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# Challenges of social change: The 2021 Republic of Slovenia report card on physical activity of children and adolescents

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## ABSTRACT

**Background:** Slovenian children are facing considerable health challenges from the rapid social changes that influence their opportunity to engage in daily physical activity.

**Objective:** To overlay the social changes to the established Report Card model as a means of contextualising the extreme changes in physical activity and fitness observed over several years.

**Methods:** Benchmarks were graded for 10 core indicators, plus two (Sleep, Seasonal Variations). Active Healthy Kids Slovenia members met (predominantly via zoom) liaising with team leader(s) on a flexible, individual basis, based on coronavirus disease 2019 (COVID-19) regulations, over the ~2-year assessment period of the project. Data were separated to the years prior to, 'pre' 2018–2020, and 'during' the global pandemic (2020–2021). Where sufficient data existed for both timeframes, grades were averaged to produce an overall grade.

**Results:** Grade results are expressed as pre/during/final grade, where the final grade (bolded) is a straight average of the two preceding time epochs: Overall Physical Activity (A-/A-/**A-**), Organized Sport and Physical Activity (C+/C/C), Active Play (D/C+/C), Active Transport (C/INC/C), Sedentary Behaviour (B/C/C+), Physical Fitness (A+/A-/**A**), Family and Peers (B+/INC/**B+**), Schools (A/A/**A**), Community and Environment (A+/A+/**A+**), Government (A/F/**D**), Sleep (D-/INC/**D-**), Seasonal Variations (D/C-/**D+**).

**Conclusion:** Although Slovenia has some of the most consistently physically-active children in the world, the effects of the COVID-19 pandemic exerted significant reductions in physical activity opportunities, and especially when coupled with funding re-distributions, resulted in the steepest decline of child physical fitness observed within the >35-year history of Slovenia's well-established national fitness surveillance system.

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## 1. Introduction

The 2021 Slovenian Report Card is the third Report Card prepared by the Active Healthy Kids Slovenia (AHKS) team. Although

the immediate period following the 2016 and 2018 Report Cards did not bring any drastic changes or developments foreseen to affect child physical activity (PA), there were extreme perturbations to daily life following the start of the coronavirus 2019 (COVID-19) global pandemic.<sup>1–3</sup> In general, Slovenia has fared very well compared to international peers on both the 2016<sup>4</sup> and 2018<sup>5</sup> Report Cards in terms of the Overall Physical Activity and Schools indicators (As for both indicators, all years). The Family and Peers

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and Community and the Built Environment indicators (both incomplete, INC) are indicators that were highlighted as needing improvement or needing more high-quality research data to make adequate grading decisions. The target theme of the 2016 Report Card was “Introducing a Physical Activity Report Card” and in 2018, it was “Celebrating 30 years of SLOfit” (referring to Slovenia’s national child fitness surveillance programme, SLOfit).<sup>6</sup>

The current 2021 Report Card (Fig. 1) theme highlights the pressures of social changes on children’s physical activity (PA). Social changes result in the adaptation of individuals to new environmental challenges. Adaptation typically results in an initial worsening of health indicators – such as decline in PA – which start improving in latter generations, after their socio-economic status improves in society.<sup>7</sup> For example, Slovenia is a post-socialist society in which dietary and PA patterns have shifted, almost overnight. These deviations are rapid and clearly identifiable.<sup>8</sup> Slovenia has been experiencing at least four major social changes within the past several decades that negatively affect child PA (Fig. 2). In 1991, Slovenia became the first republic to split from the former Yugoslavia, so the first social change was a transition from an ~ equitable socialist distribution of resources to consumerism, accompanied by a sudden inflow of western style, nutrient dense food. Next, the domestication of personal computers (circa 1990’s), including gaming technology and smartphones (c. 2009), followed by COVID-19 lockdowns/mitigation measures, have increased sedentary

behaviours in its citizenry.<sup>9</sup> Slovenia has had some modest success reversing childhood obesity rates<sup>10</sup> and improving child fitness trends.<sup>11,12</sup> Unfortunately, the extreme reduction observed in child fitness over the course of the COVID-19 pandemic (Fig. 3) has underscored an urgent need for advocacy to enshrine robust public health policies into practice in order to ensure every child has access to high-quality PA and avoid the negative effects of prolonged physical inactivity.

## 2. Methods

The 2021 Report Card is a two-point snapshot ‘State of the Republic’ report on the overall PA of Slovenian schoolchildren. Data and figures encompass two distinct time-points: 2018–2020 prior to the COVID-19 pandemic, and 2020–2021 whenever robust, novel data existed. The two-point snapshot was undertaken because for many indicators, Slovenia was able to collect direct PA data during the first and subsequent wave(s) of the pandemic. The final grades are calculated as a straight mean from the ‘pre’ and ‘during’ scores. If one epoch is listed an incomplete (INC), then only the graded score is used. Draft grades were reviewed by all stakeholders from Active Healthy Kids Slovenia (AHKS) following previous methodology,<sup>13</sup> with oversight from Active Healthy Kids Global Alliance (AHKGA), following procedures published elsewhere.<sup>14</sup>

### 2.1. Summary of data sources, benchmarks and grading

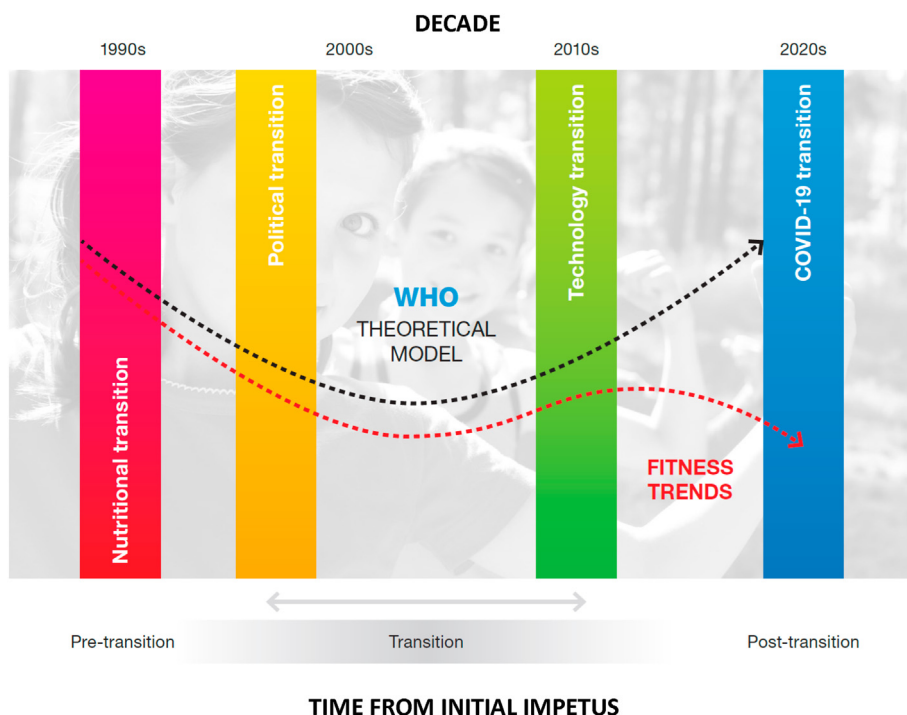
Grades were determined as defined by AHKGA methodology,<sup>14</sup> namely the % of children meeting evidence-based benchmarks, using a grading scheme. There are two additional indicators relevant to the region (Sleep and Seasonal Variation, Table 1). In general, Slovenian-specific grades have historically relied on the national ‘ACDSi’ study,<sup>15</sup> which, when combined with Slovenia’s annual national physical fitness surveillance/monitoring system SLOfit,<sup>6</sup> enables the country to maintain a fairly comprehensive snapshot of its state of affairs regarding child PA and fitness. Although large portions of the 2013/2014 ACDSi data were used to produce our maiden 2016 Report Card,<sup>4</sup> and novel analyses conducted to supplement the 2018 Report Card’s evidence,<sup>5</sup> this 2021 Report Card does not to rely so heavily on ACDSi data since it is not appropriate to reflect the massive changes observed in PA patterns during 2020–2021,<sup>3</sup> especially when strict pandemic movement restrictions greatly affected overall child PA.<sup>16,17</sup> Thus, the team preferentially sought national government policy documents, buttressing new data with internal SLOfit reports, and traditional peer-reviewed sources.

### 2.2. Novel ‘data confidence’ score

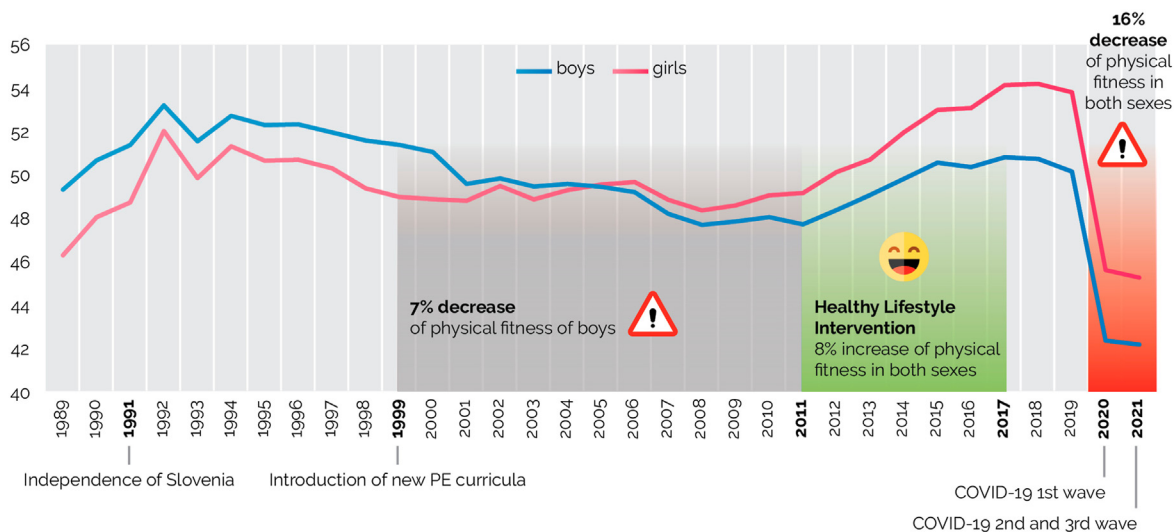
An overall ‘data confidence’ score has been applied to all PA indicators, using a standardised approach. This new ‘confidence’ score is included beside each indicator grade (Table 2). The data confidence score is a 4-point ‘sneaker’ scale which encompasses the following four questions: (1) Is the data nationally-representative? (2) Is the data both objectively and subjectively measured? (3) Is the data diverse (e.g., representing a wide range of age, gender, location, socio-economic factors), and (4) Is the data repeatable? Data that has been objectively measured, reflecting a diverse, national perspective, and has been replicated (or explained in sufficient detail to be replicated in the future), would attain our top sneaker rating. Failure to meet one of these criteria would remove one sneaker from the confidence rating.



Fig. 1. Front cover of the 2021 Republic of Slovenia Report Card for Physical Activity in Children and Youth.



**Fig. 2.** World Health Organisation (WHO) theoretical model (dashed black line) of what generally happens to a culture during social transition from one state (e.g. change in nutrition/food availability) to a new social norm. There is usually a dip (e.g. decrease in fat free mass), before the society adjusts to the ‘new normal’ and returns to their pre-perturbed state. In the past 4 decades, Slovenia has undergone massive transitions to 4 key elements which would affect child physical activity levels: (1) nutritional - ‘western’ style, nutrient dense food, (2) economical - from more equitable socialist distribution of resources to consumerism (3) technological - advent of ubiquitous smart phones, screen times, and (4) COVID-19 global pandemic - movement restrictions associated with disease mitigation measures heavily reduced PA opportunities within the population.



**Fig. 3.** Secular trends in the Physical Fitness Index from 1989 to present. The y-axis represents centile scores of girls (red line) and boys (blue line) for each year of national testing. Consistent declines in fitness from 1999 to 2019 prompted the Healthy Lifestyle Intervention programme, a national initiative aimed at introducing extra PA minutes for schoolchildren across the country. In one year alone the COVID-19 pandemic had erased child fitness gains that took over a decade to realise. Recovery strategies are now being brainstormed at the national level to address this growing crisis in child fitness and health.

### 3. Results

Full results of the 10 core indicators (+2 regional indicators) are available in Table 1. Results are further broken down by pre-versus during-pandemic years, along with the Data Confidence Scores (Table 2). The Republic of Slovenia ranked first among nations for the Overall Physical Activity, Community and Environment, and

Physical Fitness indicators.<sup>14</sup> Below, we highlight some key evidence which led to the grades for each indicator. More details can be requested by contacting the corresponding author directly.

#### 3.1. Overall Physical Activity

From 2018 to 2020, reported data in a sub-sample (N = 108,



**Table 1**  
Physical Activity Indicators, Mean Grades and Benchmark criteria for the 10 core and 2 custom indicators comprising the Slovenian 2021 Report Card compared to the overall Global Matrix 4.0 (GM 4.0) worldwide grades.

INDICATOR	SLO GRADE	GM 4.0	BENCHMARK
Overall Physical Activity	A-	D	(1) % of children and youth who meet the Global Recommendations on Physical Activity for Health, which recommend that children and youth accumulate at least 60 min of moderate- to vigorous-intensity PA per day on average.
Organized Sport and Physical Activity	C	C-	(1) % of children and youth who participate in organized sport and/or PA programs.
Active Play	C	C-	(1) % of children and youth who engage in unstructured/unorganized active play for several hours a day. (2) % of children and youth who report being outdoors for several hours a day.
Active Transportation	C	C-	(1) % of children and youth who use active transportation to get to and from places.
Sedentary Behaviours	C+	D+	(1) % of children and youth who meet the Canadian Sedentary Behaviour Guidelines (5- to 17-y-olds: no more than 2 h of recreational screen time per day).
Physical Fitness	A	C-	(1) Average percentile achieved from Table S4c from Tomkinson et al., 2017 across age and sex for available data. (2) % of children and youth who meet criterion-referenced standards for muscular strength. (3) % of children and youth who meet criterion-referenced standards for muscular endurance. (4) % of children and youth who meet criterion-referenced standards for flexibility.
Family and Peers	B+	C-	(1) % of family members (e.g., parents, guardians) who facilitate PA and sport opportunities for their children (e.g., volunteering, coaching, driving, paying for membership fees and equipment). (2) % of parents who meet the Global Recommendations on Physical Activity for Health, which recommend that adults accumulate at least 150 min moderate to vigorous physical activity (MVPA) throughout the week or do at least 75 min of MVPA throughout the week or equivalent combination. (3) % of family members (e.g., parents, guardians) who are physically active with their kids. (4) % of children and youth with friends and peers who encourage and support them to be physically active. (5) % of children and youth who encourage and support their friends and peers to be physically active.
Schools	A	C+	(1) % of schools with active school policies (e.g., daily physical education (PE), daily PA, recess, “everyone plays” approach, bike racks at school, traffic calming on school property, outdoor time). (2) % of schools where the majority (≥80%) of students are taught by a PE specialist. (3) % of schools where the majority (≥80%) of students are offered the mandated amount of PE (for the given state/territory/region/country). (4) % of schools that offer PA opportunities (excluding PE) to the majority (>80%) of their students. (5) % of parents who report their children and youth have access to PA opportunities at school in addition to PE classes. (6) % of schools with students who have regular access to facilities and equipment that support PA (e.g., gymnasium, outdoor playgrounds, sporting fields, multi-purpose space for PA, equipment in good condition).
Community and Environment	A+	C+	(1) % of children or parents who perceive their community/municipality is doing a good job at promoting PA (e.g., variety, location, cost, quality). (2) % of communities/municipalities that report they have policies promoting PA. (3) % of communities/municipalities that report they have infrastructure (e.g., sidewalks, trails, paths, bike lanes) specifically geared toward promoting PA. (4) % of children or parents who report having facilities, programs, parks and playgrounds available to them in their community. (5) % of children or parents who report living in a safe neighbourhood where they can be physically active. (6) % of children or parents who report having well-maintained facilities, parks and playgrounds in their community that are safe to use.
Government	D	C	(1) Evidence of leadership and commitment in providing PA opportunities for all children and youth. (2) Allocated funds and resources for the implementation of PA promotion strategies and initiatives for all children and youth. (3) 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).
<sup>a</sup> Sleep	D-	N/A	(1) % of children who meet international AASM (American Association of Sleep Medicine) standards for nocturnal sleep duration for their age category.
<sup>a</sup> Seasonal Variations	D+	N/A	(1) % of children who remain consistently physically active throughout the year, i.e., for daily PA deviations greater than 5% between calendar months by season, one letter grade will be reduced or advanced accordingly. (2) % of children who report greater sedentary behaviours within a given season compared to other months of the year and can be attributed to weather events or seasonal variations in weather (e.g., heatwaves, polar vortex, midnight sun, etc.).

<sup>a</sup> Denotes custom Slovenian indicators for sleep and seasonal variations which may affect overall child PA levels each year.













N = 48 boys, 11-14-year-olds), of objectively measured data (UKK RM 42 accelerometers, UKK Terveyspalvelut Oy, Tampere, Finland), found 25% of children were meeting the previous WHO recommendations for achieving at least 60 min moderate to vigorous physical activity (MVPA) every day.<sup>18</sup> An ongoing European study was revisited (e.g. EUPASMOS database) to calculate total weekly average MVPA of all children in the study (N = 219, aged 8–17 years) and found that 82% were meeting the current WHO recommendations (A-). Objective data is lacking from 2020 onwards, although self-reported evidence shows Slovenian schoolchildren (ages 6–18 y) were meeting PA guidelines on average 5 out of 7 days per week during the COVID-19 lockdown, with 26.7% meeting MVPA guidelines everyday, placing them first amongst 10 countries surveyed.<sup>16</sup> Finally, data retrieved from SLOfit was queried via the in-house My SLOfit app (by SHAPES questionnaire<sup>18,19</sup>), where

82.4% of N = 239 children (aged 11–15 years, A-) were meeting WHO recommendations mean weekly PA levels.

### 3.2. Organized Sport and Physical Activity

In Slovenia, high performance sport data are compiled each year in annual reports and released by the Slovenian Olympic Committee and the national government. Supporting data include: (1) number of registered sport organisations active in the country (2018: 8,187, 2019: 8,152, 2020: 8,178, 2021: 8318), (2) number of registered sportspersons from ages 6–16 years (2018: 33,916, 2019: 32,164, 2020: 32,215, 2021: 21,714), (3) number of possible active days for training and competitions from ages 6–16 years (2018: 365, 2019: 365, 2020: 224, 2021: 178–187 days), and (4) national funding for sport (2018: 23,720,482 €, 2019: 20,569,754 €, 2020:

**Table 2**  
Separated grades for each indicator, including the novel data confidence score created to assist readers and policy-makers with data interpretation and strength of the grade assignments..

Indicator	2018-2020	2020-2021	Data Confidence Score
Overall Physical Activity	A-	A-	
Organised Sport and Physical Activity	C+	C	
Active Play	D	C+	
Active Transport	C	INC	
Sedentary Behaviours	B	C	
Physical Fitness	A+	A-	
Family and Peers	B+	INC	
Schools	A	A	
Community and Environment	A+	A+	
Government	A	F	
*Sleep	D-	INC	
*Seasonal Variations	D	C-	

22,398,795 €, 2021: 26,107,369 €). On balance, for 2018–2019 there were no significant changes in number of children participating compared to 2018, but for 2020–2021, there is clear evidence that despite more money being allocated to organized sport, it did not translate to more child participation rates.

### 3.3. Active Play

In 2020, (remarkably), novel data surveyed during the height of the first lockdown (Feb–May 2020) found that 56% of children played outdoors more than 2 h per day,<sup>16</sup> and child PA patterns were reversed, such that levels of MVPA were reported higher on weekends than weekdays.<sup>17</sup> These family activity patterns were confirmed (in principle) after interrogating the Google Mobility reports feature which found that from March 26 to May 7, 2020, during the first-wave pandemic lockdown there was a 37% increase in Slovenian movement patterns to public outdoor spaces like national parks, public gardens, and beaches.<sup>1</sup> Although these trends are promising, the data confidence score is low since data were primarily questionnaire based, were not nationally representative, and may be open to sampling bias.

### 3.4. Active transportation

A 2020 study on travel habits showed that many children are still driven to school/kindergarten by car, even for very short

distances. Survey data found that 68% of parents report taking their children to school or kindergarten by car occasionally, 23% of them driving everyday, and 13% several times a week. Indeed, 14% of children who go by car live less than 500 m away (!), and 18% live at a distance between 500 m and 1 km from their school/kindergarten. Of primary school children, 41.0% walk to school, 23.6% are driven by car and 20.0% by school bus. Encouragingly, of children who live up to 500 m from secondary school, 97% go to school on foot and only 2% are driven by car. The overall number of children engaging in active transport remains within the C range (i.e., succeeding with about half of children, 47%–53%), but since schools were closed during 2020–2021, grades were incomplete (INC).

### 3.5. Sedentary behaviours

Kovacs and colleagues (2021) reported that 48.7% (C) of Slovenian children sampled (N = 1897; 802 boys) were meeting the 2-h or less screen time recommendations on weekdays in 2020. This rose to 55.8% (C+) for weekends.<sup>16</sup> This reversal of typical weekday/weekend trends were later confirmed in a small, repeated-measures study on N = 62 school children who found that although MVPA decreased by ~46 min per day, screen time demonstrated an interaction effect (i.e. spent less recreational screen time on weekends during lockdown compared to no movement restrictions).<sup>17</sup> Children meeting weekday/weekend screen time recommendations before lockdown were 75% (B+) and

54.7% (C+), which changed to 65.6% (B-, weekday) and 70.3% (B, weekend) during lockdown. Finally, a Joint Research Centre European Commission technical report was conducted in the spring/summer of 2020 to query how children (10–18 y) experienced online risks during the Covid-19 lockdown.<sup>20</sup> Slovenia participated with N = 506 schoolchildren (female = 45%) surveyed on various aspects of their online behaviour. Children reported 6.69 h online on weekdays (~3.85 h on schoolwork), and 54% reported that they spent more time online now than before the pandemic.

### 3.6. Physical fitness

The Global Matrix 4.0 includes Physical Fitness as one of their standard PA indicators, with a published international standard as its benchmarking criteria.<sup>21</sup> This is an excellent peer-reviewed and evidence-based source, however using this paper as the sole criteria for grading the Physical Fitness component is problematic for Slovenia because there is only one comparable measure to the article. The SLOfit test battery<sup>6</sup> doesn't measure flamingo, our plate-tapping test is a sitting version with an electronic board whereas the Eurofit protocol has a standing version with manual counting, there is no sit and reach (stand and reach) and no hand grip either; there are sit-ups, but they are measured in 60 s epochs (not 30-s), and the bent arm hang is done with an under-grip, not over-grip technique. From previous work, cardiorespiratory (CRF) fitness in Slovenian children is universally high,<sup>12</sup> with boys and girls of all ages meeting or exceeding international health risk cut-offs (A+). When comparing centile values for all children (6–19 y) standing long jump scores from the FitBack data portal (<https://www.fitbackeurope.eu/en-us/fitness-map>), 81.8% of all Slovenian children meet the health zone cut off criteria (A-).

### 3.7. Family and Peers

Quality evidence remains scarce for this benchmark in Slovenia likely because other areas of society emphasise child PA priorities (e.g. Schools, Organized Sport, Community), so this is by far the weakest indicator to rank objectively. One recently published study performed in autumn 2018 investigated whether family PA habits affect children's PA<sup>22</sup>. The sample included N = 174 children (77 boys, 97 girls, 11–14 y) and their families (N = 225 parents, N = 52 grandparents) who wore accelerometers continuously for one week. The authors report that mothers' MVPA was associated with their child's MVPA, and fathers' sedentary time was associated with boys' sedentary time. It was not possible to systematically quantify benchmarks during the pandemic (INC).

### 3.8. Schools

By grades 4 to 5, 50% of physical education (PE) teachers are specialists; from grade 6 through secondary school, 100% of PE classes are taught by PE teachers with a university degree, as decreed by law. All schools in Slovenia have written, public, PA policies (e.g., bike racks at school, traffic calming on school property, outdoor play time).

In 2020 during lockdown periods, 69.2% of 11–14-year-old children (N = 1897, 802 boys) reported being active in online PE classes sometimes, often, or always.<sup>16</sup> This is because of intense efforts made by both individual PE teachers to continue their curricula, even when forced to perform lessons remotely, and the education system at Faculty of Sport, which (in coordination with other stakeholders) responded quickly to the pandemic lockdown situation.<sup>3</sup> On average, both PE teachers and students completing their practical pedagogical training, reported that most PE lessons took the form of independent student activity following written or

recorded instructions, and the rest took the form of online outdoor or indoor live classes.<sup>23</sup> Between the infrastructure laws which remain unchanged, and the concerted efforts of PE teachers nationwide to deliver quality PE instruction remotely, the (A) ranking was retained for this indicator in both epochs.

### 3.9. Community and Environment

All municipalities in Slovenia must implement policies promoting PA and publish annual reports on this data, including detailed infrastructure plans, thus for every AHKGA benchmark, Slovenia objectively ranks each 100%. These infrastructure metrics did not change in 2020 *per se*, but access to community infrastructure, (especially first wave lockdown measures) did. At that time, all outdoor public spaces in urban dwelling areas (e.g. playgrounds, sports halls, and running tracks) were prohibited to the public.

### 3.10. Government

Unfortunately, the Slovenian Government response to the global pandemic in terms of policy decisions related to providing PA opportunities, allocated funds and resources, and progress through decision making processes, was disastrous for child PA overall. Despite aggressive campaigns to maintain PA at home,<sup>1</sup> the country experienced tremendous decreases in child fitness as self-isolation measures were mandated by national authorities, prompting researchers to create a method to track and communicate government decisions with direct impact on child PA, fitness, and overall health to the public (i.e., the SLOfit Barometer).<sup>3</sup> Moreover, leisure sport programmes for children and youth received 38% less money in 2021 in comparison to 2020. Also, funding for competitive sport of children and youth went down by 13%. At the same time, the Ministry for Education, Science and Sport failed to assure the continuation of the highly successful Healthy Lifestyle project after the year 2018. For context, The Republic of Slovenia has been experiencing the greatest slide in its democratic index amongst the Eastern Europe and Central Asian region, due in part to the fact that a fragmented, center-left ruling coalition was kept together only by polarized relations with the political right ([https://freedomhouse.org/sites/default/files/2022-04/NIT\\_2022\\_final\\_digital.pdf](https://freedomhouse.org/sites/default/files/2022-04/NIT_2022_final_digital.pdf)).

### 3.11. Sleep

Sleep data were retrieved from self-reported questions from ACDSi, which found that less than 40% of children between 11 and 18 years were meeting sleep recommendations during school days, but on weekends, 77% of boys and 87% of girls did meet recommendations. The HBSC study found that in 11, 13, 15, and 17-years-old, just over one fifth (22.1%) of adolescents sleep 9 h or more per night during the school week (D-).<sup>24</sup> More recently, sleep duration data was self-assessed in N = 62 schoolchildren before and during the first wave lockdown period from March–May 2020, finding greater variability in sleep patterns, with some children reporting far less, and others reporting far more nocturnal sleep durations.<sup>17</sup>

### 3.12. Seasonal variations

Daily maximum temperatures are significantly associated with MVPA and sedentary time,<sup>25</sup> children's thermoregulation physiology differs to fully mature adults,<sup>26</sup> and when children play outdoors, MVPA is associated with pronounced elevations in heat strain.<sup>27</sup> In Slovenia, anecdotal evidence comparing ACDSi data (sampled in September) to SLOfit data (sampled in April) suggest fitness trends are negatively affected by summer holidays.

Slovenian children overall PA decreases by 18% ( $p < 0.001$ ), physical inactivity increases by 5.5% ( $p < 0.001$ ), moderate PA decreases by 53% ( $p < 0.001$ ) and moderate to vigorous PA decreases by 45% ( $p < 0.001$ ) during summer holidays.<sup>28</sup> Additionally, pilot work evaluating 24-h movement behaviour and thirst found differences between children and adults on days when a local heat alert is broadcast.<sup>29</sup> Researchers found that on heat alert days (Temperature range: 26.7°C–33.54 °C), children engaged in significantly more moderate (children: 107 ± 90 min, adults: 56 ± 53 min) and vigorous (children: 62 ± 46 min, adults: 19 ± 33 min) PA compared to adults, but also reported greater thirst sensation, highlighting the need for more research into weather-related effects on child PA habits.

#### 4. Discussion

Sudden changes in society can cause ripple effects to many aspects of modern life in often far-reaching, unforeseen, and long-term ways. These social changes can follow a generalised pattern whereby there is a perturbation to an original factor (e.g. obesity rate) which may take months, or even decades to recover to its pre-event baseline (if ever). The COVID-19 global pandemic represents one such social challenge, although changes in economic freedom, climate culpability, and human development index are other examples of factors which can affect societal norms, like child and adolescent PA patterns.<sup>9,30</sup>

The current Republic of Slovenia Report Card has uncovered some interesting dynamics regarding which sectors came under the greatest 'pressure of change' during the first and second waves of the COVID-19 pandemic. In general, by compiling this report in a systematic way, and following published procedures,<sup>14</sup> there is confidence in reporting that although the *Overall Physical Activity* of children were still being met, this was largely based on the strength of the robust *Schools* system in Slovenia, which employs specifically-trained physical education teachers for children, even in elementary school. Countermeasures to physical inactivity due to COVID-19 policies were swiftly adopted across the country in a uniform manner,<sup>1</sup> coordinated by leaders from the SLOfit research team,<sup>6</sup> and published into universal PA guidelines.<sup>2</sup> Other sectors of society that held up well under these rapid social changes included infrastructural areas like: *Organized Sport and Physical Activity* and *Community and Environment*.

The indicator with the greatest decline between epochs was the *Government* indicator, which fell precipitously from achieving an 'A' to an 'F' due to the many regulations imposed on physical movement patterns and re-directing of state funding; these decisions directly and negatively impacted opportunities for people to engage in PA as the pandemic continued. Certain policy decisions were often in conflict with advice from healthcare professionals, spurring the establishment of a new national initiative called the "SLOfit Barometer of Public Health Engagement",<sup>3</sup> which aimed to keep track of real-time policy changes that directly affected child physical activity opportunities across the country. The urgency in the response was because Slovenian researchers were able to see large, dramatic decreases in child fitness outcomes in near-real time, thanks to their annual *Physical Fitness* testing scores (Fig. 3) derived immediately post-lockdown in May and June 2020. And, although certain fitness metrics were not immediately affected in some highly-fit children from a small sample study,<sup>17</sup> there were many changes to the nature of 24-HMB in terms of *Sedentary Behaviour* and *Sleep*. Some indicators were not able to be scored at all (*Active Transport*, *Family and Peers*, *Sleep*) due to the restrictions on studies or lack of available research during 2020–2021 timeframe. Finally, *Seasonal Variations* was added as an indicator of interest because more research is needed on how climate change and

global warming will affect PA patterns and health risk in the next generation,<sup>31,32</sup> and recent research found there were significant changes in PA behaviour patterns when children were on summer vacation with their families.<sup>28</sup>

Physical inactivity is a major public health concern. Less than 8% of youth meet 24-HMB guidelines for PA, sedentary behaviour and sleep, with fully 19% of children not meeting the criteria for any one guideline.<sup>33</sup> The top three international priorities for physical fitness testing in children highlighted by a recent Delphi study include: (i) "conduct longitudinal studies to assess changes in fitness and associations with health", (ii) "use fitness surveillance to inform decision making", and (iii) "implement regular and consistent international/national fitness surveys using common measures".<sup>34</sup> The 2021 Republic of Slovenia Report Card has highlighted the urgent need for regions to establish their own robust child fitness surveillance systems which can inform public health policies and provide longitudinal data to study how the many ongoing changes in society affect the health and well-being of children globally. Ongoing projects and collaborations, including the recently-established FitBack consortium, are working to turn these goals into reality. By launching a free-for-use, multi-lingual, online child fitness portal based on updated reference values,<sup>35</sup> there is concerted efforts being made to close the gap in terms of child fitness standardisation, accessibility and monitoring worldwide (available online here: [fitbackeurope.eu/en-us/](http://fitbackeurope.eu/en-us/)). Establishing long-duration, population-scaled PA intervention studies can reverse negative health trends (like obesity),<sup>36</sup> but this must come with a willingness to invest in future health outcomes now. Maintaining childhood fitness will become increasingly important in an ever-changing world, especially as global warming,<sup>32</sup> conflict, and rapid changes in technology continue to push societies in continuous and unexpected ways.

#### 5. Conclusions

Although Slovenia has some of the most consistently physically-active children in the world, the effects of the COVID-19 pandemic exerted significant reductions in PA opportunities, and especially when coupled with funding re-distributions, resulted in the steepest decline of child physical fitness observed within the >35-year history of Slovenia's well-established national fitness surveillance systems. The challenge of monitoring the effects of rapid social change on physical activity and other health outcomes is made easier when there is a robust national surveillance system in place which can alert relevant multi-disciplinary actors (e.g. healthcare, government, education, policymakers) to emerging negative outcomes. Thus, this 2021 Report Card for the Republic of Slovenia emphasizes the need for all regions to consider implementing national fitness monitoring and surveillance programmes to better identify dynamic changes in public health patterns due to external driving factors, like conflict, climate change and more.

#### Author contributions

SAM and VS Conceptualization; SAM Data curation; SAM and VS Formal analysis; GJ and GS; Funding acquisition; SAM and VS Investigation; SAM, GJ, GS, MK, MGo, PPS, MGa, PK, KM, MP, VS Methodology; SAM Project administration; GJ and GS; Resources; SAM Visualization; SAM Writing - original draft; SAM, GJ, GS, MK, MGo, PPS, MGa, PK, KM, MP, VS Writing - review & editing.

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## Declaration of competing interest

None to declare for all authors.

## References

- Morrison SA, Jurak G, Starc G. Responding to a global pandemic: republic of Slovenia on maintaining physical activity during self-isolation. *Scand J Med Sci Sports*. 2020;30(8):1546–1548. <https://doi.org/10.1111/sms.13745>.
- Jurak G, Morrison SA, Leskošek B, et al. Physical activity guidelines during the COVID-19 pandemic outbreak. *J Sport Health Sci*. 2020;9(4):325–327. <https://doi.org/10.1016/j.jshs.2020.05.003>.
- Jurak G, Morrison SA, Kovač M, et al. A COVID-19 crisis in child physical fitness: creating a barometric tool of public health engagement for the republic of Slovenia. Perspective. *Front Public Health*. 2021;9(179). <https://doi.org/10.3389/fpubh.2021.644235>. March-05 2021.
- Sember V, Starc G, Jurak G, et al. Results from the republic of Slovenia's 2016 report card on physical activity for children and youth. *J Phys Act Health*. 2016;13(11 Suppl 2):S256–S264. <https://doi.org/10.1123/jpah.2016-0294>.
- Sember V, Morrison SA, Jurak G, et al. Results from Slovenia's 2018 report card on physical activity for children and youth. *J Phys Act Health*. 2018;15(S2):S404–S405. <https://doi.org/10.1123/jpah.2018-0542>.
- Jurak G, Leskošek B, Kovač M, et al. SLOfit surveillance system of somatic and motor development of children and adolescents: upgrading the Slovenian Sports Educational Chart. *Kinanthropologica*. 2020;56(1):28–40.
- Physical Status: The Use and Interpretation of Anthropometry: Report of a WHO Expert Committee*. WHO technical report series; 2014:854.
- Buonocristiano M, Spinelli A, Williams J, et al. Childhood overweight and obesity in Europe: changes from 2007 to 2017. *Obes Rev: Off J Int Assoc Stud Obes*. Nov 2021;22(suppl 6):e13226. <https://doi.org/10.1111/obr.13226>.
- Lee EY, Abi Nader P, Aubert S, et al. Economic freedom, climate culpability, and physical activity indicators among children and adolescents: report card grades from the global matrix 4.0. *J Phys Act Health*. 2022;19(11):745–757. <https://doi.org/10.1123/jpah.2022-0342>. Nov 1.
- Sorič M, Jurak G, Đurić S, Kovač M, Strel J, Starc G. Increasing trends in childhood overweight have mostly reversed: 30 years of continuous surveillance of Slovenian youth. *Sci Rep*. 2020;10(1):11022. <https://doi.org/10.1038/s41598-020-68102-2>.
- Potočnik ŽL, Jurak G, Starc G. Secular trends of physical fitness in twenty-five birth cohorts of slovenian children: a population-based study. Original research. *Front Public Health*. 2020;8(616). <https://doi.org/10.3389/fpubh.2020.561273>. October-19 2020.
- Morrison SA, Sember V, Leskošek B, Kovač M, Jurak G, Starc G. Assessment of secular trends and health risk in pediatric cardiorespiratory fitness from the republic of Slovenia. *Front Physiol*. 2021;12:644781. <https://doi.org/10.3389/fphys.2021.644781>.
- Tremblay MS, Gray CE, Akinroye K, et al. Physical activity of children: a global matrix of grades comparing 15 countries. *J Phys Act Health*. May 2014;11(Suppl 1):S113–S125. <https://doi.org/10.1123/jpah.2014-0177>.
- Aubert S, Barnes JD, Demchenko I, et al. Global matrix 4.0 physical activity report card grades for children and adolescents: results and analyses from 57 countries. *J Phys Act Health*. 2022;19(11):700–728. <https://doi.org/10.1123/jpah.2022-0456>. Nov 1.
- Jurak G, Kovač M, Starc G. The ACDSi 2013 – the analysis of children's development in Slovenia 2013: study protocol. *Anthropol Noteb*. 2013;19(3):123–143.
- Kovacs V, Starc G, Brandes M, et al. Physical activity, screen time and the COVID-19 school closures in Europe - an observational study in 10 countries. *Eur J Sport Sci*. 2021;29:1–10. <https://doi.org/10.1080/17461391.2021.1897166>.
- Morrison SA, Meh K, Sember V, Starc G, Jurak G. The effect of pandemic movement restriction policies on children's physical fitness, activity, screen time, and sleep. *Front Public Health*. 2021;9:785679. <https://doi.org/10.3389/fpubh.2021.785679>.
- Premelc J, Meh K, Vähä-Yppä H, Sember V, Jurak G. Do fitter children better assess their physical activity with questionnaire than less fit children? *Int J Environ Res Publ Health*. 2022;19(3). <https://doi.org/10.3390/ijerph19031304>. Jan 24.
- Wong SL, Leatherdale ST, Manske SR. Reliability and validity of a school-based physical activity questionnaire. *Med Sci Sports Exerc*. 2006;38(9):1593–1600. <https://doi.org/10.1249/01.mss.0000227539.58916.35>. Sep.
- Lobe B, Velicu A, Staksrud E, Chaudron S, Di Gioia R. *How Children (10-18) Experienced Online Risks during the Covid-19 Lockdown*. 2020;JRC124034.
- Tomkinson G, Carver K, Atkinson F, et al. European normative values for physical fitness in children and adolescents aged 9–17 years: results from 2 779 165 Eurofit performances representing 30 countries. *Br J Sports Med*. 2018;52(22):1445–14563. <https://doi.org/10.1136/bjsports-2017-098253>.
- Zovko V, Djuric S, Sember V, Jurak G. Are family physical activity habits passed on to their children? *Front Psychol*. 2021;12:741735. <https://doi.org/10.3389/fpsyg.2021.741735>.
- Markelj N, Potočnik ŽL, Jurak G, Kovač M. The quality of practical pedagogical training during the epidemic through the eyes of the slovenian physical education student teachers. *Coll Antropol*. 2021;45(3):179–189.
- Jeriček Klansček H, Roškar M, Drev A, et al. *Z Zdravjem Povezana Vedenja V Šolskem Obdobju Med Mladostniki V Sloveniji: Izsledki Mednarodne Raziskave HBSC*. 2019.
- Lewis LK, Maher C, Belanger K, Tremblay M, Chaput JP, Olds T. At the mercy of the gods: associations between weather, physical activity, and sedentary time in children. *Feb Pediatr Exerc Sci*. 2016;28(1):152–163. <https://doi.org/10.1123/pes.2015-0076>.
- Notley SR, Akerman AP, Meade RD, McGarr GW, Kenny GP. Exercise thermo-regulation in prepubertal children: a brief methodological review. *Med Sci Sports Exerc*. 2020;52(11):2412–2422. <https://doi.org/10.1249/mss.0000000000002391>. Nov.
- McGarr GW, Saci S, King KE, et al. Heat strain in children during unstructured outdoor physical activity in a continental summer climate. *Temperature (Austin, Tex)*. Aug 12 2020;8(1):80–89. <https://doi.org/10.1080/23328940.2020.1801120>.
- Volmut T, Pišot R, Planinsec J, Šimunič B. Physical activity drops during summer holidays for 6- to 9-year-old children. Original research. *Front Public Health*. 2021;8(1060). <https://doi.org/10.3389/fpubh.2020.631141>. January-18 2021.
- Ravanelli N, Morris NB, Morrison SA. Effect of heat waves on 24-hour movement behaviour, thermal perception, and thirst in children and adults: a pilot study. *Appl Physiol Nutr Metabol*. 2021;46(10):71. <https://doi.org/10.1139/apnm-2021-0562>.
- Silva D, Aubert S, Ng K, et al. Association between physical activity indicators and human development index at a national level: information from global matrix 4.0 physical activity report Cards for children and adolescents. *J Phys Act Health*. 2022;19(11):737–744. <https://doi.org/10.1123/jpah.2022-0321>. Nov 1.
- Heildén D, Andersson C, Nilsson M, Ebi K, Friberg P, Alfvén T. Climate change and child health: a scoping review and an expanded conceptual framework. *Lancet Public Health*. 2021;5(3):e164–e175. [https://doi.org/10.1016/S2542-5196\(20\)30274-6](https://doi.org/10.1016/S2542-5196(20)30274-6).
- Morrison SA. Moving in a hotter world: maintaining adequate childhood fitness as a climate change countermeasure. *Temperature*. 2022;1–19. <https://doi.org/10.1080/23328940.2022.2102375>.
- Tapia-Serrano MA, Sevil-Serrano J, Sánchez-Miguel PA, López-Gil JF, Tremblay MS, García-Hermoso A. Prevalence of meeting 24-Hour Movement Guidelines from pre-school to adolescence: a systematic review and meta-analysis including 387,437 participants and 23 countries. *J Sport Health Sci*. Jan 20 2022. <https://doi.org/10.1016/j.jshs.2022.01.005>.
- Lang JJ, Zhang K, Agostinis-Sobrinho C, et al. Top 10 international priorities for physical fitness research and surveillance among children and adolescents: a twin-panel Delphi study. *Sports Med*. 2023;53(2):549–564. <https://doi.org/10.1007/s40279-022-01752-6>. Feb.
- Ortega F, Leskošek B, Blagus R, et al. European fitness landscape for children and adolescents: updated reference values, fitness maps and country rankings based on nearly 8 million test results from 34 countries gathered by the FitBack network. *Br J Sports Med*. 2023;57(5):299–310. <https://doi.org/10.1136/bjsports-2022-106176>.
- Jurič P, Jurak G, Morrison SA, Starc G, Sorič M. Effectiveness of a population-scaled, school-based physical activity intervention for the prevention of childhood obesity. *Mar Obesity (Silver Spring, Md)*. 2023;31(3):811–822. <https://doi.org/10.1002/oby.23695>.