

10 Questions

Ten questions concerning a new adolescent health urbanism

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ABSTRACT

This article sets out an urban health model and conceptual framework for researching environments that support adolescent health and wellbeing. Our focus is on 10–19 year olds, an age group that has been neglected by researchers in the otherwise emerging and dynamic field of design and health over the past decade. The Ten Questions address adolescent urban lifestyles and their relation to health outcomes in Europe, adolescent perceptions of the built environment and age specific physical, social, digital and emotional affordances as well as, addressing how to increase participation of adolescents in health-oriented urban design processes. A model of *adolescent health urbanism* is introduced that integrates place and person characteristics in a dynamic model that addresses everyday practices across the adolescent age span. Based on a review of the evidence from urban planning and environmental psychology literature, this article emphasises the need for a more adolescent-responsive urban design process, the need for more research into age-specific urban affordances; integration of new technologies to forge mobility in and engagement with in the co-design of cities allowing stakeholders to make better-informed planning decisions.

Introduction

Adolescent health and wellbeing has been overlooked in global health and social policy, but with a new Lancet Commission on Adolescent Health and Wellbeing [67], together with the UN's Global Strategy for Women's, Children's and Adolescents' Health [78]; there is a new global momentum to drive investment, capacity building, research, and evaluation on adolescent health. This reflects the unprecedented social, economic, and cultural changes currently facing adolescents. Globalization and urbanization present significant risks for our young people that include the densification of our cities, a new global economic order, the digital world and new global communication systems, and social media. In addition, adolescent health and wellbeing is at risk from rapid global health trends that include unhealthy lifestyles and obesity, the crisis of youth unemployment, reduced family stability, environmental degradation, armed conflict, and mass migration.

The new research vista emerging pays little attention to the built environment and, in particular, the potential value of salutogenic (health-improving) characteristics of cities, including design for active transportation and walkability, on adolescent health. We argue that the built environment of our cities offers an outstanding opportunity to invest in adolescent health and wellbeing but that this is currently a neglected opportunity. Good urban design can significantly advance the

physical, cognitive, emotional, social, and economic resources of young people that build the foundations for later life health and wellbeing. Adolescence is a critical phase in life for achieving human potential that has huge impacts for future society [67]. It is therefore vital that the built environment is integrated into the newly emerging adolescent health frameworks in order that we can build healthy adolescent cities that bring multiple benefits now and for the future.

Terms of reference: The age span under which adolescent health and wellbeing is explored and analysed, varies; the World Health Organisation (WHO) defines 'adolescence' as the span between ages 10–19 years, the age group on which this paper focused [93]. 'Young people' are defined as individuals aged 10–24 [79] and 'youth' as individuals aged 15–24 [79]. The Convention on the Rights of the Child [77] defines a child as below the age of 18 years and often data on adolescent health and wellbeing is included in child-led health surveys. In addition, adolescent health and wellbeing profiles very differently between countries, with most surveys capturing either individual country level data or global comparatives. Our focus for the purpose of this paper is on adolescent health and wellbeing in the European region, although we recognize that adolescent wellbeing is very much a neglected area of research in low to middle income countries (LMICs).

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1. How is adolescent health and wellbeing defined?

In reviewing the literature, we found adolescent health and wellbeing to be an ambiguous and poorly defined concept, that requires broadening to address the dynamic course of adolescence and transition in young adulthood (ages 10 to 24). The World Bank [90] defines these transitions in stages from primary to secondary school, and to higher education and the workforce. Further important transitions include the transition into marriage and/or longer lasting relationships, a move from family dependence to autonomy and parenthood, and from dependency to responsibility for one's own health, and the transition to responsible citizenship [90]. We found no models of adolescent health and wellbeing that integrate these transitions.

In general population terms, health has been defined by WHO [91] as a “*a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.*” Since 2009 criticism of this definition of ‘complete health’ has intensified in that “*It contributes to medicalization of society, it is inadequate for chronic diseases, and it is neither operational nor measurable*” [36]. Definitions need to shift from ‘whole’ health formulations towards dynamic, multi-dimensional descriptions that recognize how a person may be flourishing in one health domain (e.g. mental wellbeing) regardless of age, disability or health status. New definitions of health have subsequently been proposed that include “*the resilience or capacity to cope and maintain and restore one's integrity, equilibrium, and sense of wellbeing*” [40] drawing on how individuals (and communities) adapt and self-manage social, physical and emotional challenges. We propose that these newer definitions of health resilience are better aligned to developing a new adolescent health urbanism, and are better aligned to current city planning and urban design initiatives focusing on resilience (e.g. Rockefeller's global 100 Resilient Cities initiative) [1].

Another branch of literature has defined adolescent wellbeing in terms of personal goals and aspirations; personal goals are an integral component of wellbeing in adolescence [60,75]. Channelling behaviour, choice, co-regulation (i.e. achieving goals with others), and compensation (i.e. adapting and letting go of your dreams) - all play a key role in how young people navigate their life [75] and have important implications for wellbeing. Frameworks for measuring adolescent wellbeing include Brian Little's socio-ecological model of wellbeing, called personal project analysis (PPA) [53,56]. This framework explores youth wellbeing from the context of a young person's needs, lifestyles and aspirations via the lens of personal goals and integrates the social and physical context in which adolescents manage their goals [54]. Little's model is illustrated in Fig. 1, which shows how stable person and place characteristics (Boxes A and B) join with dynamic place features (Box C and D) to impact on personal projects (Box E) and ultimately, human flourishing (Box F).

Adolescents' goals – and the social and physical environments that support them – are directed by age-specific needs for autonomy, relatedness and competence [62], and goals that support mastery, meaning, challenge, manageability, identity and fun [54,56,71]. But the adolescent goal system is in constant flux and varies by age, a feature that PPA recognizes in a dynamic model that allows for change depending on the adolescent age span and in relation to specific developmental needs such as identity (for an example, see Ref. [6] longitudinal study of adolescent identity and personal projects measured across the secondary school age span). PPA also captures wellbeing across three key components — *evaluative* wellbeing (fulfilment), *hedonic* wellbeing (feelings of happiness, sadness, anger, stress, and pain), and *eudemonic* wellbeing (sense of purpose and meaning in life) [74]. In our proposed framework for a new health urbanism we posit that adolescent wellbeing is captured through the window of personal goals and aspirations (Fig. 2).

2. What determines adolescent health and wellbeing?

The individual determinants of adolescent health and wellbeing include demographics (e.g. age, gender, ethnicity) and socio-economic circumstances (e.g. education, family affluence, household circumstances (e.g. housing tenure, single parent household), means-tested free school meals). From a health resilience perspective, the literature has focused on how a ‘strengths based approach’ (defined as assets and resources) promotes health and wellbeing in defence of stressors and risk exposure in adolescence [27]. Assets are defined as the positive attributes that reside within the individual (e.g. self-esteem, coping skills) while resources are positive attributes that reside outside the individual (e.g. community support, family income). A large body of the health resilience literature has evolved from exploring adolescent risk exposure to trauma (e.g. exposure to violence) [99]. Both assets and resources have been shown to buffer mental wellbeing in adolescence including emotional regulation skills [44], family support [24,38] and regulatory, interpersonal, and meaning-making strengths [33].

The WHO defines the social determinants of health as “*the conditions in which people are born, grow, live, work and age*” [92]. For adolescents, these include material resources (e.g., wealth, employment, socio-economic status) and social factors (e.g. culture, social media, connections to family and peers) [82]. As adolescents' age, social determinants from outside the family become more influential on health as they test out new identities, experiment with new behaviours, make academic and career decisions, and forge independence from parents. New determinants come to the fore during adolescence (e.g. peer influence and school connections) whilst others begin to recede in their influence (e.g. family). The social determinants of adolescent health are therefore in constant flux [83], but little research establishes changes in these patterns over the adolescent age span.

The structural determinants of health are defined as the national structures that generate governance and social stratification, such as wealth, income inequality, educational status, gender norms or ethnic group [83]. The influence of these structural determinants of adolescent health tends to be more consistent over time as compared to the social determinants [83]. Both sets of determinants act as a major source of health inequalities in adolescence, but information about this is scarce [25]. Proximity to health improving urban environments (e.g. natural settings, vibrant cultural downtown areas) is also a health equity issue for adolescents. Nowhere in the current debate on adolescent health did we detect a role for the built and natural capital in our cities and its contribution to adolescent health and wellbeing. And yet built environment attributes such as neighbourhood safety, aesthetics, and walkability, access to public transportation, play a distinct role in adolescent physical, social and mental wellbeing [76]. Overall, there is a need for a broader and more dynamic model of adolescent health that recognizes transitions across the 10 to 19 age span and integrates built and natural capital as a determinant of health.

3. How is adolescent health and wellbeing measured?

UNICEF and WHO define quantitative frameworks for the measurement of adolescent health. Both organisations undertake regular global surveys, but these tend to explore health and wellbeing up to aged 18 (<https://www.unicef-irc.org/publications/686/>). These surveys bring together multiple comparative indicators, including indicators of overall health status, indicators of physical and mental health, health outcomes (diseases and injuries), health risk (health risk typically include nutritional risk (the proportion of overweight individuals and obesity), substance use (the prevalence of binge drinking) and sexual health risk (e.g., the proportion of adolescents who have sex under the influence of substances) [83]. Additional indicators typically include education and learning outcomes, and employment. The OECD Better Life Initiative (a global initiative), for example, combines indicators across age groups 0–17 year olds) measuring child and youth

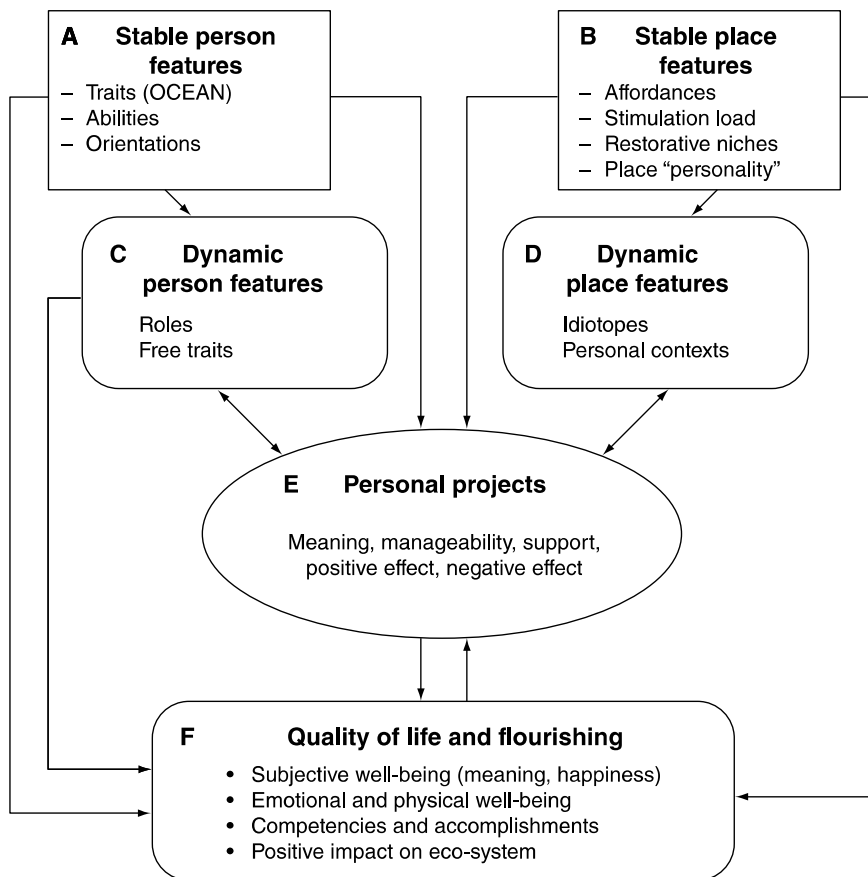


Fig. 1. Social ecological framework for measuring human flourishing (reproduced, with permission from Brian Little, [55]).

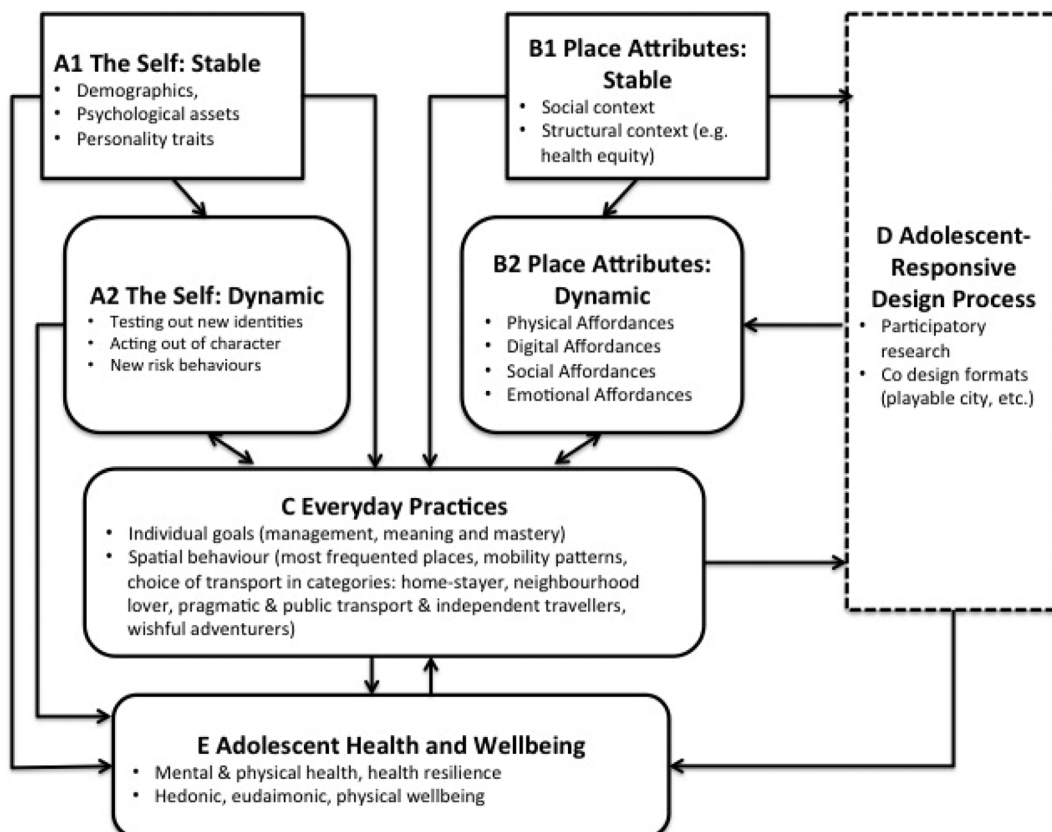


Fig. 2. Describes the new model of an adolescent-responsive health urbanism, based on [53,55].

wellbeing across six dimensions: material wellbeing; housing and environment; education; health; risk behaviours; and quality of school life (<https://www.oecd.org/els/family/43570328.pdf>). The Global Youth Wellbeing Index [32] provides an international ranking of youth wellbeing (aged 12–25) across high to low income countries, on six domains of youths' lives: citizen participation, economic opportunity, education, health, information and communications technology, and safety and security. The overall score is a weighted composite of the 6 domain scores. The Index mostly uses objective measures, such as expenditure and access to health and education, and includes only one subjective measure of wellbeing, on perceived stress. Social measures of wellbeing are poorly developed in most survey tools e.g. connections to place, family, peers etc. and civic and participatory engagement in city life.

In Europe the dominant data comes from school surveys, but this means that marginalised youth (youth at risk, at home for any reason, youth in juvenile centre's) or in employment are missed. Data on young adolescents, particularly those aged 10–14, is also very limited.

A consistent problem globally in measuring adolescent wellbeing is that adult wellbeing metrics are applied, which are not sensitive to the particular developmental stages of adolescence. For example, the UK's Office of National Statistics (ONS) measures population wellbeing (including youth aged 16 and above) using 4 indicators (i.e. that tap constructs of life satisfaction, happiness, anxiety and sense of worth) but capture none of the social processes that are so critical to adolescent wellbeing. Life satisfaction is a metric universally applied to measure wellbeing but has little resonance to an adolescent's life. The danger here is that adolescents are misunderstood as “well” or “unwell” in terms of a metric that is not meaningful to the context of their lives, resulting in health statistics that are inaccurate. The quality of being “well” is quite distinctive to age. Where specific indicators do exist for youth, no distinctions are drawn across the adolescent age span.

Overall there seems to be little consistency in how the data is captured or in what adolescent age groups. Geographic collection is widely variable, depending on what comparable global data is available. Comparative indicators of psychological wellbeing – and how these impact on resilience and capacity to flourish – are rarely represented in the evidence.

4. What does a snapshot of adolescent health and wellbeing look like in Europe?

Exploring adolescent health data for Europe requires selectively extracting indicator data from, mostly, global surveys. In exploring the most recent data global data by UNICEF [80]; general trends show adolescent wellbeing in Europe is higher than for the average population, which in part explains why it has received so little attention to date. In Europe most adolescents aged 11 to 15 appear to have ‘reasonable’ health wellbeing; although overall self-rated health is lower in Greece, Italy, Macedonia, Slovakia, Spain, and Switzerland. The OECD survey [63] reports, within Europe, Iceland and Sweden are the strongest performers in adolescent health and wellbeing, and Greece the least strong performance. This pattern is confirmed by data from the Global Youth Wellbeing index [32], which also ranked Sweden at the top for adolescent health and wellbeing.

Since the greatest threat to adolescent health and wellbeing is defined as mental health, substance abuse disorders, and physical health problems such as obesity [67], our snapshot review focuses on trends in these three categories:

4.1. Mental wellbeing

Adolescent mental health is an issue of growing concern. A recent study by UNICEF has shown that the proportion of adolescents in Europe with mental health symptoms is rising [7]. This survey collected data across 31 industrialised European countries in school-age children and adolescents using a non-clinical tool, the Health Behaviour in

School-aged Children survey (HBSC) (see Currie et al. [16] on the design of the HBSC study). One in four adolescent children (23%) reported experiencing two or more psychological symptoms more than once a week. The lowest rates of mental health symptoms were found in Germany (14%), Austria (15%) and Portugal (15%), with the highest rates reported in Bulgaria (33%) and Italy (37%). The survey found distinct gender differences, with almost twice as many girls reporting mental health symptoms as compared to boys at ages 13 and 15. In the majority of countries surveyed the prevalence of mental health symptoms increased with age, with the highest rate observed among 15-year-olds. The findings show gender disparity in mental health problems is substantial and increases with age.

The most serious mental disorders commonly emerge during the 15–19 age group. Many problems at this age persist into adulthood with consequences for mental health across the life course [67]. The challenge, therefore, is to intervene in early child and adolescent years to build resilience and help prevent serious mental health issues. In a period of rapid migration, there is a particular need to explore wellbeing in migrant youth. Another challenge is to get quality data that captures mental wellbeing in young people across the full adolescent life span (i.e. ages 10 to 19) and not just in school age children.

4.2. Physical activity and sedentary behaviour

Physical activity decreases in adolescence, particularly in girls [100]. With the exception of boys aged 13 years in Slovakia, no country had more than 50% of either boys or girls achieve the recommended exercise level (i.e. 60 min or greater on each of the past 7 days). On average, only 35% of teenagers are getting daily recommended levels of moderate to vigorous physical activity (MVPA) with strong gender and geographic patterns. Boys were more likely to fulfil the exercise criteria for activity than girls. Geographically, Ireland and Slovakia have higher rates, with Germany Norway, Russia, and Switzerland having lower rates [100].

Sedentary behaviour, such as computer usage, is also increasing. Percentages doubling or tripling over time, at weekend around 25% spending more than 3 h per day on computers. Teens spend hours on screens during their free time, either watching TV, playing computer games or surfing the internet [15]. Sedentary behaviour is causing rising obesity in youth, alongside associated health problems (e.g. diabetes, heart disease) – a growing adolescent health burden of the future. In higher income countries, rates of obesity are substantially higher in boys than girls; Greece, Italy, Malta are notable for their high rates, particularly in boys—more than a third were overweight. The European Association for the Study of Obesity [26] estimate 20% of Europe's school-age children are overweight (<http://easo.org/task-forces/childhood-obesity-cotf/>); the problem is compounded not just by poverty, but the prevalence of obesogenic environments near schools (e.g. fast food outlets); poor social structures (e.g. lack of family meal time); and poor availability of fresh, healthy food in deprived urban communities.

4.3. Substance abuse

Substance abuse begins during adolescence, and can be a trend with lasting health implications across the life span. It diminishes fitness, increases risks for many later-life chronic health problems, and heightens the risk for later substance use disorders. Some forms of substance use can also affect adolescent cognitive development and ultimately reduce peak cognitive abilities [67]. Online availability of recreational and performance drugs is a concerning trend, but wide variations exist by geography, age and gender. Within Europe, early tobacco use is highest in Austria and Malta. Austria and Ireland have highest levels of alcohol abuse (i.e. binge drinking) and cannabis use is highest in France, the Netherlands, and Spain.

All of the above adolescent health issues vary according to age,

gender, socioeconomic circumstances, geography, and culture. Protective mechanisms to youth wellbeing include supportiveness of family and peer networks, the school and local community resources [67,95] but there has been little research on how urban design can help in addressing the above health challenges, although the role of the built environment in health is increasingly recognized in general population health [31].

5. What constitutes health and wellbeing for adolescents as perceived by themselves?

We found no evidence in our search for perceptions of health and wellbeing from the perspective of European adolescents themselves. In an Australian study ($n = 79$) the key aspects of health and wellbeing defined by young people are social, psychological and physical health [5]. Important relationships are those with friends, family and teachers, youth workers and counsellors. However, this study identified an important mismatch between adolescents' perceptions of what constitutes wellbeing and how older adults perceive youth wellbeing. Youth workers put more emphasis on the structural and social determinants of wellbeing; adolescents put more focus on the self, which includes their personal goals, and the present context in terms of wellbeing. This mismatch in perceptions shows the importance of co-creating concepts of adolescent wellbeing. Adolescents need to be empowered to participate, not just in decisions about their health and wellbeing, but also in how it is conceptualized, measured, and what's important to their wellbeing.

6. What are the dynamic place affordances that make a difference to adolescent health and wellbeing?

Planning cities for adolescent health requires understanding where and how best to intervene and how a host of inter-related components operate as a wider system [73]. We propose an affordance framework that allows urban design interventions to be targeted to different user needs across the adolescent age span. Gibson's theory of affordances states an affordance is an opportunity for action in the environment perceived relative to the individual; *'The affordances of the environment are what it offers the animal, what it provides or furnishes either for good or ill'* ([30]; p. 127). Appleton [2] interpreted this as a *'what's in it for me'* approach to person-environment interactions. The framework has evolved from understanding the *physical* opportunities presented to a prospective users within the context of children's activities [37,50] from the perspective of what's *'do-able'* in the environment e.g. a tree is *'climb-able'*, a slope is *'roll-able'*. In the context of adolescents' lives Clark and Uzzell [11] have extended this framework to include *social* affordances; teenage interactions with their environment are richer and more intricate than simply functional possibilities - the affordances available to an adolescent change in the context of another person(s) and their peers. A social affordance is a highly motivational driver in the use of public city space for adolescents.

In addition, the concept of *emotional* affordances has been postulated [70] building on the *'good and the ill'* premise of Gibson's original conception. An emotional affordance is the opportunity that an environment offers for pleasure or displeasure, *'how will this object, person or place make me feel?'* Affect is the motivator for all of our actions [72], and affordances most linked with, say, fun are most likely to draw adolescents into certain spaces. Emotional affordance also include the opportunity a place offers for emotional self-regulation, defined as *actively* seeking out a favourite place that supports coping with moods and emotional situations [49]. Affect is the motivator for all of our actions, and affordances most linked with fun are more likely to draw adolescents into certain spaces. The feeling elicited will prompt a physical response – e.g. pleasure will result in the repeat of an action or staying in a space; dislike or fear will result in retreat or removal from an object or space. Physical affordances are therefore actualised via a situational

evaluation of what the environment affords for pleasure or displeasure. But emotional affordances drive adolescents' use of urban space is poorly defined in the literature.

In addition, we propose, digital affordances now need to be integrated into this framework. The *digital* affordances include the layer of hardware that includes TVs, personal computers, mobile devices, wearable sensors (e.g. Fitbits), the infrastructure of available Internet access, and the software of social media and mobile phone applications that offer adolescents opportunities to socialize, communicate, learn, work or play. These digital affordances interact with social, physical and emotional affordances, and in this respect, affordances are multi-dimensional concept.

In applying this framework to adolescent health urbanism it is fundamental to understand the spatial and/or social dimensions that produce opportunities or constraints for action, including the form and scale of space, accessibility, temporality (season, time of day), objects (i.e. physical attributes of our city streets, utilities etc.), people (i.e. the social dynamics of place), the desired actions of the user (e.g. to climb, jump, walk) and the physical and psychological characteristics of the person. We explore these dimensions further below across the four types of affordances identified above but generally the specific attributes of place (i.e. the dimensions listed above) that foster affordances is poorly defined in the literature.

6.1. Physical affordances

6.1.1. Physical activity affordances

Sedentary behaviour and the risk of obesity is a critical health risk for adolescents [67]. Prolonged sedentary screen-time behaviours (STB) in adolescents during leisure time, such as watching TV or using computers for gaming and social networks, has increased over the last decade and has been seen detrimental to health [8].

The dimensions of cities that foster physical activity (PA) (i.e. walking, running and cycling) for the general population include dense and diverse land-use patterns, good street connectivity, smart and connected public transport systems and urban design elements such accessible pavements and stress tree density [28]. Young participants of a global study "Growing Up in an Urbanizing World" aged 10–15 years, stated that "good cities" for them would provide similar elements: a *variety* of places to meet friends, places to talk and play formally and informally, to do sports, join in community work or shop. Young people rate safety and freedom of movement in our cities, they want to celebrate their community's history, social accomplishments and cultural life, and appreciate access to green space for a wide range of affordances including risk and social interactions [9,70].

However, the impact of structural interventions aimed at increasing adolescents' physical activity is hard to untangle and may be restricted. Audrey et al. [3] found little evidence between single-component interventions in public space, such as park upgrades, and effects on increasing physical activity in children and young people. The evidence is stronger for associations with primary school settings and PA than for the public realm, as exposure time may be greater and the studies are easier to design and control [3]. The authors point out that, besides methodological problems of emerging studies (e.g. common experimental designs and health indicators?), most of the interventions to the built environment were part of multi-component programmes such as *'Safe Routes to School'* programmes.

Active travel (walking and cycling to school) has been shown an important contributor to young people's overall physical activity levels [52]. Coombes et al. [13] investigated the "supportiveness" of school commute environments including availability of greener environments, density of road network and destinations to visit for children aged 10–11 years. They found that 63.9% of children, living and commuting to a school in a "supportive environment" also remained active travellers when changing from primary to secondary school. This was in contrast to 40.3% living and commuting to schools with less supportive

environments. Other contributory factors included family socio economic status (SES) and learnt behaviours in earlier years. They conclude “supportive environments” are important in maintaining active travel behaviour, and a focus of interventions should also be on active travel programs in very young ages [13].

Generally, the literature on “healthy places” [19] “people-centred urban design” [29] and “active design” guidelines [10] are mostly geared towards the general public. In our view, they do not cater for specific needs of young people or their particularly uniquely independent modes of transport, e.g. bikes, skateboards, skates. Borden [4] describes that crucial urban design factors for the experience of skateboarding in cities include the details of street furnishing, the (smooth) quality of surfaces, free access to facilities, and the possibility of abandoned spaces to become personal projects for users who co-create half-pipes, curves and rails. In our view, the focus in design aiming to promote physical activity is currently too much on ‘walkability’, with researchers only slowly recognizing the potential of qualitative place attributes and the importance of a more inclusive design process.

6.1.2. Healthy food affordances

There is a strong correlation between better food affordances in a neighbourhood and health and wellbeing outcomes. Neighbourhoods that offer easy access to healthy food supplies (e.g. wholefood grocery supermarkets, farmer's markets, quality food restaurants) are associated with lower rates of obesity at a population level [41]. Healthy food affordances for adolescents largely depend upon structural changes in policy and marketing practices e.g. school nutrition policies that foster healthy food options for lunch and breakfasts, schoolyard farming initiatives linked with in-class cookery classes. A cross-national overview into dietary behaviour in school-aged children (11–15 years) has focused on aspects such as eating breakfast every school day, daily fruit consumption, and soft drink consumptions. The lowest levels of soft drink consumptions are found in northern Europe and Baltic states, which the authors relate to policies on marketing, availability, price and accessibility of these products to young people (WHO: Fact sheets on dietary habits, HBSC, in more detail in Ref. [16]). A US study shows a correlation between intake of sugar-sweetened soft drinks in adolescents with residential proximity to restaurants (including fast food), convenience stores, grocery stores and other retail facilities within the 800 and/or 1600 m residential buffers ($P \leq 0.01$) [51]. In the UK in 2018 a soft drinks levy will be introduced to promote sugar reduction in soft drinks. Action on the social determinants of adolescent dietary habits is also important, e.g. understanding how adolescent food behaviour is related to the social food affordances, e.g. the parents' and siblings' nutritional habits.

How food is marketed to young people is also a critical affordance dimension in the environment. There can be a high concentration of soft drink billboards in areas around schools [58]. Advertisements, however, are generated and perceived across multiple platforms, using both physical and digital environments. There is accumulating evidence that food marketing on new media is increasing and influences adolescent food preferences and choices. The impact of healthy eating campaigns that work with new media and interact more personally with adolescents is likely to be greater than that of traditional marketing [43].

6.2. Digital affordances

Adolescents are rapid adopters and high-end consumers of digital and social Media. That offers both positive opportunities for health and wellbeing, as well as some significant constraints. Using social media, for instance, or gaming, provide affordances for adventure, excitement, belonging and fulfilment that many adolescents find missing in ordinary life [67]. For adolescents and young adults, new media promote access to new and extended social networks, without geographic or

cultural constraints, and bring the potential for engagement with new ideas and new social interactions. Constraints, on the other hand, include the risks of cyber bullying, grooming for sex, sharing of sexual images, and social contagion around self-harm, eating disorders and potential sleep disturbance [67].

Gamification is one field that potentially offers positive health affordances to adolescents i.e. using game design elements in non-game environments such as the workplace or our city streets to engage youth [21]. It has been theorized that if health promotion initiatives can incorporate components that make games addictive, they can also be more effective in making healthy behaviours addictive, which in turn would be then more likely to be habitualised [17]. The range of smartphone apps using gamification elements to invite young people to become active in urban environments has evolved from experimental prototypes to commercially available massive multiplayer games such as Google's Ingress [46] and more recently Pokemon Go [45]. Very few studies are available on the effectiveness of these approaches in adolescents. The pilot “Beat the Street” includes gamification elements to promote active school travel in school children between 8 and 10 years. This study showed an improvement in active travel in a 20 week intervention period, reporting an increase (+21,1%) of moderate to vigorous physical activity (MVPA) time during active travel and more reported trips in those participants that were highly engaged in the intervention [12]. The authors conclude that more research is needed on the effectiveness of interventions using gamification in youth, and especially on how they can be designed to be more engaging.

The effectiveness of single-component digital interventions on adolescent health and wellbeing has not yet been evidenced and is - is difficult to untangle from the interdependent elements within an urban system. More research is needed in order to be able to give more specific recommendations to policy makers and planners and understand how digital affordances interact with the social and physical attributes of city environments for adolescents, for example, how does renovation to a public park interact with behavioural change interventions promoted via new technologies? The role of digital environments in stimulating and supporting behaviour change needs more research.

6.3. Social affordances

The local neighbourhood, school and town centre all support social interactions in adolescents, although the city or town centre appear to provide significantly more affordances for social interaction [11]. Generally, adolescents rate communities high on social affordances where they feel included and welcome along with other age groups [23]. A culturally rich neighbourhood with a variety and density of ‘free ranging’ space (i.e. space adolescents can freely move around and feel welcomed in) and supporting frameworks such as institutions, accessible to young people has been shown to foster a sense of belonging and a better development of understanding and making sense of the world [14, 59].

6.4. Emotional affordances

Environments that offer opportunities for recovery from stress, depression and fatigue are defined as restorative environments. Typically they offer four components: a sense of fascination (i.e. they appeal to our involuntary attention mechanisms rather than our directed attention), being away (i.e. they offer a sense of escape from everyday routines), extent (i.e. they provide a sense of connectedness to a larger whole) and compatibility (i.e. there is a good fit with one's intentions and needs) [42]. Restorative environments supporting wellbeing in adolescents include natural settings and the home environment [11,48]. Adolescents' bedrooms, in particular, offer retreat affordances involving interactions with close friends and also solo retreat for safety and security purposes [11,70]. Other settings offering emotional regulation in teens include neighbourhood green space, city spaces (e.g.,

sport settings, urban town) context and further afield adventure spaces (e.g., beach, national parks, hills) [70], supporting self-efficacy, challenge, identity and risk for adolescents.

In summary, we suggest an affordance framework for a healthy adolescent city should integrate the four categories above and speak to: adolescent developmental needs for risk and adventure/thrill; exploration and curiosity; for independence and the right to roam freely; allow experimentation, social integration, foster meaningful projects and generate forums that allow the adolescent voice to be heard; to co-create the city, and offer places to escape, rest and recuperate.

7. What are health-related everyday urban practices of adolescents?

De Certeau [18] has introduced the notion of “the practice of everyday life” to describe how people respond to, re use and ultimately influence their urban environment. He has used the example of people taking a short cut through an open space while ignoring the more rigid grid system of footpaths. We understand adolescent everyday urban practices as dynamic patterns of actions (travelling, learning, eating, working, hanging out with friends and family, etc.) manifesting in sequences of settings (home, school, open spaces, etc.). Whereas traditional models of spatial behaviour foresaw young children exploring the world in concentric circles starting from their home, streets to their neighbourhood, Zeiher and Zeiher [98] have pointed out that as a result of modern planning with separate zoning for living areas, education, work and leisure facilities, children and young adolescents experience their environment as insulated and highly specialised spaces. These would often be only connected by a car drive facilitated by their parents. Von Seggern et al. [84] emphasize that there is little research on how adolescents are using and perceiving the city as an increasingly well-connected network of places, peers and access points to information. They argue that in contrast to children, adolescents have access to a wider spectrum of mobility means including public transport, motorbikes or cars. Their research shows that individual disposition, goals and aspirations, in connection to context and place attributes manifest in adolescents' everyday urban practices. Von Seggern et al. [84] gained data from an exploratory study with 12–16 year old adolescents in Germany and constructed profiles of their “spatial routines” based on their choice of most frequented places, movement patterns and choice of transport. They distinguish between *home-stayers*, *neighbourhood lovers*, *city surfers*, *inter neighbourhood travellers*, *city-hoppers* [84]. The research from Roe and Aspinall [70] suggests the need to add a sixth category of *Wishful adventurer* (person who dreams of going beyond) (Table 1).

The profiles of everyday practice do, to some extent, correspond with increasing age and degree of independent mobility. However, they intend to integrate individual status such as developmental or personality needs (e.g. for security/safety vs. risk/adventure in order to highlight patterns in perception and usage of open space). The profiles are responsive to fixed contextual attributes such as urban vs. rural settings, distance from home to school, living in one or two households in varying family configurations [84]. We argue that everyday practices

listed in Table 1, provide a starting point to analyse qualitative urban design aspects stimulating physical activity (See Q6) and co design projects (See Q9). It is important to note, however, that they do not include adolescents' individual goals and aspirations. We argue that the interaction between adolescent everyday practices and their personal projects – as constructed from data on frequented places, mobility patterns and aspirations – provide a framework to understand the capabilities, motivations and opportunities of young people to engage in healthy behaviours (see Ref. [69] for an integrated goal and health behaviour framework). This includes opportunities for active travel as much as motivations for interacting in the life of a place, be it at a micro (e.g. home) scale to a macro scale setting (e.g. periphery of the city/national parks). We assume that adolescent everyday practices act as a mediator between fixed and dynamic place attributes of the self (See Q3) on the one hand and outcomes in health and wellbeing on the other hand (Fig. 1).

8. What does a new model of adolescent health urbanism look like?

Health behaviours do not act in isolation; they are embedded within an individual's overall goal system [101]. Our proposed model for this study draws on a health behaviour framework that uses individual goal systems, i.e. personal project analysis (PPA) by Ref. [53]; (Little, 2014), as introduced in Q1 (Fig. 1) as the window to adolescent health and wellbeing.

Within this framework, there are opportunity structures that initiate and drive a behavioural action in the direction of a particular goal and/or health behaviour. We define an opportunity as everything that makes a behaviour possible or prompts it [57]. These constitute *the Self* (e.g. age, gender, socio-economic status) (Box A in our model), which consists of ‘fixed’ characteristics (A1) (e.g. demographic, traits) and ‘dynamic’ person characteristics (A2) (e.g. acting out of character to pursue a goal, or in, in the context of adolescents' life, testing out new identities). Opportunity structures also include *Place* characteristics (Box B in our model) – which constitute ‘stable’ place attributes (i.e. the structural and social context) (B1) – and ‘dynamic’ place attributes (B2), which include physical, digital, emotional and social place affordances that support or hinder behaviour. A and B interact to generate Box C, the *Everyday Practices* of adolescents (as defined in Q7). This framework indicates that Boxes A (Self), B (Place) and C (Everyday Practices) – in interaction with a more adolescent-responsive urban design process (Box D) – acts as a conduit to adolescent health and wellbeing, Box E.

We argue that urban design should be more responsive to adolescent goals and aspirations and suggest the following interaction points in that process (Box D). First, urban designers and health experts should better understand the social and structural determinants driving adolescent health (Box B1). In our view, this is crucial to integrate relevant policies and stakeholders into design briefs and master planning processes affecting adolescents' lives. Second, urban designers have to seek expertise in developing participatory research and co design formats with the aim of understanding the place affordances that constrain and build health and wellbeing (Box B2) and identify opportunities to

Table 1

Profiles of adolescent everyday practices with a short description of typical distribution of places visited, movement patterns and choice of transport. Based on von Seggern et al. [84].

Everyday Practice	Description
1. Home-stayer	Strong focus on home and places in neighbourhood – connected by foot, bike or skates.
2. Pragmatic neighbourhood lover	Focus on neighbourhood, added with places outside (i.e. football stadium, city centre, homes of friends and family members) – connected with transport according to distance.
3. Spontaneous city surfer	Distribution of places across city, home is central but not connected to places, all transport is part of routes.
4. Mobile city traveller	Great distances between places including the distance between school and home; Places and activities are located along public transport lines as well close to school or home, connected with public transport.
5. Communicative city-hopper	Distribution of places extensively across the city in clusters, on local level – connected by foot, otherwise public transport.
6. Wishful adventurer	Aspires for risk and adventure, and for novelty and curiosity in faraway places.

positively impact on adolescent everyday practices including health-related behaviours (C). Finally, we encourage policy makers to include adolescent health and wellbeing as important evaluation criteria for successful urban design.

9. How can adolescents participate in co-developing a new health urbanism?

Undertaking youth-led participatory action research is increasingly used to generate interventions that tackle real world problems in adolescents' communities. Ozer and Paitt [66] present a useful and recently published summary of innovation and practice in adolescent participatory research. Whilst participatory methods are well used in public health, education, environmental studies, they are rarely employed to understand what health wellbeing *constitutes* for young people or to generate a set of meaningful health and wellbeing indicators by which youth designed interventions can be evaluated by adolescents themselves (See Q4). PPA (Q3) provides one participatory wellbeing evaluative framework youth can actively lead and engage in.

Much like community-based participatory research, adolescent participatory research uses iterative techniques to first, analyse the problem and then generating solutions designed to foster change. Integral to the concept is the notion of youth as 'agents of change', fostering change not just in their own lives, but in their communities and/or institutions serving them (e.g. schools). This process has proven efficacy in promoting social capital in youth (e.g. civic and political engagement), building skills in research and advocacy, improving attitudes towards school, as well as addressing inequalities in health, education and other systems [66]. However, the role of participatory approaches in generating long-term health and wellbeing outcomes is yet to be demonstrated.

In the built environment, young researchers have participated in domains as diverse as housing (Boulder's *Great Neighbourhoods* project), open space planning (Boulder's Burke Park) [20], urban agriculture for [68], shaping the course of the "playable city" [85] and "urban exergaming" inviting young people to exercise with digital technology [46], as well as educational projects in which architecture students team up with young people to re-programme fringe spaces and generate short-term tactical urban interventions. *Growing up in Boulder* is an exemplar in youth led participatory urban design and planning (<http://www.colorado.edu/cedar/current-projects/growing-boulder>). Over 6 years this program has built a culture of child and youth participation in the city, engaging adolescents in community planning and sustainability initiatives, in the planning of parks and recreation, transportation, arts and culture, open space and mountain parks, and, now, in the city's resilience program via the Rockefeller Foundation [20].

There are many additional models of successful youth-led participatory design (see Ref. [66] for examples relating to low income and developing countries). Typically they employ a multiple methods approach using a variety of methods such as focus groups/interviews, diagramming, photovoice (i.e. taking and interpreting photographs of communities or specific contexts), mapping techniques using location based data, observation, collecting data via mobile phones using photo, text messaging and mobile phone apps (Fig. 3).

10. What are the potential applications of implementing this new health urbanism in urban design practice and research?

We see a new adolescent health urbanism as part of an urban design process that can be more responsive and inclusive to specific adolescent user needs. Universal design approaches [65] is one well established direction that takes into account specific needs and skills of user groups (e.g. users with mobility or cognitive restrictions) and empathically works with users to 'get into their shoes' and integrate their perspectives on urban design, resulting in increased access and usability of public space for all.

The presented model (Fig. 2) can be adapted to specific life situations adolescents find themselves in, which are driven by various global factors to adolescent health and wellbeing such as migration, unemployment or sedentary lifestyles. We believe the presented model can guide designers in outlining relevant aspects in adolescent health and wellbeing that need to be part of iterative design processes. For example, when designing for and with adolescent migrants, it is important to understand how relevant factors of *The Self* (e.g. psychological assets and personality traits, new risk behaviours), fixed *Place Attributes* (e.g. no family support in unaccompanied adolescents, peer networks) and dynamic *Place Attributes* (e.g. restricted physical affordances in the temporary home for asylum seekers) as well as the resulting *Everyday Practices* (e.g. individual goals such as learning a foreign language, spatial behaviour such as travelling between a home and school, etc.) form a conduit to build health and wellbeing. We believe the model may give guidance to designers and adolescents in better understanding how factors interact with each other and what may be the framework and scope, when aiming to improve one factor, for example 'dynamic' *Place Attributes*. In our view, such an understanding is key to make better informed decisions on priorities and qualities of place affordances.

We believe a new adolescent health urbanism can furthermore be driven by the collection and mining of location-based data on how we use and perceive the city, and is becoming increasingly available to urban designers and planners [64]. There are future opportunities for the presented model (Fig. 2) to be integrated into research projects analysing multiple sets of big data with the aim to investigate the role of specific place attributes in adolescent health and wellbeing. For example, young patients with type-1-diabetes are actively collecting location-based data on their physical activity, visited places, food and insulin intake and sugar levels as part of smartphone apps [39]. The presented adolescent health urbanism framework allows researchers to identify dynamic *Place Affordances* (e.g. physical, digital, social and emotional affordances) relevant to young patients' *Everyday Practices* (e.g. personal projects, therapy goals and physical activity patterns) and explore these outcomes in relation to adolescents' individual circumstances (e.g. demographic and socio-economic status) and outcomes in health and wellbeing (e.g. sugar levels and physical activity). Potentially, such research can aim to better visualise positive influences on personal diabetes therapy and can engage young people with diabetes to co-design places that invite for example for physical activity and better food choices [47].

11. Conclusion

The emerging discussion on adolescent health and wellbeing, reflected in the recent Lancet Commission [67], has widely ignored insights how the built and social environment can contribute to support physical activity, mental health and resilience against drug abuse. The Lancet Commission also identifies that adolescent mental health is very much a neglected area of research in low to middle income countries (LMICs).

We argue that place affordances, including the increasingly important digital affordances, are a suitable concept to better integrate the built environment to a model of adolescent health and wellbeing. We see the current focus on quantitative measures presented in the reviewed literature (e.g. focus on walkability scores and indices in planning), critical. It is crucial to balance the emphasis given to these quantitative measures with qualitative measures of how adolescents use and perceive the built environment. We have used the examples of skateboarding, exploring playful technologies and participatory research and design to emphasize the chances to integrate health-related behaviour with personal projects meaningful to adolescents.

We argue that there is a need to include adolescent everyday practices in any model – but this needs to be considered across periods of transition (e.g. primary school to high school, secondary to



Fig. 3. Shows participants playing the location-based game *Stadtflucht* learning about positive effects of healthy places [34], and visualization of data on “stressful” (red) and “relaxing” (green) areas collected by young people using a smartphone app and a Geo information System [35]. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

university, education to workforce, family to autonomy). Even though we believe that the presented model and framework helps to understand the dynamism in transition periods, more research is needed to further specify single aspects and their interactions responsive to gender, age groups, personal disposition and specific life situations influenced by global developments like digitalisation, migration, and youth unemployment.

Youth have much to offer their cities but the idea of the adolescent healthy city is a concept yet to gain any traction in public health and urban planning, unlike the momentum the Child Friendly City and Healthy Ageing City have achieved globally. We argue building an adolescent health urbanism – using a model that captures the dynamic qualities of adolescent health and wellbeing and their everyday practices – will afford transformative processes to build a ‘healthy teen-agerdom’ for the health and wellbeing gain of all.

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