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【Review Article】

Increasing Global Research Capacity in Physical Activity for Children and Youth

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ABSTRACT Physical activity is associated with improved health status in children and youth. However, a large proportion of the world's children are currently not physically active, and children in countries undergoing epidemiological transition may be vulnerable to decreasing physical activity levels. Thus, a research priority is the development of effective interventions that can be adapted and deployed in low, middle and high income countries. Given that most current research evidence is from studies conducted in high income countries, further work is required to understand the determinants and correlates of physical activity among children across low and middle income countries. This will require investments in large multi-national studies and in developing research infrastructure and capacity in regions of the world that have not yet conducted physical activity research.

Key words: pediatric, epidemiologic transition, research capacity, international

Introduction

Considerable research has highlighted the importance of physical activity for achieving optimal health in childhood.[1)] However, a large proportion of the world's pediatric population is not physically active. For example, across 105 countries, approximately 80% of 13-15 year olds are not meeting the recommendation of 60 min/day of moderate-to-vigorous physical activity.[2)] In order to develop effective physical activity interventions for children living in different settings, a better understanding of the correlates and determinants of physical activity is required. To date, a large majority of physical activity research has been conducted in middle and upper-income countries, which limits the generalizability to other countries and regions.[3)] Thus, the degree to which an intervention that was developed in one country or region can be implemented or adapted for implementation in another country or region is not well understood. Further research is required to better understand the correlates of physical activity among children from low and middle income countries around the world. This will require an investment in large multi-country studies and in developing research capacity in low and middle income countries that typically have not yet participated in physical activity research to a large extent, particularly in regions that are undergoing rapid economic and demographic changes.

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The Physical Activity Transition

The "physical activity transition" is a model that describes long terms shifts in physical activity patterns and levels as a consequence of economic and demographic changes in a country or region.[4)] The physical activity transition builds upon concepts described in models of epidemiological[5,6)] and nutritional transition.[7)]

The epidemiological transition is a model that explains long-term shifts in population morbidity and mortality rates that are tied to economic and demographic changes.[5,6)] The model is described in terms of four stages or ages: 1) pestilence and famine, 2) receding pandemics, 3) degenerative and man-made

diseases, and 4) delayed degenerative diseases. The age of pestilence and famine is associated with high mortality rates and low life expectancy, and is characterized by infectious disease epidemics and famines. The age of receding pandemics is characterized by increases in life expectancy, largely due to lower mortality rates at young ages. These changes are often brought about by targeting the spread of infectious disease through improvements in sanitation and by stabilizing the food supply. The age of degenerative and man-made diseases is associated with increases in life expectancy as the mortality burden from cardiovascular disease and cancer shifts to older ages. The final stage of epidemiological transition, the age of delayed degenerative diseases, sees further increases in life expectancy achieved largely by improvements in health at older ages, mainly through improved prevention and the treatment of chronic diseases.

The theory of nutritional transition builds upon the demographic and economic shifts associated with the epidemiological transition and seeks to explain how changes related to lifestyle, particularly diet, have occurred in parallel with the increasing prevalence of obesity and chronic disease.[7-9] The nutritional transition is characterized by a shift away from traditional diets (based on indigenous staple grains, local legumes, fruits and vegetables, and limited foods of animal origin) in favor of a more "industrialized" diet (comprised of more animal-based food products and processed food high in saturated fats and sugar). At the global level, these changes have been accompanied by a rising prevalence of obesity and are contributing to shifting morbidity and mortality profiles around the world.[10,11]

The physical activity transition is aligned with the demographic and economic shifts that drive the overall epidemiological transition; however, it posits that changes in physical activity patterns and levels that accompany economic and demographic shifts could be contributing to the observed changes in obesity, and in morbidity and mortality rates.[4] Given that physical activity is negatively related to premature mortality,[12] the adoption of a lifestyle characterized by lower levels of physical activity would be expected to attenuate the expected gains in life expectancy associated with the epidemiological transition.[13]

Two recent studies provide evidence of elements of the on-going physical activity transition in Africa. Using a nationally representative sample of 3323 adults from urban and rural regions of Mozambique, Padrao et al.[14] demonstrated that vigorous physical activity was less common among urban and better educated adults, indicated that shifts in physical activity levels were occurring when moving from a rural to an urban lifestyle. Similarly, Onywera et al.[15] showed using pedometers that children from urban Kenya took significantly fewer steps per day than children living in rural Kenya. Further, Kenyan children from urban areas watched more television than children from rural areas.[15] These studies highlight urban-rural differences in physical activity in individual countries undergoing economic and demographic transitions, and provide insights into potential longer term trends that may occur with further demographic shifts in the population.

2014 Global Summit on the Physical Activity of Children

The Global Summit on the Physical Activity of Children was held in Toronto, Canada in May, 2014. This event was attended by over 750 delegates from 32 countries across 5 continents. This summit brought together leading researchers and experts from around the world to share evidence and best practices to drive coordinated action and initiatives to stem the growing global childhood physical inactivity crisis. A highlight of the summit was the release of 15 report cards on the

Table 1 Indicators Used in 15 National Report Cards on Physical Activity in Children and Youth.

1	Overall Physical Activity
2	Organized Sport Participation
3	Active Play
4	Active Transportation
5	Sedentary Behaviour
6	Family and Peers
7	School
8	Community and the Built Environment
9	Government Strategies and Investments

physical activity of children and youth. The countries that issued report cards included Australia, Canada, Colombia, England, Finland, Ghana, Ireland, Kenya, Mexico, Mozambique, New Zealand, Nigeria, Scotland, South Africa, and the United States. These report cards used a common rubric and grading system to provide grades across several indicators of physical activity in children and youth that contributed to a global "matrix" of grades.[16] The nine common indicators that were graded across the 15 countries are provided in Table 1. The list of indicators was developed to capture information about levels of physical activity and sedentary behaviour, as well as facilitators and barriers to physical activity.

The grades for overall physical activity ranged from "D-" in Australia, Canada, Ireland and the United States to "B" in Mozambique and New Zealand. The traditional letter grades in the global matrix[16] were converted to a numerical score (F = 1, D = 2, C = 3, B = 4, A = 5) and data on the Gross Domestic Product (DGP; per capita) of each country were obtained from the World Bank[17] as an indicator of country-level socio-economic development. Figure 1A presents the relationship between the country-level GDP and overall physical activity grades across the 15 countries (r = - 0.54), and Figure 1B presents the association between GDP and the grades for "community and built environment" (r = 0.92). Finally, the association between the overall physical activity grade and the community and built environment grade is presented in Figure 2 (r = - 0.69).

Taken together, the results from the global matrix analysis suggest that countries with higher socio-economic status have better infrastructure developed for physical activity, but at the same time they have lower grades for overall physical activity. The inverse relationship between grades for overall physical activity and the community and built environment indicate that simply building better infrastructure for physical activity does not necessarily translate into higher physical activity levels. Indeed, the results suggest that in a global context, built environment interventions may not prove fruitful at increasing

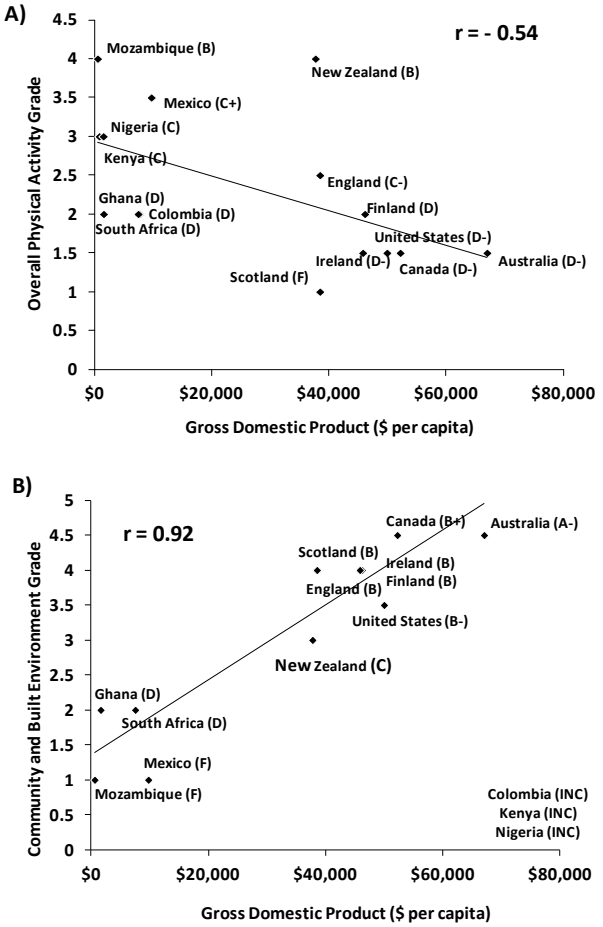

Figure 1 Associations between Gross Domestic Product (GDP) and grades for indicators of A) overall physical activity levels, and B) community and built environment.

Grades were obtained from the global matrix of report cards.[16] INC = incomplete grade.

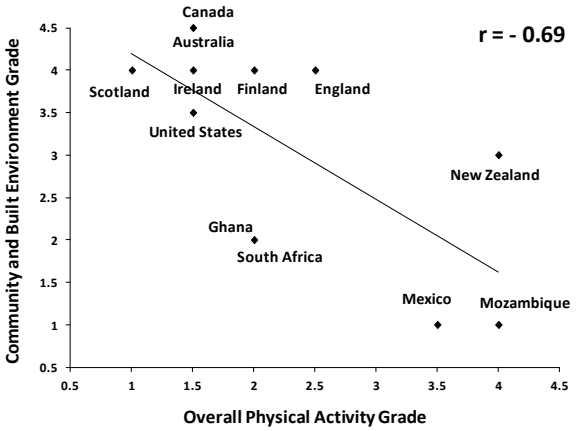

Figure 2 Association between grades for overall physical activity levels and community and built environment.

Grades were obtained from the global matrix of report cards.[16] Note that Colombia, Kenya and Nigeria are not shown due to incomplete grades for community and the built environment.

physical activity levels in children and youth. In fact, the absence of "official" physical activity infrastructure may actually promote physical activity through active transportation, active play, and other means.

The global matrix of physical activity report card grades allows for an examination of trends across countries at different stages of epidemiologic transition, and provides insights into possible intervention options for physical activity in different cultural and environmental contexts. This exercise also highlights the complexity of the problem of physical inactivity in children and youth, and the necessity to understand the context-specific role of physical activity in the overall spectrum of movement performed by children and youth throughout the day.

The International Study of Childhood Obesity, Lifestyle and the Environment

The International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE) is a cross-sectional, multi-national study conducted at sites in 12 countries from all major world regions, including Australia, Brazil, Canada, China, Colombia, Finland, India, Kenya, Portugal, South Africa, United Kingdom and United States.[18] These countries represent a range of economic development (low to high income) and human development index (0.509 (low) in Kenya to 0.929 (high) in Australia). The primary aim of ISCOLE is to determine the relationships between lifestyle behaviours and obesity in a multi-national study of children, and to investigate the influence of higher-order characteristics such as behavioural settings, and the physical, social and policy environments, on the observed relationships within and between countries.

At all sites, participants were recruited via schools, and data were collected at the individual level, family and neighbourhood level, and the school environment level.[18] The standardization of the ISCOLE protocol across sites, a rigorous system of training and certification of study personnel, the use of a web-based data entry system, and centralized data management and analysis at the coordinating center ensured the quality of data collected. A unique feature of ISCOLE is the collection of 24-hour accelerometry data over 7 days on all participants, which allows for the objective quantification of sedentary behaviour, different intensities of physical activity (light, moderate, vigorous), and sleep duration.

ISCOLE represents a multi-national collaboration among all world regions, and represents a global effort to increase research understanding, capacity and infrastructure in childhood physical activity and obesity. To date, more than 240 people have worked on ISCOLE in some capacity, including junior and senior scientists, post-doctoral fellows, students and staff. Each study site had a local principal investigator who collaborated on the development of the study protocol, and who ensured that the standardized protocol was implemented correctly with their local research team who conducted the research. It is anticipated that ISCOLE will provide a robust examination of the correlates of body weight and obesity in children, focusing on both sides of the energy balance equation. The results will also provide important new information that will inform the development of lifestyle, environmental, and policy interventions to address childhood obesity that can be culturally adapted for implementation around the world.

Conclusions

There is a need to develop sustainable interventions for the promotion of physical activity in children and youth. These interventions need to be culturally adapted for implementation in different countries and settings, which will require a better understanding of the correlates and determinant of physical activity across low, middle and high income countries. Initiatives such as the global matrix of report cards for physical activity in children and youth[16] and studies like ISCOLE[18] are providing a framework to increase global research capacity in physical activity research in children and youth.

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