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1 **Report Card Grades on the Physical Activity of Children and Youth Comparing 30 Very High**

2 **Human Development Index Countries**

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25 **Abstract**

26 **Background**

27 To better understand the childhood physical inactivity crisis, Report Cards on physical activity of children

28 and youth were prepared concurrently in 30 very high HDI countries. The aim of this article was to

29 present, describe, and compare the findings from these Report Cards.

30 **Methods**

31 The Report Cards were developed using a harmonized process for data gathering, assessing, and assigning

32 grades to ten common physical activity indicators. Descriptive statistics were calculated after converting

33 letter grades to interval variables, and correlational analyses between the ten common indicators were

34 performed using Spearman's rank correlation coefficients.

35 **Results**

36 A matrix of 300 grades was obtained with substantial variations within and between countries. Low

37 grades were observed for behavioral indicators, and higher grades were observed for sources of influence

38 indicators, indicating a disconnect between supports and desired behaviors.

39 **Conclusion**

40 This analysis summarizes the level and context of the physical activity of children and youth among very

41 high HDI countries, and provides additional evidence that the situation regarding physical activity in

42 children and youth is very concerning. Unless a major shift to a more active lifestyle happens soon, a high

43 rate of non-communicable diseases can be anticipated when this generation of children reaches adulthood.

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137   **Introduction**

138   A compelling body of empirical work shows moderate to high levels of physical activity to be associated

139   with a lower risk of cardiovascular disease and all-cause mortality among adults.[1] Conversely, physical

140   inactivity has been recognized by some as "the biggest public health problem of the 21st century".[2,3]

141   Among school-aged children and adolescents, meeting physical activity guidelines is associated with

142   positive physical, psychological, social, and cognitive health indicators[4,5] while physical inactivity,

143   defined as not meeting physical activity guidelines, is associated with adverse physical, mental, social and

144   cognitive health outcomes.[4–7]

145

146   The Human Development Index (HDI) is a composite index, ranging from zero to one, calculated using

147   education, life expectancy, and per capita income.[8] This index was created by the United Nations

148   Development Programme to rank countries on a scale of human development conceptualized in terms of

149   capabilities of humans within the countries to function.[9] To be classified as very high HDI, the score of a

150   country must be equal or superior to 0.80. Among children living in countries categorized as being very

151   high by the HDI, moderate-to-vigorous intensity physical activity (MVPA) was positively related to

152   markers of cardiovascular health[10–13] and self-reported health-related quality of life.[14] Physical inactivity

153   has been estimated to be responsible for at least 10% and 9% of all-cause mortality in North-American

154   and in European countries, respectively.[15] Furthermore, very high-income countries bear the largest

155   proportion of economic burden of physical inactivity worldwide (81% of health-care costs and 60% of

156   indirect costs).[16] However, the majority of children[17–21] and youth[19–25] do not meet the current

157   recommendations of 60 minutes of MVPA per day[26] in very high HDI European and North American

158   countries and regions. Similar findings were observed among children and/or adolescents from other very

159   high HDI countries or regions such as Australia,[27] Chile,[28] Chinese Taipei (Taiwan),[29] Hong Kong, [30]

160   Japan,[31] South Korea,[32] Qatar,[33] and United Arab Emirates.[33–35] Very high HDI countries share similar

161   characteristics in terms of education, life expectancy and income; however, differences also exist

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162 geographically, politically, culturally, religiously, and environmentally that may influence physical

163 activity behavior differently across the very high HDI countries. Cooper et al.[36] found that there was

164 substantial between-country variation in objectively measured MVPA in the International Children's

165 Accelerometry Database, even between apparently similar countries, and concluded that further research

166 is needed to explore environmental and sociocultural explanations for these differences.

167

168 To develop a better understanding of childhood physical activity and inactivity across countries, the first

169 Global Matrix (Global Matrix 1.0) of Report Card grades on physical activity was launched in 2014.[37]

170 Report Cards, based on the Canadian Report Card model,[38] were developed by research teams from 15

171 countries (including eight very high HDI countries) using a harmonized process for data gathering,

172 assessing, and assigning grades.[37] For each participating country, grades were assigned to nine common

173 physical activity indicators: Overall Physical Activity, Organized Sport Participation, Active Play, Active

174 Transportation, Sedentary Behaviors, Family and Peers, School, Community and the Built Environment,

175 and Government Strategies and Investments. Global Matrix 1.0 grades provided new information upon

176 which researchers, advocates, practitioners, and policy-makers could reflect and derive inspiration for

177 children's physical activity research projects and promotion activities around the world.[37]

178

179 Building on the Global Matrix 1.0, investigators from each participating country committed to repeat and

180 further develop the Global Matrix initiative along with teams of researchers from 23 new countries. The

181 Global Matrix 2.0, which was released in 2016 in Bangkok, presented a comprehensive summary of the

182 physical activity behaviors and sources of influence indicators from 38 countries (including 24 very high

183 HDI countries).[39] Findings suggested the presence of a complex variety of strengths and limitations across

184 the participating countries, with some universal patterns emerging when comparing countries by

185 continent, HDI, or income inequality. For example, a strong positive correlation was found between the

186   source of influence grades (combining the grades from Family and Peers, School, Community and the

187   Built Environment, and Government Strategies and Investments) and HDI.[39]

188

189   In 2017, the Active Healthy Kids Global Alliance[40] (AHKGA) called for more countries to participate in

190   the Global Matrix 3.0. Forty-nine countries registered and followed the harmonized steps to develop their

191   country's Report Card. Out of the 49 participating countries, 30 (61%)were very high HDI countries,

192   from five different continents: Asia (n = 6), Europe (n = 19), North America (n = 2), Oceania (n = 2) and

193   South America (n = 1). The aim of this article is to present, describe, and compare the Report Card grades

194   from the very high HDI countries and regions participating in the Global Matrix 3.0: Australia, Belgium

195   (Flanders), Canada, Chile, Chinese Taipei (Taiwan), Czech Republic, Denmark, England, Estonia,

196   Finland, France, Germany, Guernsey, Hong Kong, Japan, Jersey, Lithuania, Netherlands, New Zealand,

197   Poland, Portugal, Qatar, Scotland, Slovenia, South Korea, Spain, Sweden, United Arab Emirates, United

198   States, and Wales. Companion papers published in this issue of the *Journal of Physical Activity and*

199   *Health* present the collective results from the low and medium HDI countries, and the high HDI countries.

200

201   **Methods**

202   The AHKGA distributed an open call through established networks for interested countries and opened

203   registration for the Global Matrix 3.0 in April, 2017. As a result, 49 countries from five different

204   continents fully participated in the Global Matrix 3.0. Workgroups consisting of experts and stakeholders

205   were established in each country to gather the highest quality and most recently published and

206   unpublished evidence. The workgroups critically appraised the available evidence and reported on 10

207   common indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play,

208   Active Transportation, Sedentary Behaviors, Physical Fitness, Family and Peers, School, Community and

209   the Built Environment, and Government) for school-aged children and youth (~5-17 years-old). Through

9

210   a harmonized and transparent Report Card development process, each country's workgroup compiled the

211   available evidence from local, national or international studies, national surveys and official reports, and

212   then synthesized findings and reached consensus for the grading of each indicator. Full details of the

213   Report Card development process based on the Canadian Report Card model[38] have been previously

214   described and the detailed methods for the Global Matrix 3.0 are described in a companion paper

215   published in this issue of the *Journal of Physical Activity and Health*.[41]

216   For each of the 49 registered countries, up to three joint Report Card leaders were charged with forming a

217   multidisciplinary research workgroup (including physical activity experts, stakeholder groups, and

218   communication specialists) to manage the Report Card project, and to ensure the effective communication

219   between AHKGA and the Report Card team. The workgroups identified and finalized the list of indicators

220   to be graded (i.e., the ten common indicators and potential additional ones that would be included in their

221   national Report Card but not in the Global Matrix 3.0), and compiled potentially relevant datasets and

222   documents that would be used to inform the grades. Countries were advised to consider and synthesize

223   the best available evidence from approximately the past five years for each indicator. Common

224   benchmarks, presented in Table 1, and a common grading scheme, shown in Table 2, were provided by

225   the AHKGA to the 49 Report Card workgroups. Experts in each country evaluated the compiled evidence

226   and reached consensus on the grade assigned for each indicator. Draft country Report Card grades were

227   submitted along with their rationale and were audited by the members of the AHKGA Executive

228   Committee to ensure that the grades were consistent with the harmonized benchmarks and grading

229   scheme. The Report Card leaders were also asked to report details concerning the datasets used to inform

230   their overall physical activity grade (i.e., subjective or objective measures, representativeness, instrument

231   used, age range, and sample size).

232   For analysis purposes, the 49 participating countries and regions were divided into three categories using

233   the United Nations' HDI groupings (low or medium, high, and very high). The results and analyses

234   presented in this article are on the 30 very high HDI participating countries.

235   Descriptive statistics (average grade and standard deviation) were calculated after converting categorical

236   variables (letter grades) to interval variables (see corresponding numbers in Table 2), and the incomplete

237   grades (INC) converted into "No Grade" which was treated as a missing value. Averages were calculated

238   from the interval values and the floor (for a given value, the greatest integer less than or equal to the

239   average value) was converted back to a letter grade. Three scores were computed for analysis: 1) Overall

240   score, 2) Behavioral score (Overall Physical Activity, Organized Sport and Physical Activity

241   Participation, Active Play, Active Transportation, and Sedentary Behaviors), and 3) Sources of influence

242   score (Family and Peers, School, Community and the Built Environment, and Government). Scores for

243   each group of indicators were calculated by summing the relevant interval data. INC grades were

244   removed and the scores were re-weighted accordingly. Categorical variables (letter grades) were grouped

245   into one of four levels ("A-B", "C", "D-F", and "No grade") based on the overall score. These categories

246   were then used to rank countries by letter grade/score and category level in scatter plot data

247   visualizations. Correlational analyses between the ten common indicators were performed using

248   Spearman's rank correlation coefficients. Pairwise deletion was used to treat missing data (incomplete

249   grades) instead of other techniques (e.g., list-wise deletion) in order to minimize the number of cases

250   excluded from the analysis. All statistical analyses were performed using R version 3.4.1 (The R

251   Foundation for Statistical Computing, Vienna, Austria). Several packages were loaded to extend base R

252   including corrplot,[42] ggplot2,[43] UpSetR,[44] and VIM.[45] In addition, descriptive statistics of the qualitative

253   information regarding the measurement of overall physical activity were performed.

254

255   **Results**

256   The sociodemographic characteristics of the 30 very high HDI countries are presented in Table 3. The

257   HDI scores ranged from 0.840 for United Arab Emirates to 0.939 for Australia. Chile was the country

258   with the lowest Gross National Income per capita, the highest Gini Index (highest income inequality), and

259   the highest child poverty rate (0.225). Qatar had the highest Gross National Income per capita, the lowest

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260 relative public health expenditure and the highest Gender Inequality Index. Slovenia had the lowest Gini

261 Index (least income inequality) and the lowest percentage of urban population (49.8%). The life

262 expectancy at birth was above 80 years for most of the countries (23 countries, 77%), with a maximum of

263 84.2 years for Hong Kong. Lithuania had a notably lower life expectancy of 73.5 years compared to other

264 countries. The mean years of schooling ranged from 8.9 years in Portugal to 13.3 years in the United

265 Kingdom nations (England, Scotland, and Wales). Finally, population density ranged from 3.2

266 people/km^2 of land area for Australia, to 6987.2 people/km^2 of land area for Hong Kong. In summary,

267 despite all 30 countries being within the very high HDI category, countries varied substantially in other

268 characteristics.

269 The 30 country grades for the 10 core Report Card indicators (300 grades or INC in total) and the average

270 grades for each country are shown in Table 4, and the corresponding descriptive information are

271 presented in Table 5. In total, 233 letter grades and 67 INC grades were assigned (Table 4). The country

272 with the highest average grade was Slovenia with "B", and the countries with the lowest average grade

273 were Chile and the United States with "D". All 30 countries assigned a grade to Sedentary Behaviors, 29

274 countries (97%) to Overall Physical Activity, and 28 countries (93%) to Organized Sport and Physical

275 Activity and to Active Transportation. Active Play was the indicator with the largest number of INC

276 grades (n = 20), followed by Physical Fitness (n = 13), and Family and Peers (n = 13). The indicator with

277 the highest average grade was Community and the Built Environment with "B-", while the indicator with

278 the lowest average grade was Overall Physical Activity with "D-". An average grade of "D+" was

279 obtained for the behavioral indicators combined, "C+" for the source of influence indicators combined,

280 and "C-" was the overall average for the 233 grades. Qatar's Report Card workgroup decided not to

281 evaluate Active Transportation and considered it "not applicable (N/A)" because of unsafe road

282 conditions and the hot climate during most times of the year.[46] Correlation analyses showed that there

283 were no relationships between the Overall Physical Activity grade and any of the other nine core indicator

284 grade (results not shown). Frequency plots illustrating the distribution of the overall 233 grades as well as

285 the behavioral and the sources of influence indicators are presented in Figure 1A and Figure 1B,

286 respectively. A normal distribution of the letter grades is evident in both Figures 1A and 1B, with the

287 mode being "C" for the 233 letter grades overall, "D" for the behavioral indicators, and "B" for the

288 sources of influence indicators.

289 A plot for the overall score for each country estimated from the 10 indicators is presented in Figure 2, and

290 the behavioral and the source of influence scores in Figure 3 and Figure 4, respectively. For the overall

291 score, Slovenia ranked first while Chile ranked 30th (see more rankings in Figure 2). In terms of the

292 grading completion, the United Arab Emirates had only four graded indicators that were included in the

293 calculation of this score while four other countries (Slovenia, Finland, Czech Republic and Canada) had

294 all 10 indicators graded. For the behavioral score, Japan ranked first while Estonia ranked 30th (see more

295 rankings in Figure 3). The United Arab Emirates had only two out of five indicators, and Japan and Qatar

296 only had three graded indicators that were included in the calculation of the behavioral score. Similar to

297 the overall score, Slovenia also ranked first for the sources of influence score while Guernsey, with only

298 one out of four graded indicators available, ranked 30th (see more rankings in Figure 4).

299 Finally, the description of the data sources used to inform the Overall Physical Activity grade for each

300 country (except for Japan that had an INC) are presented in Supplemental File 1. In total, 87 surveys or

301 studies informed the grades of the very high HDI countries, representing a total sample size of 1,005,989

302 children and youth. A total of 21 surveys/studies used an objective measurement of physical activity

303 while 66 used a subjective method, mostly via self-administered questionnaires. Out of 21 surveys/studies

304 that measured physical activity objectively, 20 used accelerometry and one study used pedometry. A

305 minimum wear time for accelerometer ranged between 3 to 7 consecutive days, and nine different

306 accelerometer cut-points were applied for analysis across 20 surveys/studies with the most commonly

307 used cut-points (n = 8) from Evenson et al.[47] Regarding the subjective measurement of physical activity,

308 survey-specific questionnaires were used in a significant number of surveys (n = 35), followed by original

309 or adapted versions of the *Health Behaviour in School-Aged Children* questionnaire (n = 14), uniquely in

310   European countries), the *Global School-based Student Health Survey* questionnaire (n = 5), the *Youth*

311   *Risk Behavior Surveillance System* questionnaire (n = 4), the *International Physical Activity*

312   *Questionnaire* (n=3), and others (n=5).

313

Discussion

315   The objective of this paper was to present, describe, and compare the Report Card grades from the 30

316   very high HDI countries and nations participating in the Global Matrix 3.0. A wide range of grades was

317   observed for most indicators across countries. These 30 countries are geographically distributed across

318   Asia, Europe, North America, Oceania, and South America and have very different climatic, geographic,

319   demographic, and cultural characteristics. Despite these contextual differences, most of these countries

320   shared concerning low grades for Overall Physical Activity and Sedentary Behaviors. No country was

321   consistently leading nor falling behind the others across the 10 common indicators, however some

322   countries showed greater or less success than others. The characteristics of the most and the least

323   successful countries are discussed below, followed by a discussion of the findings for each indicator, and

324   an integrated discussion of the findings including the strengths and limitations of this study.

325

Most successful countries

327   Slovenia had sufficient data to inform the 10 indicators and obtained the best grades for Overall Physical

328   Activity ("A-"), Family and Peers ("B+"), and Government ("A"), as well as on average ("B"); and

329   shared the best grades for Sedentary Behaviors with Spain ("B+"), and for School ("A") with Finland and

330   Portugal. A notable feature of Slovenia is the importance of sport for the culture of this almost 30-year

331   old country as "Slovenes tend to view sports as an effective tool in fostering national identity among

332   citizens and making successful global identity claims".[48] Every April since 1987, a national school-based

333   surveillance system of physical fitness (named *Slofit*) takes place, targeting the majority of Slovenian

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334   school children and youth aged 6 to 19 years.[49] Negative trends in motor skills and physical fitness were

335   observed for over two decades in Slovenia, but since 2011, these trends has been reversed after the

336   implementation of a health-oriented physical activity intervention program, which offers children two

337   (optional) additional hours of physical activity per week.[50] The estimated proportion of Slovenian

338   children and youth meeting the recommended levels of daily physical activity is now high (over 80%),

339   and this encouraging outcome seems to be the result of the collective support for childhood physical

340   activity from the government, the educational system, and the parents themselves.[51]

341   The next two most successful countries were Denmark and Japan with an average grade of "B-". The

342   positive result for these two countries should be interpreted with caution as both had "INC" grades for

343   some indicators. Active Play, Physical Fitness, and Family and Peers for Denmark, and Overall Physical

344   Activity and Active Play for Japan were not graded due to the lack of data. Nonetheless, Denmark was the

345   country with the best grade for Organized Sport and Physical Activity ("A-"), and also obtained a grade

346   of "A-" for both School and Government indicators. Sport is an important part of the Danish culture, and

347   considered important not only for individual and population health, but also in relation to issues such as

348   social inclusion and community cohesion.[52] Despite Denmark performing rather well on the strategic and

349   political levels, low grades were attributed to Overall Physical Activity ("D-") and Sedentary Behaviors

350   ("D+"), indicating an implementation gap between the governmental and individual levels.[53]

351   Japan had the best grades for Active Transportation ("A-") and Physical Fitness ("A"), and had no grades

352   lower than "C-". In fact, Japan has a highly established "walking to school practice" that has been

353   implemented since the School Education Act enforcement order, enacted in 1953, stating that public

354   elementary schools should be sited within no more than 4 kilometers, and for public junior high schools

355   no more than 6 kilometers from the student's home. This policy is still successful today at promoting

356   active transportation among Japanese children and youth.[54] The Physical Fitness grade was assigned

357   based on the performance of Japanese children and youth on the 20-meter shuttle run test. On average,

358   Japanese children were in the 90th percentile,[55] based on age- and sex-specific international normative

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359   data.[56] The Organized Sport and Physical Activity participation (graded "B-") and the favorable School

360   environment (graded "B+") may explain this high level of physical fitness; however, this is speculative

361   and more research is necessary. It was observed that only a minority of time in physical education classes

362   was spent in MVPA (27.3%/45 min/class) in Japanese primary school students.[57]

363   *Least successful countries*

364   Chile and the United States were the two countries with the lowest average grade: "D". They were

365   followed by Guernsey, Jersey, Scotland, South Korea, United Arab Emirates, and Wales, who obtained an

366   average grade of "D+". Chile had the lowest grades for Active Transportation ("F"), Family and Peers

367   ("F"), and shared the lowest grades for Organized Sport and Physical Activity with Taiwan ("D-"), and

368   for Physical Fitness with Canada, Hong Kong and Jersey ("D"). In Chile's first Report Card (2016), all

369   indicators had low grades, and data from different surveys indicated that there were consistent disparities

370   across genders, socioeconomic status, and school types.[58] In 2018, Chile's grades remained low in

371   comparison with the first Report Card in 2016 but progress was made on environmental and policy

372   aspects,[59] raising hope that these improvements will positively affect behavioral indicators in the future.

373   The low average grade of the United States should be interpreted carefully because three indicators were

374   assigned an "INC" grade: Active Play, Family and Peers, and Government. The United States shared the

375   lowest grades with the United Arab Emirates for School ("D-"), and the Community and the Built

376   Environment ("C") with England, Jersey, Lithuania, and Poland. Overall, none of the indicators were

377   graded above "C" in the United States. This is the third Report Card for the United States, and the grade

378   for Overall Physical Activity ("D-") remained consistent with the 2014 and 2016 Report Card.[60,61]

379   Similarly to Chile, major disparities in physical activity participation across gender, race/ethnicity, age,

380   and socioeconomic status were observed.[62]

381

382   *Overall Physical Activity*

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383   Among the 30 very high HDI countries, only Japan assigned an "INC" grade for Overall Physical

384   Activity. The grades ranged from "F" to "A-" for this indicator; however Slovenia was the only country

385   with a "good" grade ("A-"), and all the other countrys' grades fell between "F" and "C". Five countries

386   received an "F" (Flanders, Scotland, South Korea, Taiwan, and the United Arab Emirates), four countries

387   assigned "C" grades (England, Hong Kong, Lithuania, and Netherlands), and all the remaining countries

388   had a "D-", "D", or "D+". The comparison and interpretation of the Overall Physical Activity grades

389   should be conducted carefully given the important variation in the methods used to measure Overall

390   Physical Activity between the countries, as seen in Supplemental File 1. In fact, objective data were used

391   in 13 of 29 countries with an Overall Physical Activity letter grade, and subjective data in 27 countries

392   (11 countries combined subjective and objective data to inform their Overall Physical Activity indicator).

393   In addition, even among the subjective or the objective data, the methods differed largely in terms of

394   instruments, analysis, age range, sample size, and representativeness of samples.

395   The correlational analyses showed that there was no relationship between Overall Physical Activity, and

396   the physical activity related indicators (Organized Sport and Physical Activity, Active Play, and Active

397   Transportation). For example, only 56% of children and 33% of adolescents met the international physical

398   activity recommendations in the Netherlands despite a high level of Organized Sport and Physical

399   Activity, Active Play, and Active Transportation (graded "B", "B", and "B-", respectively).[63] A similar

400   pattern was observed in Belgium (Flanders), Denmark, Scotland, South Korea and Spain where Overall

401   Physical Activity was graded "F" or "D/D-" despite the fact that grades between "A" and "C" were

402   assigned to Organized Sport and Physical Activity, Active Play, and Active Transportation (note: an

403   "INC" grade was assigned to Active Play for Flanders, Denmark, Scotland, and South Korea).[53,64–67] The

404   opposite situation was observed in Slovenia where Overall Physical Activity was graded "A-", while

405   Organized Sport and Physical Activity, Active Play and Active Transportation were graded "C+", "D",

406   and "C", respectively.

17

407 The absence of a relationship between Overall Physical Activity and other behavioral indicators can

408 potentially be explained by the aforementioned differences in methods used to measure these indicators

409 and the diversity of benchmarks between countries. The recommended benchmark for physical activity

410 was "% of children and youth […] who accumulate at least 60 minutes MVPA per day on average, or %

411 of children and youth meeting the guidelines on at least four days a week (when an average cannot be

412 estimated)" (Table 1). The available data in each country did not necessarily allow them to use either of

413 these benchmarks strictly when estimating the prevalence of physically active children and youth in their

414 sample. For example, in France, a "high level of physical activity" corresponded to engage in physical

415 activity five or more days a week, and the regular use of active transportation, for 6-10 year olds (reported

416 by the parents); and practicing a MVPA at least five days a week for 11-17 year olds (self-reported).[68]

417 While in England's 2018 Report Card, the percentage of children and youth accumulating at least one

418 hour of MVPA seven days a week was evaluated.[69] In addition, among the countries where objective

419 methods were used to measure physical activity, the estimated number of children meeting the physical

420 activity guidelines could also have been significantly affected by the cut-off point that defines the count

421 per minute threshold for MVPA.[70] Although the majority of studies included in Global Matrix 3.0 used

422 the Evenson cut-off point,[47] several studies used different ones. For example, the Freedson cut-off point[71]

423 was used in Hong-Kong, while the Puyau cut-off point[72] was used in Canada (Supplemental File 1).

424 Notwithstanding the presented methodological issues across countries, 29 out of 30 very high HDI

425 countries assigned a letter grade to the Overall Physical Activity indicator, and for 28 of them, this grade

426 was between "C" and "F", with an average of "D-". These results are consistent with the current

427 literature. A systematic review of physical activity in European children and adolescents found that 5%-

428 47% of children and adolescents when measured subjectively, or 0%-60% of children and adolescents

429 when measured objectively, achieved the recommended levels of physical activity.[73] In another study

430 describing objectively-measured physical activity and sedentary time patterns in children and youth in 10

431 countries (nine very high HDI countries and Brazil), only 9% of boys and 2% of girls accumulated ≥60

18

432   minutes of MVPA on all measured days.[36] The present study provides additional evidence that the

433   situation regarding the physical activity of children and youth is very concerning in very high HDI

434   countries, and public investment to implement effective interventions for increasing physical activity

435   opportunities are needed urgently. Unless a major shift to a more active lifestyle happens soon, a high rate

436   of premature non-communicable diseases can be anticipated when this generation of children will reach

437   adulthood.

438

439   *Organized Sport and Physical Activity*

440   Most of the countries assigned a letter grade to Organized Sport and Physical Activity, excepting Jersey

441   and the United Arab Emirates. With an average grade of "C+", Organized Sport and Physical Activity

442   was the most successful behavioral indicator in the very high HDI countries. Only three countries had a

443   low grade for this indicator: Chile ("D-"), Taiwan ("D-"), and France ("C-"); while 12 countries had

444   relatively higher grades ("B+", "B", "B-") behind the lead of Denmark ("A-"). In Canada, Organized

445   Sport and Physical Activity was the only behavioural indicator with a high grade ("B+"),[74] in which the

446   high participation rate (77%) has been relatively stable since 2005.[75] Similarly, Organized Sport and

447   Physical Activity was also the highest graded indicator in Sweden.[76] In relation to its geographical and

448   population size, Sweden is considered as one of the world's most sporting nations: out of the seven

449   million inhabitants between the ages of 7 and 70, more than three million were active members of sport

450   clubs and more than two million were competing regularly in 2012.[77] However, as presented before, these

451   high rates of sport participation were not associated with a sufficient level of physical activity in the

452   population.

453   Given that the benchmark for Organized Sport and Physical Activity ("% of children and youth who

454   participate in organized sport and/or physical activity programs") does not specify intensity, duration, or

455   frequency, we are missing important contextual information of this indicator. These characteristics should

456　be evaluated to estimate the dose of physical activity associated with sport participation among children

457　and youth. However, the popularity of sport among children and youth from very high HDI countries

458　suggests that increasing organized sport opportunities and accessibility could be a strategic solution to

459　address the prevalence of childhood physical inactivity in these countries. Further research focusing on

460　this indicator is needed to evaluate if the available organized physical activity opportunities are indeed

461　saturated. Moreover, are all countries providing free or affordable and appealing physical activity and

462　sport participation opportunities for the entire youth population including different age, gender,

463　socioeconomic, ethnic, and special population groups (e.g., children with learning and/or physical

464　disabilities)?

465

466　*Active Play*

467　The main finding concerning Active Play was the amount of missing data: 20 out of the 30 very high HDI

468　countries assigned an "INC" grade to this indicator. Among the 10 countries with a letter grade, the

469　Netherlands attained the highest grade ("B"); Estonia the lowest grade ("F"); and the eight remaining

470　countries had "C"s or "D"s. The average grade of "D+" for this indicator suggests that there is a low level

471　of engagement in this behavior, and/or that researchers were not able to detect it with the measurement

472　instruments they used. Indeed, valid and reliable tools to assess active play is largely limited.[78] In the

473　Czech Republic, Active Play was measured using self-reports of unstructured/unorganized active play for

474　at least two hours per day;[79] while in New Zealand, surveys asked parents/guardians or youth report to

475　indicate if the children or youth had been active while playing (on their own or with others) in the last

476　seven days, if they had been active while playing for at least seven hours in the last seven days, and if

477　they were allowed to go out on their own in the neighborhood.[80] The development of standardized tools

478　for the measurement of Active Play is challenged by the need for consensus on a definition. In a recent

479　systematic review synthesizing the literature to identify key concepts used to define and describe active

480　play among young children, Truelove et al.[78] proposed the following definition: "a form of gross motor or

481   total body movement in which young children exert energy in a freely chosen, fun, and unstructured

482   manner". But a consensus definition needs to be officially internationally agreed upon and acknowledged

483   to advance the development and acceptance of standardised measurement tools.

484

485   *Active Transportation*

486   For Active Transportation, the grades ranged from "A-" (Japan) to "F" (Chile), with an average of "C-".

487   Qatar and the United Arab Emirates were the only two countries that did not assign a letter grade to this

488   indicator. Interestingly, three of the four countries from Eastern Asia are leading this indicator: Japan

489   ("A-"), Hong Kong ("B+"), and South Korea ("B+"). The successful school policy that has been

490   identified underlying this high prevalence of active transportation among children and youth in Japan was

491   discussed previously in this paper. In Hong Kong, a high proportion of children using active

492   transportation can be explained by the very high population density of the city: most districts are highly

493   self-contained so children usually attend schools close to their home.[81] Similarly, because most students

494   live within 10-minute walking distance to/from school, national data showed that active commuting is

495   prevalent in South Korea: 79.4% of children and youth reported that they take active modes of transport

496   to/from places.[66] Previous research has shown that active transportation is associated with increased

497   physical activity;[82] however, the Active Transportation indicator was not correlated with Overall Physical

498   Activity among children in very high HDI countries in this study. Similar to Organized Sport and

499   Physical Activity and Active Play, the benchmark for this indicator does not indicate duration or intensity

500   of activity. Therefore, it is not possible to evaluate the extent to which this indicator is contributing to the

501   Overall Physical Activity of children and youth.

502

503   *Sedentary Behaviors*

21

504   Sedentary behavior corresponds to any waking behavior characterized by an energy expenditure ≤1.5

505   metabolic equivalents (METs), while in a sitting, reclining, or lying posture.[83] For example, in children

506   and youth, it includes to the use of electronic devices while sitting, reclining or lying, as well as reading,

507   writing, or drawing while sitting.[83] While reading is associated with positive outcomes such as higher

508   academic achievement, screen time, often used as a proxy for sedentary behavior in research, has been

509   shown to be associated with a variety of negative health outcomes among children and youth.[84] For this

510   reason, guidelines focusing specifically on screen time were developed for the first time in Canada in

511   2011, recommending limiting screen time to two hours daily for the 5-17 year-olds.[85] Consistent with the

512   current guidelines, the benchmark for Sedentary Behaviors was solely based on screen time: "% of

513   children and youth who meet the *Canadian Sedentary Behaviour Guidelines* (5- to 17-year-olds: no more

514   than 2 hours of recreational screen time per day)".

515   Sedentary Behaviors was the only indicator without any "INC" grades. Estonia, Scotland, and Wales were

516   the three countries with the lowest grade for this indicator ("F"), while Slovenia and Spain had the highest

517   grade ("B+"). The remaining countries all had "C"s or "D"s, and the average for this indicator was "D+".

518   In total, only five out of the 30 very high HDI countries had a grade of "C" or higher. A small

519   methodological difference was observed between the very high HDI as few countries such as Estonia,

520   France, and Sweden reported the percentage of children and youth who had less than two hours (<2

521   hour/day) of daily screen time, while most of the countries reported those spending two hours or less (≤2

522   hour/day) in front of a screen. Another potential source of bias was not taking into account the potential

523   multi-tasking use of screens (e.g., using a phone while watching a movie) as it was the case for France,

524   which could have led to an overestimation of screen time.[68] Despite these potential methodological issues,

525   the grades observed for this indicator are extremely concerning among the very high HDI countries. In

526   Estonia, the prevalence of children meeting the screen time recommendation was estimated as low as

527   7%.[86] The development of more effective interventions targeting the reduction of screen time among

528   children and youth in very high HDI countries should be a public health priority.

529

Physical Fitness

531 This is the first time that Physical Fitness has been evaluated in the Global Matrix. Physical fitness
532 corresponds to a state characterized by an ability to perform daily activities with vigor, and a
533 demonstration of traits and capacities that are associated with a lower risk of the premature development
534 of diseases associated with physical inactivity.[87] The health-related components of physical fitness are
535 cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility.[88]
536 A recent systematic review of the relationship between the 20-meter shuttle run performance and health
537 indicators among children and youth found that performance on this test was associated with favourable
538 indicators of adiposity, and some indicators of cardiometabolic, cognitive, and psychosocial health in
539 boys and girls, and concluded that physical fitness can be used as a holistic indicator of population health
540 in children and youth.[89]

541 The benchmark for this indicator was the average percentile achieved on certain health-related physical
542 fitness component-based on the normative values published by Tomkinson et al.[56] On average, Physical
543 Fitness was graded "C-". The highest grade was obtained by Japan ("A"), closely followed by Slovenia
544 ("A-"); and four other countries (Canada, Chile, Hong Kong, and Jersey) shared the lowest grade ("D").
545 An "INC" grade was assigned to Physical Fitness in 13 countries. Various health-related physical fitness
546 components and different normative values were used to calculate the percentile achieved by their sample
547 of children and youth and inform this indicator from one country to another. For example, in Hong Kong
548 this indicator was graded based on peak oxygen consumption, estimated with the performance on the 20-
549 meter shuttle run performance among 9-17 year olds;[90] Jersey had data on cardiorespiratory fitness,
550 muscular strength, muscular endurance, flexibility, and motor fundamental movement skills development
551 for school-aged children.[91] Lithuania had data on endurance, lower body muscular power, upper body
552 muscular endurance, and lower body muscular endurance for 11-18 year olds. Given these significant
553 variations, the comparison of the Physical Fitness indicator between very high HDI countries is

554 compromised and this highlights the need for developing international standardized measurements of

555 health-related physical fitness components.

556

557 *Family and Peers*

558 Similarly to Physical Fitness, 13 countries assigned an "INC" grade to the Family and Peers indicator. On

559 average, this indicator was graded "C-", with Slovenia having the highest grade ("B+") and Chile having

560 the lowest grade ("F"). Parental support and significant others support has been identified as two of the 16

561 correlates that are consistently associated with physical activity of children and/or adolescents in a

562 systematic review of reviews.[92] Because of the complexity of this indicator, several benchmarks were

563 proposed for its evaluation (Table 1), and measurement variations were observed. In Poland, the grade

564 was based on self-report of their parents' (material, emotional) support to their physical activity

565 participation, on self-report of their parents' regular participation in physical activity, and on the

566 prevalence of youth who declared being regularly physically active with their father, their mother, and

567 their siblings.[93] In Germany, the prevalence of parents regularly participating in physical activity and the

568 prevalence of children feeling that they receive positive support from their parents and friends to be

569 physically active informed the Family and Peers indicator.[94] These findings show that there is still a need

570 for an established definition of Family and Peer Influence, and then standardised and validated methods

571 of measurement for the Family and Peers indicator.

572

573 *School*

574 The School indicator had an average of "C+", and only three countries had an "INC" grade for this

575 indicator: Guernsey, Scotland, and Wales. The United Arab Emirates and the United States had the lowest

576 grade ("D"), and Finland and Portugal shared the best grade for School ("A"). A variation in data was

577 used to inform this indicator within the countries. In Finland, 87% of the schools participated in the

578   national *Finnish Schools on the Move* programme. This programme aims at achieving more pleasant and

579   active schooldays for children and encourages schools to increase physical activity during the school day

580   as well as commuting.[95] In Portugal, physical education classes are mandatory for all students from pre-

581   school to 12th grade. The time allocated to physical education classes ranges from 90 to 150 min/week

582   over two or three sessions/week, and these classes are taught by a certified physical education teacher. In

583   addition, 85% of Portuguese schools offer school clubs under the supervision of a physical education

584   teacher, including competitions within and between schools.[96] The correlational analyses did not find an

585   association between the School and the Overall Physical Activity indicators, but similarly to other

586   indicators, the heterogeneity of data used to inform the School indicator are potentially affecting this

587   relationship.

588   A review of the relationship between academic performance and participation in school-based physical

589   activities, including physical education, free school-based physical activity, and school sports, found that

590   adding time to academic or curricular subjects by taking time from physical education programmes does

591   not enhance grades in the corresponding academic subjects, and could be detrimental to health.[97] On the

592   contrary, the authors also suggested that more time can be allocated to physical activity from other

593   subjects without the risk of hindering students' academic achievement.[97] These findings suggest that the

594   school environment, policy, and curriculum have the potential to increase physical activity among

595   children and youth, and more specific interventions targeting the creation of daily physical opportunities

596   at school need to be developed in very high HDI countries.

597

598   *Community and the Built Environment*

599   With an average of "B-", Community and the Built Environment was the highest graded indicator of the

600   10 core indicators among the 30 very high HDI countries. The lowest grade for this indicator was "C",

601   shared by five countries (England, Jersey, Lithuania, Poland, and the United States), and the highest

602 grade, "A", was assigned by Sweden. Eight countries assigned an "INC" grade for this indicator. With an

603 "A-", Australia was the second most successful country for this indicator. In the Australia's 2018 Report

604 Card, parent-report data showed that most of youth were not faced with problematic traffic in their home

605 or school neighborhood, had access to good roads and footpaths and to public transport in their

606 neighborhood, had a park or playground near their home, and lived in a safe neighborhood.[98] In Taiwan,

607 where this indicator was graded "B+", 81% of 13- to 17-year-olds felt that there were sufficient exercise

608 facilities in their neighbourhood, and they reported spending an average of 9.7 min to reach their primary

609 exercise facilities.[99] The lack of correlation between this indicator and the Overall Physical Activity is

610 aligned with some of the research available on access to facilities.[92] Community and the Built

611 Environment. In accordance with previous Global Matrices,[37,39] the available evidence from this indicator

612 may suggest that the characteristics of the built environment potentially influencing the physical activity

613 of children are already meeting the criteria to be considered favorable in the very high HDI countries.

614 This indicates that having favorable environmental infrastructure alone is not sufficient to promote

615 physical activity in very high HDI countries. Social factors such as family, home, school, and community

616 are also important to promote physical activity among children and youth.

617

618 *Government*

619 The average grade for the Government indicator was "C+", and the grades ranged from "A" (Slovenia) to

620 "D" (Australia, Guernsey, Jersey, and South Korea). Five countries assigned an "INC" grade to this

621 indicator. With the exception of the four countries with a "D", all the other very high HDI countries

622 obtained a favorable grade ("C" or higher) for the Government indicator. Despite the recommended

623 benchmark for this indicator, Government grades were informed by different types of data in different

624 countries. For example, in Wales, 21 policy documents assessed across different sectors including Health,

625 Sport, Education, Environment, Transport, and Urban Design/Planning were evaluated using the *Health-*

626 *Enhancing Physical Activity Policy Audit Tool*, obtaining a final score of 54% that was converted to a

627 letter grade of "C+".[100] In some other countries that did not have relevant quantitative data, a letter grade

628 was graded primarily based on expert opinion. Although most countries reported government physical

629 activity strategies and policies, the absence of a relationship between the Government grades and the

630 Overall Physical Activity grades and the mostly low behavioral grades suggest that these actions are not

631 singularly effective at increasing the prevalence of MVPA among children and youth.

632

633 *Integrated Discussion*

634 Generally, higher grades were reported for the source of influence indicators in comparison with the

635 behavioral indicators among the 30 very high HDI countries integrated in this study. The average grade

636 for the behavioral indicators was "D+" (ranging from "B-" to "D-") while the average grade for the

637 sources of influence indicators was "C+" (ranging from "A" to "D"). This finding is consistent with

638 previous Global Matrices,[37,39] and may be partially explained by the fact that more than half of the

639 countries that participated in the Global Matrix 1.0 and 2.0 belonged to the very high HDI category.

640 Japan, the Netherlands, and Slovenia had the highest behavioral score, while Estonia, Chile and the

641 United Arab Emirates had the lowest score (Figure 3). This score was calculated based on the grades for

642 five indicators, and most of the countries had four to five letter grades to inform the score, with the

643 exception of the United Arab Emirates with only two letter grades, and Qatar, Jersey, and Japan with only

644 three letter grades. The amount of "INC" grades for these four countries questions the accuracy of their

645 ranking, in particular for Japan, in the leading position. For the sources of influence score, Slovenia,

646 Denmark, and Finland led the ranking, while the United States, South Korea, and Guernsey ranked at the

647 bottom (Figure 4). While the calculation of the source of influence score was based on the letter grades

648 for four indicators, eight countries had only two letter grades to inform this score, and Guernsey, the

649 Netherlands and Spain had only one. The amount of "INC" grades challenges the correctness of this

650 classification, in particular for the three countries with only one source of influence indicator graded. The

27

651 comparison of these groups of indicators suggests that the adequate to good grades observed for the

652 source of influence indicators are not translated in good behavioral grades for the very high HDI

653 countries.

654 In total, 24 countries had three or less "INC" grades, but six countries were missing data to grade four to

655 six indicators. Including countries with a significantly large number of "INC" grades in the Global Matrix

656 3.0 is a limitation to this study as it limits the comparisons. For example, the United Arab Emirates had

657 six "INC" grades,[101] Guernsey had five "INC" grades,[102] and Qatar had four "INC" grades, and a "not

658 applicable" for Active Transportation.[46]Another major limitation of this study is the diversity of the data

659 that were used to inform the 10 core indicators, challenging the comparativeness of the grades within the

660 same indicator. Two identical grades for the same indicator can potentially reflect very different situations

661 from one country to another. An alternative approach would have been to exclude the countries with

662 insufficient data from the Global Matrix 3.0, and to have assigned "INC" grades to all the countries with

663 data that were not fitting exactly with the benchmarks for each indicator. Yet, this strategy would have

664 considerably reduced the number of countries and indicators included in the analyses of this study and

665 decrease the relevance of conducting international comparisons within an HDI category. Finally, a loss of

666 information potentially occurs when translating original data to a letter grade, as letter grades provide less

667 information than continuous variables.

668 The main strength of this study is the large number of participating countries who adopted the harmonized

669 data gathering, assessing, and grading process and the quantity of data that are informing the international

670 physical activity comparisons. This was possible as a result of the inclusive strategy adopted by AHKGA.

671 This project offers the opportunity to paint a picture of the characteristics of childhood physical activity in

672 each country, as determined and explained by a diverse group of experts within each country. In addition,

673 despite the presented methodological issues, this study allows the identification of major trends

674 concerning the characteristics of the physical activity of children and youth among very high HDI

675 countries. The need for the development and the international adoption of standardized methods to

676 conceptualise and measure the ten indicators was also highlighted in this paper. An "INC" grade can be

677 useful for advocacy in individual countries in future cards, and the Global Matrix project has the potential

678 to influence the physical activity national surveillance systems in the short to long term. Finally, as

679 demonstrated in the study presenting the international impact of the Report Cards and Global Matrices

680 published in this special issue,[103] the development of a national Report Card of physical activity for

681 children and youth, and the participation in the Global Matrix initiative, contributes to raising awareness

682 on the childhood physical inactivity issue nationally and internationally, building capacity within

683 participating countries, and potentially influencing the creation of physical activity opportunities in the

684 future.

685

686 **Conclusion**

687 This analysis and comparison of the Global Matrix 3.0 grades provide a comprehensive summary of the

688 level and context of the physical activity of children and youth among the participating very high HDI

689 countries. While methodological limitations and research gaps were identified, this work allowed the

690 portrayal of major trends across the 10 physical activity indicators. The majority of very high HDI

691 countries had better grades on the sources of influence levels, but this was not translated in positive

692 outcomes concerning childhood physical activity and sedentary behavior, indicating an implementation

693 gap between the policy/governmental and individual level. This paper provides additional evidence that

694 the situation regarding physical activity in children and youth living in very high HDI countries is

695 extremely concerning. Strategic public investments to implement effective interventions within families,

696 communities, and schools to increase physical activity opportunities are needed. Unless a major shift to a

697 more active lifestyle happens soon, a high rate of non-communicable diseases can be anticipated when

698 this generation of children will reach adulthood.

699

705

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1022   **Table 1: Global Matrix 3.0 indicators and benchmarks used to guide the grade assignment process**

Indicator	Benchmark
Overall Physical Activity	% of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity per day on average. Or % of children and youth meeting the guidelines on at least 4 days a week (when an average cannot be estimated).
Organized Sport and Physical Activity	% of children and youth who participate in organized sport and/or physical activity programs.
Active Play	% of children and youth who engage in unstructured/unorganized active play at any intensity for more than 2 hours a day. % of children and youth who report being outdoors for more than 2 hours a day.
Active Transportation	% of children and youth who use active transportation to get to and from places (e.g., school, park, mall, friend's house).
Sedentary Behaviors	% of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-year-olds: no more than 2 hours of recreational screen time per day). Note: the Guidelines currently provide a time limit recommendation for screen-related pursuits, but not for non-screen-related pursuits.
Physical Fitness	Average percentile achieved on certain physical fitness indicators based on the normative values published by Tomkinson et al.[56]
Family and Peers	% of family members (e.g., parents, guardians) who facilitate physical activity and sport opportunities for their children (e.g., volunteering, coaching, driving, paying for membership fees and equipment). % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity physical activity. % of family members (e.g., parents, guardians) who are physically active with their kids. % of children and youth with friends and peers who encourage and support them to be physically active. % of children and youth who encourage and support their friends and peers to be physically active.

School	% of schools with active school policies (e.g., daily PE, daily physical activity, recess, "everyone plays" approach, bike racks at school, traffic calming on school property, outdoor time).
	% of schools where the majority ($\geq$ 80%) of students are taught by a PE specialist.
	% of schools where the majority ($\geq$ 80%) of students are offered the mandated amount of PE (for the given state/territory/region/country).
	% of schools that offer physical activity opportunities (excluding PE) to the majority (> 80%) of their students.
	% of parents who report their children and youth have access to physical activity opportunities at school in addition to PE classes.
	% of schools with students who have regular access to facilities and equipment that support physical activity (e.g., gymnasium, outdoor playgrounds, sporting fields, multi-purpose space for physical activity, equipment in good condition).
Community and the Built Environment	% of children or parents who perceive their community/municipality is doing a good job at promoting physical activity (e.g., variety, location, cost, quality).
	% of communities/municipalities that report they have policies promoting physical activity.
	% of communities/municipalities that report they have infrastructure (e.g., sidewalks, trails, paths, bike lanes) specifically geared toward promoting physical activity.
	% of children or parents who report having facilities, programs, parks and playgrounds available to them in their community.
	% of children or parents who report living in a safe neighbourhood where they can be physically active.
	% of children or parents who report having well-maintained facilities, parks and playgrounds in their community that are safe to use.
Government	Evidence of leadership and commitment in providing physical activity opportunities for all children and youth.
	Allocated funds and resources for the implementation of physical activity promotion strategies and initiatives for all children and youth.
	Demonstrated progress through the key stages of public policy making (i.e., policy agenda, policy formation, policy implementation, policy evaluation and decisions about the future).

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1029   **Table 2: Global Matrix 3.0 grading rubric**

Grade	Interpretation	Corresponding number for analysis
A+	94% - 100%	15
A	We are succeeding with a large majority of children and youth (87% - 93%)	14
A-	80% - 86%	13
B+	74% - 79%	12
B	We are succeeding with well over half of children and youth (67% - 73%)	11
B-	60% - 66%	10
C+	54% - 59%	9
C	We are succeeding with about half of children and youth (47% - 53%)	8
C-	40% - 46%	7
D+	34% - 39%	6
D	We are succeeding with less than half but some children and youth (27% - 33%)	5
D-	20% - 26%	4
F	We are succeeding with very few children and youth (<20%)	2
INC	Incomplete - insufficient or inadequate information to assign a grade	No Grade

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1040   **Table 3: Sociodemographic information of the 30 very high HDI countries in the Global Matrix 3.0**

Country	HDI[a]	GNI per capita[a]	Public Health Expenditure (% of GDP)[a]	Gender Inequality Index (GII)[a]	Life expectancy at birth[a]	Mean years of schooling[a]	Gini index[b]	Global Food Security Index[c]	Child Poverty Rate[d]	Urban Population Percentage[e]	Population Density (people/km2)[f]
Australia	0.939	42822	6.3	0.12	82.5	13.2	34.7	83.3	0.13	89.4	3
Belgium	0.896	41243	8.3	0.073	81	11.4	27.7	79.8	0.11	97.5	374
Canada	0.92	42582	7.4	0.098	82.2	13.1	34	82.2	0.171	80.8	4
Chile	0.847	21665	3.9	0.322	82	9.9	47.7	74.7	0.225	89.4	24
Czech Republic	0.878	28144	6.3	0.129	78.8	12.3	25.9	75.8	0.105	73.4	137
Denmark	0.925	44519	9.2	0.041	80.4	12.7	28.2	80.3	0.029	87.1	136
England	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Estonia	0.865	26362	5	0.131	77	12.5	32.7		0.121	69.5	31
Finland	0.895	38868	7.3	0.056	81	11.2	27.1	81	0.037	83.8	18
France	0.897	38085	9	0.102	82.4	11.6	32.7	82.3	0.113	86.4	122
Germany	0.926	45000	8.7	0.066	81.1	13.2	31.7	82.5	0.095	74.1	236
Guernsey*	0.975				82.6		40				850
Hong Kong	0.917	54265			84.2	11.6				100	6987
Japan	0.903	37268	8.6	0.116	83.7	12.5	32.1	79.5		91.9	348
Jersey**	0.985				81.9		41				845
Lithuania	0.848	26006	4.4	0.121	73.5	12.7	37.4		0.191	67.2	46
Netherlands	0.924	46326	9.5	0.044	81.7	11.9	29.3	82.8	0.102	83.6	506
New Zealand	0.915	32870	9.1	0.158	82	12.5		81	0.141	86.3	18
Poland	0.855	24117	4.5	0.137	77.6	11.9	31.8	74.1	0.134	60.8	124
Portugal	0.843	26104	6.2	0.091	81.2	8.9	35.5	79	0.155	61.6	113
Qatar	0.856	129916	1.9	0.542	78.3	9.8		73.3		98.9	221
Scotland	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271
Slovenia	0.89	28664	6.6	0.053	80.6	12.1	25.4			49.8	103
South Korea	0.901	34541	4	0.067	82.1	12.2	31.6		0.071	83.5	526
Spain	0.884	32779	6.4	0.081	82.8	9.8	36.2	78.1	0.221	77.6	93
Sweden	0.913	46251	10	0.048	82.3	12.3	29.2	81.7	0.091	85.4	24
Taiwan***	0.885	45582			80.2		33.6				
United Arab Emirates	0.84	66203	2.6	0.232	77.1	9.5		70.9		84.7	111
United States	0.92	53245	8.3	0.203	79.2	13.2	41.5	84.6	0.199	82.6	35
Wales	0.909	37931	7.6	0.131	80.8	13.3	33.2	84.2	0.112	79.7	271

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Note: HDI = Human Development Index, GNI = Gross National Income, GDP = Gross Domestic Product, GII = Gender Inequality Index. Sources of information: a., United Nations Development Programme;[8] b. and f., the World Bank;[104,105] c., the Economist Intelligence Unit;[106] d., the Organisation for Economic Co-operation and Development Child (OECD) Well-Being Data Portal;[107] and e., United Nations, Department of Economic and Social Affairs.[108] * For Guernsey, the HDI sourced from the United Nations Economic and Social Commission for Asia and the Pacific,[109] the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[110] and the Gini index sourced from the State of Guernsey.[111] **For Jersey, the HDI sourced from[109], the life expectancy at birth, population size, and the population density sourced from the United States Central Intelligence Agency,[110] and the Gini index sourced from the State of Jersey.[112] ***For Taiwan, the HDI, the GNI per Capita, the life expectancy at birth and the Gini index come from the National Statistics, Republic of China (Taiwan).[113] For England, Scotland, and Wales, the official data for UK were reported.

1063   **Table 4: Grades assigned to the 10 core physical activity indicators for the 30 very high HDI**

1064   **countries of the Global Matrix 3.0**

	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
Australia	D-	B-	INC	D+	D-	D+	C+	B+	A-	D	C-
Belgium (Flanders)	F	B	INC	C+	C	INC	C+	B-	B	B	C
Canada	D+	B+	D	D-	D+	D	C+	B-	B+	C+	C-
Chile	D-	D-	INC	F	C-	D	F	D	B	B-	D
Czech Republic	D	B-	D-	C+	D-	C+	C+	B+	B	C+	C
Denmark	D-	A-	INC	B+	D+	INC	INC	A-	B+	A-	B-
England	C-	D+	INC	C-	D+	C-	INC	B+	C	INC	C-
Estonia	D-	C	F	D	F	INC	D	C+	B	B	D+
Finland	D	C+	C	B+	D-	C	B-	A	B+	A-	C+
France	D	C-	INC	C-	D-	B-	INC	B	INC	C	C-
Germany	D-	B	D-	C-	D-	INC	B-	B+	B+	INC	C
Guernsey	D	C+	INC	D	C	INC	INC	INC	INC	D	D+
Hong Kong	C-	C	INC	B+	C-	D	D-	C	B	C	C-
Japan	INC	B-	INC	A-	C-	A	C-	B+	B-	B	B-
Jersey	D-	INC	INC	D+	C	D	C	B-	C	D	D+
Lithuania	C-	C	INC	C-	C-	C+	D	C+	C	C	C-
Netherlands	C	B	B	B-	C-	INC	INC	C	INC	INC	C+
New Zealand	D-	B	C+	C-	D	INC	C	B-	B	B+	C
Poland	D-	D	INC	C	D	C-	C-	B	C	C+	C-
Portugal	D	B-	INC	C-	C-	C	C	A	B	B	C+
Qatar	D	D+	INC	N/A	D+	INC	INC	C	INC	B+	C-
Scotland	F	B	INC	C	F	INC	INC	INC	B-	C	D+
Slovenia	A-	C+	D	C	B+	A-	B+	A	B	A	B

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	PA	SP	AP	AT	SB	PF	FAM	SCH	COM	GOV	AVG
South Korea	F	C	INC	B+	D	D+	INC	D+	INC	D	D+
Spain	D	B	C-	B-	B+	INC	INC	C+	INC	INC	C+
Sweden	D+	B+	INC	C	C+	INC	INC	C+	A	B	C+
Taiwan	F	D-	INC	C-	C-	B-	INC	B+	B+	B+	C
United Arab Emirates	F	INC	INC	INC	C-	INC	INC	D-	INC	B+	D+
United States	D-	C	INC	D-	D	C-	INC	D-	C	INC	D
Wales	D+	C+	C-	D+	F	INC	D	INC	INC	C+	D+

1065   Note: PA = Physical Activity, SP = Organized Sport and Physical Activity Participation, AP = Active

1066   Play, AT = Active Transportation, SB = Sedentary Behaviors, PF = Physical Fitness, FAM = Family and

1067   Peers, SCH = School, COM = Community and the Built Environment, GOV = Government, AVG =

1068   Average, INC = incomplete grade, and N/A = not applicable.

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1079 **Table 5: Descriptive statistics of the grades by indicator and group of indicators for the very high**

1080 **HDI countries of the Global Matrix 3.0**

	Grade count	Incomplete grades	Mean number grade	SD	Mean letter grade	Range
Overall physical activity	29	1	4.9	2.2	D-	F to A-
Organized sport and physical activity participation	28	2	9	2.4	C+	D- to A-
Active play	10	20	6.2	2.7	D+	F to B
Active transportation	28	2	7.8	2.7	C-	F to A-
Sedentary behaviors	30	0	6.1	2.4	D+	F to B+
Physical fitness	17	13	7.9	2.7	C-	D to A
Family and peers	17	13	7.5	2.6	C-	F to B+
School	27	3	9.9	2.9	C+	D- to A
Community and the Built Environment	22	8	10.7	1.7	B-	C to A
Government	25	5	9.6	2.7	C+	D to A
Behavioral indicators	30	0	6.8	1.6	D+	D- to B-
Sources of influence indicators	30	0	9.3	2	C+	D to A-
All indicators	30	0	7.9	1.5	C-	D+ to B

1081 Note: Behavioral indicators = Average of Overall Physical Activity, Organized Sport Participation,

1082 Active Play, Active Transportation, Sedentary Behavior indicator grades; Source of influence indicators =

1083 Average of Family and Peers, School, Community and the Built Environment, and Government Strategies

1084 and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster.

1085 There are no missing grades for the bottom three rows because these scores are adjusted for missing

1086 grades.

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Figure 1: Frequency plot by letter grade among 30 very high-HDI countries in the Global Matrix 3.0. A: For the 10 core indicators. B: For the behavioral indicators and for the source of influence indicators.
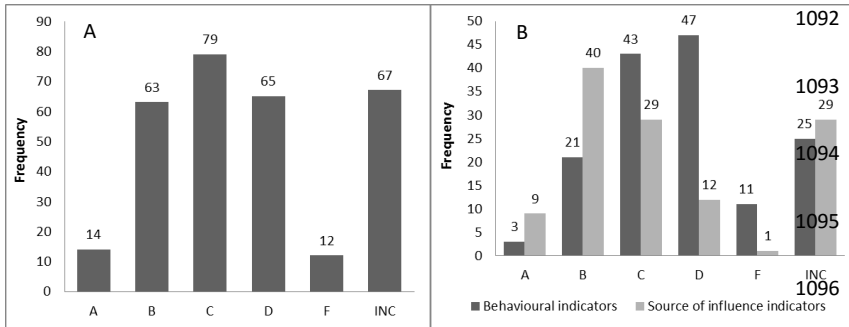
Note: Behavioral indicators = Average of Overall Physical Activity, Organized Sport Participation, Active Play, Active Transportation, Sedentary Behavior indicator grades; Source of influence indicators = Average of Family and Peers, School, Community and the Built Environment, and Government Strategies and Investments indicator grades. Physical fitness was not included in the behavioral indicators cluster.

1110 **Figure 2: Plot of the overall score estimated for the 10 core indicators for the 30 very high HDI**

1111 **countries of the Global Matrix 3.0**
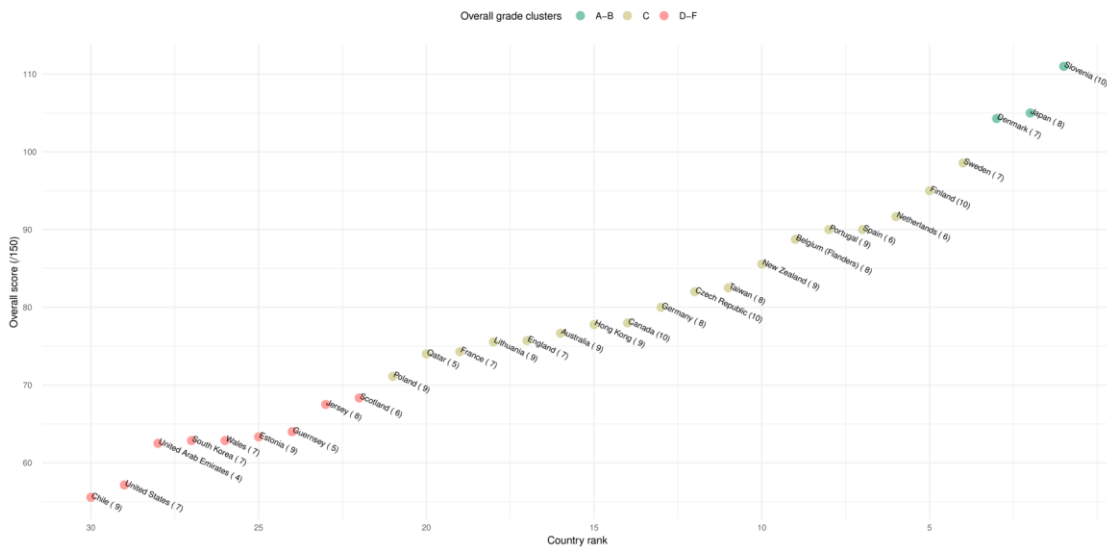
1112 Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis

1113 shows the number of grades available for the calculation of the score.
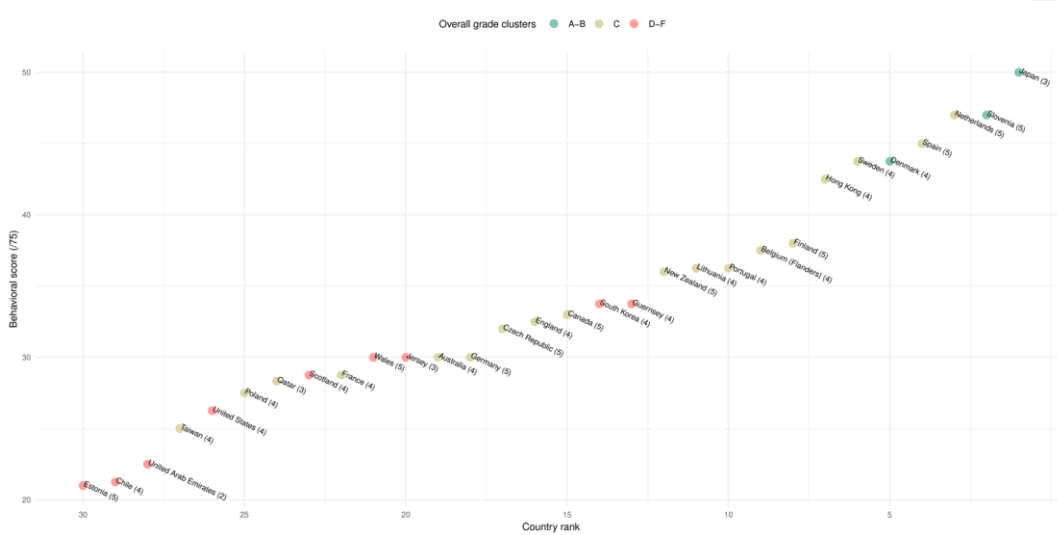
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1122 **Figure 3: Plot of the behavioral score estimated for the very high HDI countries of the Global**

1123 **Matrix 3.0**

1124 Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis

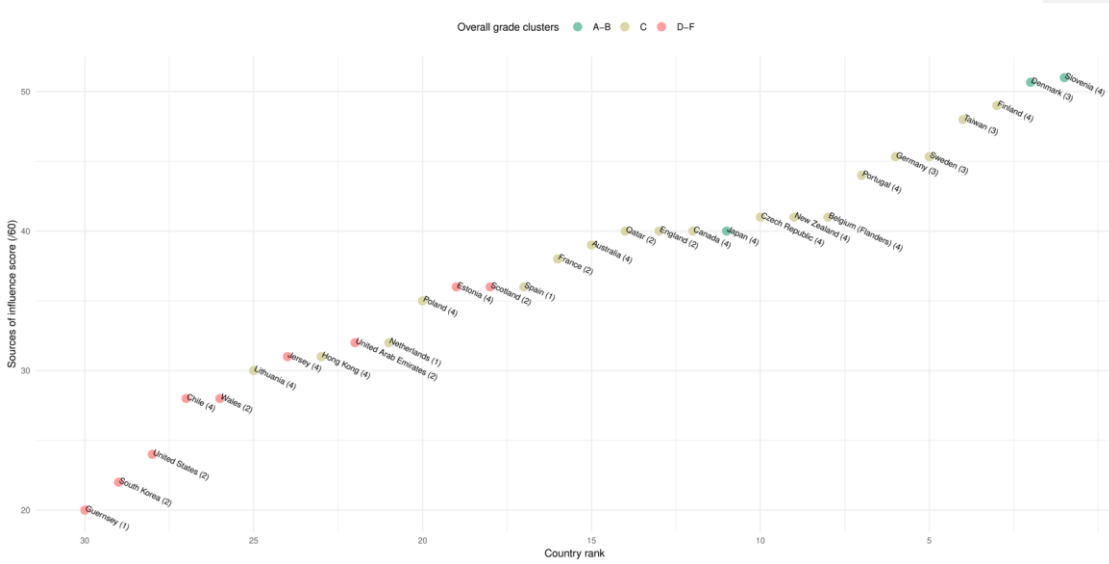1125 shows the number of grades available for the calculation of the score.

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1131 **Figure 4: Plot of the source of influence indicators score for the very high HDI countries of the**

1132 **Global Matrix 3.0**

1133 Note: The overall score was adjusted for missing and incomplete grades. The number in parenthesis

1134 shows the number of grades available for the calculation of the score. These estimates of sources of

1135 influence score are interpreted with a high degree of caution as they are likely imprecise estimates of

1136 sources of influence due to the level of missing data used to determine this score.

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