Global prevalence of physical activity for children and adolescents; inconsistencies, research gaps and recommendations

Salomé Aubert, Javier Brazo-Sayavera, Silvia A. Gonzalez, Ian Janssen, Taru Manyanga, Adewale L. Oyeyemi, Patrick Picard, Lauren B. Sherar, Evan Turner, and Mark S. Tremblay

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CHEO RESEARCH INSTITUTE
INSTITUT DE RECHERCHE
Healthy Active Living and Obesity Research Group
Recherche sur les saines habitudes de vie et l'obésité

Introduction

Benefits of physical activity for the health and well-being of individuals of all ages are now widely accepted in the scientific community.

These positive effects are seen in a multitude of health markers: blood pressure, lipid profile, glucose control, cardiometabolic disease risk score, inflammatory markers and cognition[1].

Physical activity recommendations

Early years (0-4 years)

At least 180 minutes/day of total physical activity (WHO).[2]

Children and adolescents (5-17 years)

At least 60 minutes/day of moderate to vigorous physical activity (WHO).[3]

World Health Organization

Physical activity recommendations

Early years (0-4 years)

At least 180 minutes/day of total physical activity (WHO).[2]

Children and adolescents (5-17 years)

At least 60 minutes/day of moderate to vigorous physical activity (WHO).[3]

World Health Organization

Physical inactivity

Definition

An insufficient physical activity level to meet present physical activity recommendations.[4]

Children and youth physical inactivity is associated with adverse physical, mental, social, and cognitive health outcomes, lower physical fitness, and lower physical activity levels in later life.[5]

WHO Global Action plan

In 2018, the World Health Organization released a *Global Plan on Physical Activity 2018-2030* with a goal to **reduce the global prevalence of physical inactivity by 15%** among adults and adolescents.[6]

- One of the strategic actions identified is **to enhance data systems and capabilities** at national levels to support regular population surveillance of physical activity.

Objectives

To review, compare, and discuss methodological inconsistencies and differences in physical activity prevalence estimates from the available intercontinental physical activity surveillance initiatives.

To identify methodological limitations, surveillance and research gaps, and propose recommendations for improvement.

Methods

1. Narrative review: identification by experts and non-systematic literature searches the intercontinental physical activity initiatives meeting with the following criteria:

- Collected or compiled data during or after 2000;
- Included at least multiple countries from at least two continents;
- Focused on/included early years (0-4 years-old) and/or children and adolescents (5-17 years-old);
- Early years, children and adolescents of all ability/need level and health status can be included;
- Assessed/estimated physical activity using self/proxy report and/or device measures;
- Most recent dataset presenting estimated prevalence of physical activity at the national levels are available publicly/open access.

Methods

2. Extraction of national physical activity prevalence

- Available prevalence estimates of children and/or adolescents meeting the physical activity guidelines by country

- 2016 physical inactivity estimates were extracted from Guthold et al. (2019), then converted into prevalence of physical activity

- Physical activity prevalence regional averages were calculated using a simple average calculation, with an exception for the data from Guthold et al. (2019), where the available physical activity pooled regional averages were directly extracted.

Methods

3. Extract specific information related to the methods for each included physical activity surveillance initiative (e.g., sample size, age or grade of participants, year(s) of data collection).

- For questionnaire based initiatives: definition for adherence to physical activity guidelines, specific items assessing physical activity, information concerning the languages available for these questionnaires and their validity, and the method used for their translation and cultural adaptation.

- For device-based initiatives: definition for adherence to physical activity guidelines, type of device, minimum wear time (daily wear time needed for a valid day and number of valid days needed), and cut-off points

Methods

4. Quality assessment of the included initiatives

- Adequate description of the sampling frame and recruitment methods;
- Adequate description of the sample's key characteristics;
- Adequate description of methods of data collection for physical activity;
- Adequate measurement of physical activity (validity, reliability);
- Adequate harmonization and validity of cross-country comparison
- Appropriate sex-specific analysis;
- Inclusion of kids with special needs and associated analysis
- Nationally representative sample;
- Appropriate statistics;
- Availability of the information in a/several central document(s);

➢ A score of 1 is given if criteria is met and a score of 0 is given if the criteria is not met.

Methods

5. Comparisons

- Compare the methods, and results across the included intercontinental physical activity datasets.

- Map physical activity prevalence against methods/ validity/ translation differences

Results

Intercontinental physical activity surveillance initiatives meeting the selection criteria:

- International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)[7]
- Global Matrix 3.0 on physical activity for children and youth[8]
- Global School-based Student Health Survey (GSHS)[9] official reports
- Health Behavior in School-Aged Children (HBSC) Survey[10]
- International Children's Accelerometry Database (ICAD) 1.0[11]
- Guthold et al. (2019)[12]
- Marques et al. (2020)[13]
- Xu et al. (2020)[14]

Results

Table 1: Description of the intercontinental initiatives included

Name	Location	Target population	Frequency	Description
Global Matrix on physical activity for children and youth 3.0	In the most recent cycle, 49 countries from 6 continents	5-17-year-old children and adolescents	The Global Matrix initiative occurred every 2 years since 2014. The Global Matrix 4.0 launched is planned to take place in 2022.	The Global Matrix initiative, led by the AHKGA, brings together working groups from countries across the world who follow harmonized procedures to develop their Report Cards on PA for children and youth by grading common indicators using the best available data.
Official international report of the 2017/2018 Health Behaviour in School-Aged Children (HBSC) Survey	In the most recent cycle, 48 countries and regions across Europe and North America[3]	11-, 13-, and 15-year-old school students	The HBSC survey occurred every four years since 1982	The HBSC is a school-based survey, where a standardized self-reported questionnaire is administered to a nationally representative sample of 11-, 13- and 15-year-olds within the classroom setting. One of the purposes of the HBSC is to: determine the proportion of adolescents who meet the current recommendation for daily PA, by age and gender; determine the frequency of leisure-time VPA; follow and describe trends in adolescent PA; identify correlates and determinants of MVPA and VPA; investigate health outcomes associated with PA and physical inactivity; and explore the clustering of energy balance-related behaviours (PA, screen-time behaviours, sleep and dietary patterns).
International Children's Accelerometry Database (ICAD) 1.0	Australia , Brazil, Belgium, Denmark, UK, Estonia, Norway, Portugal, Switzerland, United States	3-18-year-old children and adolescents	Data from cross sectional and longitudinal studies (1998-2009) were pooled, reduced and harmonized between 2008-2010.	The ICAD was established to pool data on device measured PA from studies using the same type of accelerometer (Actigraph) worn at the waist. Investigators from 20 studies with a sample size >400 agreed to share raw accelerometry files, and standardized data reduction and statistical analysis were performed to create comparable outcome variables across studies.

Results

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Name	Location	Target population	Frequency	Description
International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)	13 countries from five major geographic regions of the world (Europe, Africa, the Americas, South-East Asia, and the Western Pacific)	9-11-year-old children	ISCOLE is a cross sectional study where data were collected in each study site between 2011 and 2013, with the exception of Mozambique were data were collected in 2018.	ISCOLE aimed to determine the relationships between lifestyle behaviors and obesity, and to study the influence of additional characteristics such as behavioral settings, physical, social and policy environments, on the observed relationships.
Marques et al. (2020)	105 countries across eight regions: Central and Eastern Europe, Central Asia/Middle East and North Africa, East and Southeast Asia, High-income western countries, Oceania, Sub-Sharan Africa, South Asia and Latin America/ Caribbean.[8]	11-17-years-old adolescents	Single study	The aim of this paper was to present worldwide, national, and regional prevalence of PA participation according to its frequency in adolescents aged 11-17 years. The study used cross-sectional survey data from multiple different surveys (HBSC, GSHS, YRBS, PENSE, ENSANUT) that collected self-reported PA prevalence among adolescents.
Guthold et al. (2019)	194 WHO member states, 146 countries	11-17-years-old adolescents	This first round was performed in 2018 and updates over the next 15 years are expected.	The WHO GHO/authors compiled surveys that collected PA data among adolescents across the world and performed complex analyses to obtain an estimation of the prevalence of physical inactivity by sex and by country in 2001 and in 2016.

Results

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Name	Location	Target population	Frequency	Description
GSHS, reported in Official WHO Fact Sheets or official WHO GSHS country reports	WHO Fact sheets are available for 87 countries: Central and eastern Europe (1); Central Asia, Middle East, and North Africa (17); East and Southeast Asia (14); Latin America and Caribbean (32); Oceania (13); South Asia (6); Sub-Saharan Africa (18)[10]	13–18-year-old students	No established frequency, participating countries are encouraged to collect data as often as resources allow.	The GSHS is a school-based survey using a self-administered questionnaire to evaluate young people's health behaviour and protective factors related to the leading causes of morbidity and mortality among children and adults worldwide.[11] It was developed by the WHO and CDC in collaboration with UNICEF, UNESCO, and UNAIDS.[12]
Xu et al. 2020	54 low to medium income countries from 5 regions: Africa, Americas, Eastern Mediterranean, Southeast Asia and Western Pacific[15]	12-15 years-old adolescents[15]	No established frequency; single study	The aim of this study was to describe and compare the separate and combined prevalence of physical activity, active transportation, physical education, and sedentary behavior among adolescents aged 12-15 in low- and middle-income countries using GSHS data.[15]

Table 2: Extracted physical activity prevalence for 13 countries across 8 initiatives

Country	Guthold et al. (2019) 2016 estimated prevalence of physical activity activity of 11-17 years-olds (%)	Global Matrix 3.0 estimated prevalence of physical activity of 5-17 years-old (%)	2018 HBSC Estimated prevalence of physical activity (%)			WHO country Fact Sheets estimated prevalence of physical activity of 13-15/13-17 years-old (%)	ISCOLE 2012 estimated prevalence of physical activity of 9-11 years-old (%)	ICAD estimated prevalence of physical activity of 9-10 years old (%)		Marques et al estimated prevalence of physical activity physical activity among 11-17 year-olds (%)	Xu et al. (2020) estimated prevalence of physical activity 0f 12-15 years-old (%)
			Age	Boys	Girls			Boys	Girls		
Australia	11	20%–26%					55.4	14	6		
Brazil	16.4	27%–33%					43.9	7	2	12	
Canada	23.7	34%–39%	11	37	30		42.6			25	
			13	32	20						
			15	28	14						
China	15.7	<20%				12.2	15.1				
Egypt	12.5					16.5				14.5	12.6
Estonia	15.9	20%–26%	11	20	18			26	18	16.4	
			13	16	12						
			15	16	11						
Finland	24.6	27%–33%	11	52	38		61.4			27.9	
			13	33	24						
			15	22	12						
Ghana	12.5	47%–53%								13	
India	26.1	27%–33%				30.2	25				
Lebanon	17.9	27%–33%				13.2				24.6	23.4
Slovenia	20	80%–86%	11	31	22					18.5	
			13	28	17						
			15	24	11						
USA	28	20%–26%					26.5	9	2	32.3	
Zimbabwe	13.4	54%–59%									

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Results

Table 3: Methods of the intercontinental initiatives included

Name	Physical activity/ inactivity definition used	Physical activity assessment and analysis methods	Representativeness of the data
Global Matrix on physical activity for children and youth 3.0	"*At least 60 mins/day of MVPA on average*", or "*At least 60 mins/day of MVPA on 4 or more days/week*".	Participating countries gather the best available data from local, national or international studies, national surveys, official reports and normative documents. Letter grades were then assigned to the PA indicator using a grading rubric to quantify PA levels (every letter grade corresponds to a specific 5-6% prevalence interval). Participating countries reported PA data that were collected using a variety of methods (self-report questionnaire, device measures) were used across levels.	Best available data per country: locally, nationally, or not representative.
Official international report of the 2017/2018 Health Behaviour in School-Aged Children (HBSC) Survey	"*At least 60 minutes of MVPA daily*"	The 2017/2018 HBSC included two mandatory items in all participating countries/ regions to evaluate PA: "*Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Please add up all the time you spent in physical activity each day*." With eight possible answers (from "*0 days*" to "*7 days*"); and "*Outside school hours: how often do you usually exercise in your free time so much that you get out of breath or sweat?"* with six possible answers: *"Every day/ 4 to 6 times a week/ 2 to 3 times a week/ Once a week/ Once a month/ Less than once a month/ Never*". In the official 2017/2018 HBSC international report, prevalence of reporting at least 60 minutes of MVPA daily were presented according to age, gender and family affluence.	A nationally representative sample was drawn in the majority of countries/regions; where a national sample was not possible, a regional sample was drawn (the minimum size of the total population for regional samples should be 1 million). A census among the relevant age groups was taken in countries/regions where the population is sufficiently small, with all classes of young people in the relevant age groups being surveyed.
International Children's Accelerometry Database (ICAD) 1.0	"*Achieving ≥60 min of MVPA each measurement day*".	PA was assessed with *Actigraph* accelerometers waist-worn for at least three days. Data files were reintegrated to a 60s epoch and processed using *KineSoft v3.3.20*. MVPA was defined as >2296 cpm. Analysis were restricted to 9-10- and 12-13-year-olds participants.	All seven countries had MVPA data for ages 9-10 while only 4 (Brazil, USA, England and Australia) had MVPA data for ages 12-13.[6] National/regional representativeness of samples was not a requirement for inclusion.

Results

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Name	Physical activity/ inactivity definition used	Physical activity assessment and analysis methods	Representativeness of the data
International Study of Childhood Obesity, Lifestyle and the Environment (ISCOLE)	"*>60 mins/day of MVPA*"	PA was assessed with *Actigraph GT3X+* accelerometers waist worn for at least seven days, including two weekend days. Data were collected at a sampling rate of 80 Hz, downloaded in 1-s epochs with the low frequency extension filter using the *ActiLife software version 5.6* or higher (ActiGraph LLC, Pensacola, FL, U.S.A). Data were later reintegrated to 15-s and 60-s epochs for the different analyses. MVPA was defined as >574 counts per 15s.[7]	The within-site samples were not intended to be nationally representative. The sampling was done in schools, where the emphasis was put on stratification by socioeconomic status in order to maximize variability within sites.
Marques et al. (2020)	Physically active for a total of at least 60 minutes per day over the past 7 days.	According to the authors, the same unique question was used across the included surveys to assess the adolescents' PA levels: "*During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?*". Answers were given on an 8-point scale (0 = none to 7 = daily). The prevalence of PA (replying "7") was calculated stratified by sex, age (11-12, 13-15 and 16-17), eight world regions, Human Development Index, and by country.	Dataset included were collected from officially representative national sample sizes of at least 100 adolescents per country.
Guthold et al. (2019)	"*Doing less than 60 minutes of physical activity on less than seven days per week*"	Data were obtained from multi-country surveys (GSHS, HBSC, YRBS, NaSSDA, NNPAS, PENSE, ENSIN, ENSANUT) and national surveys using self-reported questionnaire. Two key adjustments were applied to survey data using linear regression modelling techniques to improve comparability: a definition conversion (for surveys in which data were only reported for the definition of doing less than 60 minutes of physical activity on less than five days per week instead of seven days per week), and an adjustment for surveys that only included data from urban populations (where they estimated prevalence in rural area). Using trend data calculated from countries with at least two comparable surveys from different years between 2001 and 2016, prevalence of insufficient physical activity was estimated for each year between 2001 and 2016 for all 146 countries, with a multilevel mixed-effects linear regression model. This model included a random slope on year, a random intercept for each country, fixed effects for country urbanisation, and location within nine previously defined regions.	Data were acquired through random sampling with a sample size of at least 100 individuals and representative of a national or defined subnational population.

Results

Table 3: Methods of the intercontinental initiatives included

Name	Physical activity/ inactivity definition used	Physical activity assessment and analysis methods	Representativeness of the data
GSHS, reported in Official WHO Fact Sheets or official WHO GSHS country reports	"*Percentage of students who were physically active for a total of at least 60 minutes per day on five or more days during the past seven days*" or "*Percentage of students who were physically active for a total of at least 60 minutes per day on seven days during the past seven days*"	The Official GSHS questionnaire uses the following item to assess PA: "*During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? Add up all the time you spent in physical activity each day*." With eight possible answers (from "*0 days*" to "*7 days*") All data processing (scanning, cleaning, editing, and weighting) are conducted at CDC. Two workshops are provided to the Survey Coordinators from each participating country. One to build the capacity of Survey Coordinators to implement the survey in their country following common sampling and survey administration procedures that ensure the surveys are standardized and comparable across countries and that data are of the highest quality; and the second to build the capacity of Survey Coordinators to conduct data analysis and generate a country-specific report and fact sheet using *Epi-Info software* provided to them.[13]	The GSHS uses a standardized two-stage sampling design to obtain a representative sample of students in grades 9–12.[14]
Xu et al. 2020	"*Adolescents who were physically active for at least 1 hour per day were considered to engage in physical activity*".[15]	The official GSHS questionnaire uses the following question: "*During the past 7 days, on how many days were you physically active for a total of at least 60 mins per day?*". Estimations of PA prevalence values and 95% confidence intervals were presented for the 12-15 by country and by sex and age, calculated using the *SAS Surveymeans* procedure. Authors added weights, stratum, and a primary sampling unit to every student record in the GSHS data file to reflect the weighting process and the two-stage sampling design in their analysis.[15]	The GSHS uses a standardized two-stage sampling design to obtain a representative sample of students in grades 9–12.[14]

Discussion

Inconsistencies observed across the included physical activity surveillances initiatives

- Physical activity definition: most studies/initiatives used >60 minutes/day of MPVA but lots of other definitions are used (i.e. 60 minutes/day of physical activity on 5 or more days/week)
- Data collection and analysis methods varied significantly between initiatives
- Estimated physical activity prevalence of children and adolescent for the same country varies across included initiatives
- Cross-country comparisons differs across initiatives (i.e. countries with the highest and lowest prevalence of physical activity are not the same!)

Surveillance gaps

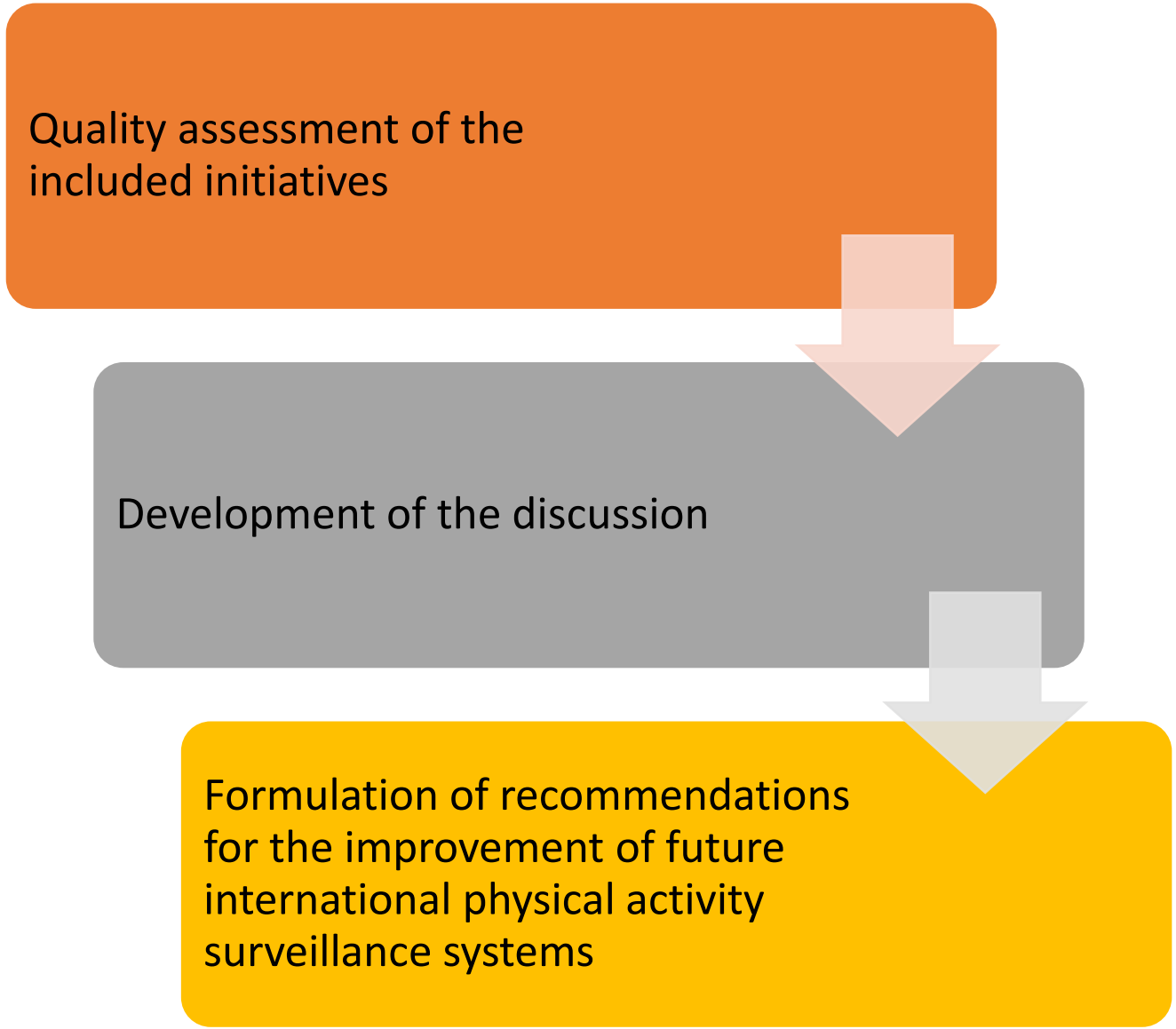
- Almost no data on early years (0-4-year-olds) and children below 10 are under represented compared to adolescents (11-17-year-olds)
- Almost no data available for children or youth with special needs
- Less data available in low-income countries and generally lower quality (i.e. smaller sample size, older data)
- Majority of the available international data was collected using self reported questionnaires vs device-based measurement

Strengths/Limitations

- Not a systematic review approach
  - Focus on open access/ public data
  - Limit overrepresentation of international European studies vs the rest of the world

- Co-authors = International panel of experts involved in several included initiatives: HBSC survey, the Global Matrix, ICAD, ISCOLE and other relevant initiatives with data not yet available (IPEN study, SUNRISE study)

Next steps before publication



Conclusions

- Insufficient physical activity levels observed across all continents and surveillance initiatives, consistent gender and age differences
  - Global physical inactivity crisis: urgent need for efficacious physical activity promotion policies and actions.

- Need for the development of a new harmonized and globally adaptable physical activity surveillance system
  - Essential step to identify priority actions for the battle against childhood physical inactivity.
  - Coordination of relevant international institutions and experts to address identified inconsistencies and surveillance gaps

Thanks for your attention!

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