Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study

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Summary

Background **Physical inactivity is a global pandemic responsible for over 5 million deaths annually through its effects on multiple non-communicable diseases. We aimed to document how objectively measured attributes of the urban environment are related to objectively measured physical activity, in an international sample of adults.**

Methods **We based our analyses on the International Physical activity and Environment Network (IPEN) adult study, which was a coordinated, international, cross-sectional study. Participants were sampled from neighbourhoods with varied levels of walkability and socioeconomic status. The present analyses of data from the IPEN adult study included 6822 adults aged 18–66 years from 14 cities in ten countries on five continents. Indicators of walkability, public transport access, and park access were assessed in 1·0 km and 0·5 km street network buffers around each participant's residential address with geographic information systems. Mean daily minutes of moderate-to-vigorous-intensity physical activity were measured with 4–7 days of accelerometer monitoring. Associations between environmental attributes and physical activity were estimated using generalised additive mixed models with gamma variance and logarithmic link functions.**

Results **Four of six environmental attributes were significantly, positively, and linearly related to physical activity in the single variable models: net residential density (exp[b] 1·006 [95% CI 1·003–1·009]; p=0·001), intersection density (1·069 [1·011–1·130]; p=0·019), public transport density (1·037 [1·018–1·056]; p=0·0007), and number of parks (1·146 [1·033–1·272]; p=0·010). Mixed land use and distance to nearest public transport point were not related to physical activity. The difference in physical activity between participants living in the most and least activity-friendly neighbourhoods ranged from 68 min/week to 89 min/week, which represents 45–59% of the 150 min/week recommended by guidelines.**

Interpretation **Design of urban environments has the potential to contribute substantially to physical activity. Similarity of findings across cities suggests the promise of engaging urban planning, transportation, and parks sectors in efforts to reduce the health burden of the global physical inactivity pandemic.**

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Introduction

Physical inactivity is a global pandemic, responsible for more than 5 million deaths per year and is one of the UN's primary targets to reduce non-communicable diseases.[1–3] Improvements to urban environments to facilitate physical activity for transportation and recreation is a recommended strategy.[4,5]

People who live in walkable neighbourhoods that are densely populated, have interconnected streets, and are close to shops, services, restaurants, public transport, and parks, tend to be more physically active than residents of less walkable areas.[6,7] Studies of built environments and physical activity have been criticised for being done in only a few countries,[6,8,9] not capturing all types of urban environment, and relying on self-reported environmental measures. International studies are needed to represent the full range of environmental variability. If findings are generally applicable across countries, then built environment interventions are likely to be viewed as relevant to non-communicable disease policies internationally.

The purpose of this 14 city and ten country study was to document the strength, shape, and generalisability of associations between neighbourhood environment attributes and total moderate to vigorous intensity physical activity (MVPA). Objective measures of built environments and physical activity enhance precision and credibility of the findings.

Methods

Study design and neighbourhood selection

The International Physical Activity and Environment Network (IPEN) adult study was a multicountry cross-sectional epidemiological study with the same design and similar methods, described in detail elsewhere.[10] The study included participants from 17 cities in 12 countries: Australia (Adelaide), Belgium (Ghent), Brazil (Curitiba), Colombia (Bogota), Czech Republic (Olomouc and

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Research in context

Evidence before this study

Evidence is growing that the design of urban environments has a role in the pandemic of physical inactivity, which is contributing to several non-communicable diseases. Numerous reviews have reported evidence that adults tend to be more physically active when they live in higher density, mixed-use neighbourhoods with destinations such as shops and parks within walking distance. However, findings have been inconsistent, perhaps due in part to assessments of only individual geographical sites with little environmental variability, infrequent use of standardised measures, and over-reliance on self-reported measures. Improvements in the evidence about built environments and physical activity are important because environments are constantly changing in ways that could have positive or negative effects on whole populations over many years.

Added value of this study

This analysis of data from a coordinated international study was designed to improve the quality of evidence by assessing a broad range of built environments across 14 cities in ten middle-income and high-income countries on five continents. The quality of measures was enhanced by using comparable objective measures of built environments (geographic information systems) and physical activity (electronic accelerometers that recorded motion every minute). Four of six environmental attributes were significantly, positively, independently, and linearly related to physical activity in the single variable models: residential density, intersection density, number of public transport stops, and number of parks within walking distance. The study provided novel information about the important role of access to public transport. In models adjusting for all the significant built environment variables, adults who lived in the most activity-friendly neighbourhoods did 68–89 min more of physical activity per week than those in the least activity-friendly neighbourhoods. This difference is larger than reported in most other studies. The relation of built environments to physical activity was generally similar across diverse cities, suggesting changing built environments is a solution that could be applied internationally.

Implications of all the available evidence

This study adds strength to previous calls for policy changes in the urban planning, transport, and parks and recreation sectors. Communities with high residential density also tend to have connected streets, shops, and services within walking distance. Access to public transport encourages physical activity because people walk to and from buses and trains. Public parks provide places for recreational physical activity. These activity-friendly characteristics can be deemed to be design principles that apply across countries. Because the associations were linear, every environmental improvement can be expected to contribute to increased physical activity, irrespective of whether the residents of the city are starting at a low or high level. The large differences in physical activity between participants living in the most and least activity-friendly neighbourhoods provide strong justification for public health agencies to work with other agencies to create healthier cities. Making cities more activity-friendly than at present could be a partial but substantial long-term solution to international pandemics of physical inactivity and non-communicable diseases.

Hradec Kralove), Denmark (Aarhus), China (Hong Kong), Mexico (Cuernavaca), New Zealand (North Shore, Waitakere, Wellington, and Christchurch), Spain (Pamplona), the UK (Stoke-on-Trent), and the USA (Seattle, WA; and Washington, DC and Baltimore, MD). The IPEN adult study was designed to maximise variation in neighbourhood walkability and socioeconomic status (SES) by identifying similar numbers of neighbourhoods stratified as having higher walkability and higher SES,[11] higher walkability and lower SES, lower walkability and higher SES, and lower walkability and lower SES. Neighbourhood walkability index scores were created for small geographical areas in each city (termed administrative units, equivalent to US Census block groups) with geographic information systems (GIS),[11] with some differences by country.[10] Net residential density, intersection density, and mixed land use variables were standardised, and the mean of the three z scores was computed as the index.[11] The SES indicator was usually area-level income, but sometimes it was education or a government-created composite.[10] Indicators were chosen based on the data available. Neighbourhoods that met the criteria for the four stratification groups were selected and participants were recruited from those neighbourhoods.

Participant recruitment

Households in selected neighbourhoods were identified with databases from commercial and government sources with various methods used to obtain representative samples in each neighbourhood, including recruitment by mail or telephone and personal visits.[10] In each selected household an adult was invited to complete a survey and wear an accelerometer to objectively measure physical activity. Study dates ranged from 2002 to 2011 across countries, with each country typically recruiting over a full year. Each country obtained ethics approval from their local institutional review boards and all participants provided written informed consent.

Participants

The IPEN adult study included 14 222 adults aged 18–66 years. The present study included 10 008 participants also aged 18–66 years from 14 of the 17 cities from