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Precision medicine and healthy living: The importance of the built environment

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ABSTRACT

The built environment encompasses the major physical spaces, including buildings, streets, homes, schools, parks, playgrounds and other infrastructure in which we live, work and play. In an ideal world, the built environment should support and facilitate a healthy engagement in physical activity across the lifespan. However, in the context of an environment characterized by increased mechanization and urbanization, physical inactivity and higher levels of overweight and obesity, too many settings are not conducive to physical activity and/or are not safe and walkable. In the knowledge that there are multiple challenges to redress the low levels of physical activity seen in many parts of the world, this paper provides some examples of opportunities for healthy living (HL) in a built environment characteristic of an increasingly urbanized world. Particular foci include opportunities for HL fostered in child-friendly cities, in which walkability is high, and active transport is encouraged and supported.

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In simple terms, the built environment can be defined as the major physical spaces, such as buildings, streets, homes, schools, parks, playgrounds and other infrastructure in which we live, work and play.[1] The built environment is one of the key supportive components for precision in healthy living (HL) medicine (HLM).[2] However, over recent generations, profound changes to the built environment, particularly in urban settings, have significantly impacted lifestyle practices of many individuals and populations. In turn, these changes to lifestyle practices have had serious downstream health consequences. For example, changes to our built environment have seen dramatic decreases in habitual physical activity (PA) levels. Reductions in PA level are commonly clustered with other unhealthy practices, including an increase in sedentary behavior, and unhealthy dietary practices.[3,4] Taken together, these fundamental changes in lifestyle represent the main drivers of a positive energy balance, and subsequent predisposition to increased overweight, obesity and non-communicable diseases (NCDs), including

Abbreviations: AWI, Active Well-being Initiative; CV, cardiovascular; HL, healthy living; HLM, healthy living medicine; IOC, International Olympic Committee; NCDs, noncommunicable diseases; PA, physical activity; US, United States; WHO, World Health Organization.

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cardiovascular diseases (CVD).[5–7] A staggering estimate is that one in every four adults and three in four adolescents (aged 11–17 years) do not meet the global recommendations for physical activity set by the World Health Organization.[8] This equates to some 1.5 billion adults having the potential to improve their health status and reduce the risks associated with NCDs, simply as a function of increasing their habitual PA level.[9] In the United States (US), it is estimated that only 26% of men, 19% of women, and only 20% of adolescents meet the PA guidelines for health.[10,11] Perhaps of greater concern is that many young people globally are less active than ever before and at the same time, more children and adolescents are overweight or have obesity.[12,13] Here we discuss the importance of the built environment as an opportunity to foster HL in a global context increasingly characterized by urbanization. Particular attention is paid to active transport and health, walkability, and making better use of parks and open spaces in cities.

The context - changes to the built environment and consequences for active transport and health

The built environment can have a profound role in shaping the health and wellbeing of people of all ages, including the youngest of children. One's physical environment is a key determinant of health, behavior and development with the potential to impact short- and longer-term health.[14] The key platforms or foundations of habitual PA in young people, walking, cycling and active play, should be the underpinnings of a physically active population.[13,15] However, in an increasingly urbanized world, high-density traffic, poor air quality, a lack of public spaces and insecurity are examples of major deterrents to people being physically active.[16,17]

To keep pace with the challenges of maintaining active modes of transport, new modalities are being explored, including e-bikes. Results of a very recent pilot study suggest that e-bikes are a sufficiently active form of transport and capable of providing a good proportion of the cardiovascular (CV) health benefits associated with the use of conventional bikes.[18] Importantly, e-bikes may reduce some of the typical barriers to cycling such as longer commuting time, inconvenience, fatigue, and lack of available facilities to change in the workplace. Not surprisingly, the dominance of cars in most cities is one of the biggest barriers to habitual PA (walking and cycling) in general, and to child-friendliness in particular. The overreliance on cars is also a key factor preventing many parents from encouraging and supporting the independent mobility of children.[19]

There is strong evidence linking the nature of the built environment and health with a number of the most important causes of numerous global health problems being poor policy and design features of the built environment.[20] However, there is less consistency in the evidence base regarding the underpinning principles of good practice in design of the built and natural environment for promoting health. A recent review by Bird et al.[21] assessed relationships between the built and natural environment and health with a focus on neighborhood design, housing, food environment, natural and sustainable environment, and transport. Non-communicable diseases and injury prevalence are also influenced by land use and transport policies through increases in pollution, noise, social isolation and sedentary behaviors and also, low levels of PA.[22]

From an historical perspective, changes to the built environment have coincided with reductions in population PA, including the most common form of mobility, walking. These changes have occurred alongside significant advances in technology and together been amongst the major contributors to dramatic declines in PA (including walking) in high-income countries[23] and many parts of the developing world.[24,25]

One of the key suggestions in the latest PA guidelines for Americans[11] is to capitalize on opportunities to leverage new technologies to encourage and support an increase in PA, including wearable devices and social media. Giroir and Wright[10] have suggested that wearable devices and social media may be beneficial in supporting efforts to initiate, maintain, and increase PA, however others have questioned the effectiveness of some technologies, including in the context of PA and weight loss. For example, Jakicic et al.[26] indicated that despite the many wearable technologies specific to PA and diet, it is unclear if they are effective at improving weight loss. In a group of young adults with a body mass index (BMI) between 25 and 40 kg/m^2, the addition of a Fitbit device to a standard behavioral intervention resulted in less weight loss over 24 months. However, Giroir and Wright's[10] suggestion that stronger alliances between major manufacturers of wearable technology and the general public to monitor health, including PA guidelines, has considerable merit.

A primary example of change in PA has been the displacement of active transport (walking, cycling and use of public transport) with the increased availability of motor cars and other motorized vehicles.[22,27,28] In addition to a reduction in active transport, other factors include concerns regarding safety and walkability. Increased congestion and associated pollution from motorized vehicles in many urban settings have seriously compromised both safety levels and walkability. From the perspective of optimizing HL practices in the young with health benefits for subsequent generations, any encouragement of active transport amongst young people must be supported.[19,29] Of similarly high priority is the need to explore approaches to redress the common decline in PA evident in many adolescent girls and thereby decreasing their risk for poor health outcomes such as obesity and related NCDs.[15,30]

A major challenge globally to reverse the substantial physical inactivity seen in many populations,[31] is to design PA back into the habitual lifestyle patterns of individuals,[15,32–34] particularly helping the least active to change from a sedentary to more active lifestyle.[35,36] Thompson and Eijsvogels[37] contend that the most important message from the latest PA guidelines[11] is that the greatest health benefits accrue by moving from no, to small amounts of PA. This should include incentivising and facilitating walking as a habitual mode of transport, commencing with very young children. Walking is the cheapest and most reliable form of transport and by maximizing the number of people walking through urban environments helps to address perceived safety risks associated with walking by making these spaces safer for others.[38–41]

From a public health perspective, there is also considerable merit in identifying the attributes of the built environment that are supportive of health through habitually active lifestyles of residents.[42] Consistent with the ecological model of health behavior, and recognising that multilevel factors (e.g. individual, social, environmental and policy) can influence behaviors, it is particularly valuable to understand the attributes of the environment that have the potential to promote some behaviors and discourage others.[43]

In the knowledge that a good proportion of the literature to date has referenced the role of the built environment on obesity and commonly been based on cross-sectional data, Chandrabose et al.[42] recently explored the built environment attributes related to cardio-metabolic diseases and their risk factors and found strong evidence for longitudinal positive relationships of walkability with obesity, type 2 diabetes and hypertension. As the evidence on potential mediation by PA was inconclusive, Chandrabose et al.[42] suggested that further longitudinal studies are warranted, both to explore which built environment attributes influence health, and how PA may be involved.

In a recent paper on urban design, transport and health, Giles-Corti et al.[44] identified a set of eight interventions with the greatest likelihood of encouraging active transport. Of particular note, the combination of these interventions, for example pedestrian- and cycling-friendly networks, and desirability of active transport, would make a significant contribution to healthier and more sustainable urban settings.

In short, the typical built environment discourages physical activity and encourages unhealthy eating. As a consequence, greater and urgent attention is needed to address the policies and practices that affect the built environment to underpin HL principles.[1,2,22,44,45]

Promoting active lifestyles in walkable environments

The benefits of PA for health at all ages are widely documented[4,46,47] with habitual activity associated with improved cardiometabolic and musculoskeletal health, cognition and reductions in symptoms of depression and anxiety.[48–50] In contrast, physical inactivity is associated with obesity and related comorbidities.[8,11,25,31,34]

Walking is widely acknowledged as the ideal form of PA being available, affordable and accessible to all.[51] Accordingly, there is considerable merit in promoting the many benefits of walking amongst children and adolescents and fostering a more positive attitude towards both walking and PA in general, from the earliest possible age. Investing in walkable environments is an ideal means of preventing chronic disease as the benefits of walking are manifold including reduction in stress, improvement of sleep, a reduction in the symptoms of mild depression, and increases in self-confidence.[52,53]

One of the primary opportunities to influence PA levels of children in the growing years is to encourage and support active travel to school, walking or cycling. A number of systematic reviews have reported that children and young people who walk or cycle to school are more likely to attain recommended levels of PA for health in contrast to those who travel by car, motor cycle or public transport.[54,55] However, active travel to school has declined in many locations in recent decades.[55–57]

A major opportunity to improve PA worldwide is to arrest and ideally reverse, the decline in walking and cycling,[58] including in young people, however, evidence suggests that major changes are needed in the built environment for active commuting to become more widespread.[44] Although a host of factors may be considered important in different demographics, the most consistent include safety, weather conditions and exposure to air and/or noise pollution. To overcome barriers to active transport, including to and from school, requires the development of local solutions,[41,57,59] including the development of safe routes to schools. One of the most commonly reported challenges associated with active travel to school is the concern of many parents regarding safety.[38] In a recent US study[57] the most common barrier to walking to school cited by parents was living too far away, followed by danger associated with traffic and poor weather conditions.

Ikeda et al.[60] found a positive association between active school travel and safety, walkability and neighborhood social interactions but negatively with travel distance and car ownership. Additional benefits of active travel to school are many and include the development of independent mobility when travel is unsupervised and associated resilience and refinement of life skills, plus road safety skills and management of risks.[41,61,62] Ghekiere et al.[63] reported that independent mobility was higher amongst boys than girls and that perceptions of young people's cycling and traffic skills and grade were positively associated with independent mobility in both genders. Perceptions of cycling skills were positively associated with independent mobility in boys living in highly urbanized but not low urbanized settings.

In summary, HL principles, including the attractiveness of the physical environment, climatic conditions, the safety of the location, plus the nature of the surfaces, level of greenness, and designated active transport infrastructure, all influence the likelihood of engagement in PA.

Greenness, open spaces and opportunities for PA

The physical environment, including the built and natural environment, are increasingly recognised as major determinants of health. Consistent with the increases in urbanization globally, greater attention has been given to the positive and negative impact of urban spaces on health. This includes the relationship between green spaces and better health outcomes, and the facilitation of walking based on the quality of the physical environment.[64] The built environment can impact physical, mental and social wellbeing, either positively or negatively,[16,17,53] particularly in deprived areas.[65]

There is also good evidence for a relationship between the built environment (reflected in connectivity and walkability, plus physical activity), and environmental exposures including green space, air pollution, and noise, with CVD and mortality.[66] This is also the case for a link between mode of transport and CVD, however, evidence is inconsistent for an association between built environment measures and weight status, and between green space and either weight status or physical activity. Importantly, Nieuwenhuiisen[66] suggests that CV disease and mortality could be reduced with better planning of urban environments and transport planning. Better planning in these areas should be consistent with the promotion of PA, reduction of noise and air pollution, and increases in green space.

To test the hypothesis that young people in socioeconomically disadvantaged circumstances may benefit more from local green space, Feng and Astell-Burt[67] used multilevel models and found that the odds of sub-optimal general health were 14% lower amongst children (0–13 years) in areas containing >21.5% green space compared to those with <10%. Higher parent-reported quality green space was associated with 18% lower odds of sub-optimal child health. However, no effect modification of the association between child health and area disadvantage across strata of green space quantity or quality was observed.

In a recent systematic review, Van Hecke et al.[68] reported on the qualitative and quantitative research related to the specific characteristics of public open spaces associated with adolescents' public open space visitation and PA. Quantitative evidence confirmed a positive association between the presence of trails, playgrounds and specific types of sports fields (e.g. basketball) with public open space visitation and PA. Further, safety and aesthetics were found to be less important.

In a number of recent reports[39,40] improvements in the feasibility, opportunity, and attractiveness of walking, including for children, has been identified as the key to optimizing the health and wellbeing of the current and future generations living in cities. Similarly, greater attention is being paid to the effect of the built environment on child development, particularly from the perspective of resilience and setting the scene early for better developmental outcomes.[14]

A novel and emerging field in relation to the built environment is child-friendly urban planning. This approach advocates the planning and design of cities with children's development, health and access to opportunities as guiding principles. The benefits of a child-friendly approach have the potential to address in tandem, multiple agendas including health and wellbeing, sustainability, resilience and safety. A framework for the facilitation of walking has been presented as underpinned by key platforms of daily PA, social cohesion, interaction with diverse people, equal opportunity, liveability, and transport efficiency. Indeed, if we consider what a sustainable and healthy city might look like into the future, and with a view to the next generation(s), this should be a child-friendly city.[40]

Potential to reduce healthcare costs

A growing body of research supports the notion that walkable environments contribute to an increase in the number of people who engage in active modes of transport and lifestyles, with consequential benefits including reduced NCDs and related health costs. Along with morbidity and premature mortality, the economic burden of PA is substantial.[31,69] The significant health cost associated with physical inactivity is projected to account for 1.5–3.0% of total direct healthcare costs in high-income countries, however this does not include costs associated with mental health and musculoskeletal conditions.[8,70] Strong evidence for the relationship between cardiorespiratory fitness (CRF) and health is well established. A recent paper by Myers et al.[71] on health of Veterans reported that low CRF is associated with increased health costs and accordingly, efforts to improve CRF may translate to reduced health costs. Ding et al.[69] have advocated

for the prioritization of PA promotion globally as a key component of a comprehensive strategy to reduce NCDs. This is also consistent with the global agenda to explore every avenue for the promotion of PA and healthy eating.[8,31,72,73]

The way forward - exemplar approaches to activate cities and promote HL

Global direction regarding the built environment and NCD prevention and control has been provided in the WHO Global Action Plan (2013−2020),[72] and more recently, the Global Action Plan on Physical Activity, 2018–2030.[8] Major initiatives cited include appropriate urban planning and transport policies to improve walking and cycling and "the creation and preservation of built environments with a particular focus on providing infrastructure to support active commuting".[72] There is good evidence regarding investments in urban environments to increase active commuting in high-income countries,[27] however the challenge is significantly greater in less developed settings.[58]

Evidence supports the tenet that activity-friendly cities encourage greater engagement in physical activity. In a study of urban environments in 14 cities worldwide, Sallis et al.[22] reported that the most activity-friendly settings completed up to 90-min more walking per week than the least-friendly settings. Increased PA in the activity-friendly settings included high residential density, high density of public transport stops, and proximity to parks.

Recent calls for innovation in the way we use the physical environment of cities include the important notion of reclaiming the city space for the people. By harnessing the collective wisdom of planners and policymakers, plus health professionals and members of the wider community, there is a greater chance of encouraging, enabling and supporting HL on a scale to impact the major health concerns of the day, namely hypokinetic diseases and associated health disparities. It is important to consider the power of such an approach and the benefits for reducing physical inactivity, overweight and obesity, related NCDs and social and economic disadvantage.[74]

There is also considerable merit in exploring novel approaches to the use or refashioning of physical spaces in cities to increase engagement in PA. For example, there is the potential to make better use of public parks to promote HLM and develop HealthParks to support healthy eating and activity behaviors.[75,76] Similarly, better use could be made of schools and their facilities to promote PA through play and not limited to the provision of quality physical education programs.[77]

Findings of a recent qualitative review[78] reinforced the importance of cooperation between transportation planning, urban design, landscape architecture, road engineering, parks, recreation, education and public health in facilitating the creation of neighborhood environments supportive of PA. Of primary importance is representation and active involvement of individuals and groups from different sociodemographic backgrounds in the planning process. This latter point may also be relevant in the context of challenging peri-urban environments. For example, in the Australian context, adults living in peri-urban areas are sedentary, insufficiently active, and have poorer health outcomes than those living in major cities. Despite activity-supportive social and environmental characteristics in peri-urban settings, most participants in a recent Australian study[79] reported inactive lifestyles. Further enhancement of existing activity-supportive environments may be required to overcome barriers to activity and support improved neighborhood walkability and the usability of public transport.

A fine example of an approach to foster the promotion of physical activity and sport for all is the Active Well-being Initiative (AWI) (http://activewellbeing.org/).[80] The AWI advocates for more sustainable urban living and assists cities and organisations to improve the lives of community members through integrative PA, sport and well-being initiatives. Founded on the notion that new forms of governance are required for cities to achieve their activity goals, the AWI provides a tool-kit of evidence-based approaches to assist policy makers and community members to drive change. Supported by the International Olympic Committee (IOC), a primary objective is to develop over time, a network of Global Active Cities.

If the aspirations of the policy actions on PA detailed in the WHO Global Action Plan on Physical Activity[8] are heeded, we will see more active people for a healthier world and PA contribute significantly to the achievement of many of the Sustainable Development Goals.

Summary

Significant changes are needed to improve unhealthy environments, including built environments that help to recalibrate the current penchant for the consumption of unhealthy food and concomitant low levels of PA[4] in favor of the promotion of HLM.[2] Changes to get more people moving must include the development and implementation of multi-level, multi-sectoral awareness and prevention initiatives for obesity and NCDs. A systems-wide approach would see greater attention applied in areas including urban planning, transport, education, food systems and taking action to a higher level to impact the global pandemic of physical inactivity.[8,32]

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