders can include patient and community representatives, local and national policy makers, health care providers and those paying for or commissioning health care. Each of these groups may influence the intervention development process in different ways. Specifying how differing groups of stakeholders contributed to the intervention development process helps the reader to understand how stakeholders were involved and the degree of influence they had on the overall process. Further detail on how to integrate stakeholder contributions within intervention reporting are available (19).	8-12	
10. Report how the intervention changed in content and format from the start of the intervention development process.	Intervention development is frequently an iterative process. The conclusion of the initial phase of intervention development does not necessarily mean that all uncertainties have been addressed. It is helpful to list remaining uncertainties such as the intervention intensity, mode of delivery, materials, procedures, or type of location that the intervention is most suitable for. This can guide other researchers to potential future areas of research and practitioners about uncertainties relevant to their healthcare context.	n.a.	
11. Report any changes to interventions required or likely to be required for subgroups.	Specifying any changes that the intervention development team perceive are required for the intervention to be delivered or tailored to specific sub groups enables readers to understand the applicability of the intervention to their target population or context. These changes could include changes to personnel delivering the intervention, to the content of the intervention, or to the mode of delivery of the intervention.	12	
12. Report important uncertainties at the end of the intervention development process.	Intervention development is frequently an iterative process. The conclusion of the initial phase of intervention development does not necessarily mean that all uncertainties have been addressed. It is helpful to list remaining uncertainties such as the intervention intensity, mode of delivery, materials, procedures, or type of location that the intervention is most suitable for. This can guide other researchers to potential future areas of research and practitioners about uncertainties relevant to their healthcare context.	11-12	
13. Follow TIDieR guidance when describing the developed intervention.	Interventions have been poorly reported for a number of years. In response to this, internationally recognized guidance has been published to support the high quality reporting of health care? interventions <sup>5</sup> and public health interventions <sup>14</sup> . This guidance should therefore be followed when describing a developed intervention.	n.a.	
14. Report the intervention development process in an open access format.	Unless reports of intervention development are available people considering using an intervention cannot understand the process that was undertaken and make a judgement about its appropriateness to their context. It also limits cumulative learning about intervention development methodology and observed consequences at later evaluation, translation and implementation stages. Reporting intervention development in an open access (Gold or Green) publishing format increases the accessibility and visibility of intervention development research and makes it more likely to be read and used. Potential platforms for open access publication of intervention development include open access journal publications, freely accessible funder reports or a study web-page that details the intervention development process.	15 & 17	

\*e.g. if item is reported elsewhere, then the location of this information can be stated here.