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Physical activity in the era of climate change and COVID-19 pandemic: Results from the South Korea's 2022 Report Card on physical activity for children and adolescents

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ABSTRACT

Background: With intensifying air pollutant levels and the COVID-19 pandemic, physical inactivity of South Korean children and adolescents may be threatened. Therefore, monitoring and surveillance of physical activity (PA) and relevant indicators are important for policy making pertaining to health promotion. Report Card is a third comprehensive evaluation of PA-related behaviors among and the sources of influence for South Korean children and adolescents.
Purpose: To provide the outcome of the South Korea's 2022 Report Card on PA for children and adolescents.
Methods: Based on a variety of sources including national surveys collected pre- and during-COVID-19 and information collected from government webpages, 11 indicators were graded by a committee of experts informed by the best available evidence. Data from during-COVID-19 were available for Overall PA, Sedentary Behavior, and Sleep and considered together in generating the overall grades.
Results: Grades were assigned to behavioral indicators (Overall PA: *D*-; Active Transportation: *B*+; Sedentary Behavior: *D*; Sleep: *F*) and sources of Influence (Family and Peers: *C*-; School: *A*; Community and Environment: *B*-; Government: *A*). Organized Sport and PA, Active Play, and Physical Fitness could not be graded due to the lack of data. The results largely indicated that children and adolescents show unfavorable behavioral grades even with favorable grades observed for the sources of influence indicators. Trivial differences were observed pre- and during-pandemic for Overall PA (≥60 min of MVPA for ≥4 d/wk: 20.8% vs 19.9%) and Sleep (met age-specific recommendation: 14.1% vs 15.0%); however, a marked increase in Sedentary Behavior was observed (≤2 h/d screen time: 28.8% vs 20.1%). A stark weekday vs weekend difference was observed in sleep duration. In terms of PA related sources of influence, high accessibility to PA facilities (81.1%) and high satisfaction of neighborhood public transit

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(74.6%) and safety (80.7%) were well reflected in our Active Transportation grade (B+). Nonetheless, perception of green environments including outdoor air quality (44.0%), noise (39.6%) and green space (56.5%) showed lower scores, suggesting that new barriers to active lifestyles are emerging for South Korean children and adolescents. Gender differences were also observed for overall PA (≥60 min of MVPA for ≥4 d/wk: 29.1% for boys vs 11.3% for girls) and sleep (met age-specific recommendations: 17.3% for boys vs 11.4% for girls), but not for sedentary behavior (≤2 h/d screen time: 26.4% for boys and 24.9% for girls).

Conclusions: Government and school policies/programs and the built environment are, in general, conducive to physically active lifestyles for South Korean children and adolescents; however, behavioural indicators received poor grades except for Active Transportation. A thorough evaluation of policies/programs at government, local, and school levels is needed to ensure that the efforts to have PA-enhancing infrastructure and systems are actually being translated into the behavior of children and adolescents in South Korea. Furthermore, improving PA surveillance, monitoring, and advocacy to ultimately establish healthy lifestyle patterns among children and adolescents is a top priority.

1. Introduction

Physically active lifestyle is beneficial for the varying aspects of (e.g., physical, mental, cognitive) health among children and adolescents.[1,2] For optimal health benefits, the World Health Organization (WHO) recommends that children and adolescents aged 5–17 years should accumulate an average of 60 min of moderate-to vigorous-intensity physical activity (MVPA) per day across a week and spend less time being sedentary, especially recreational screen time (ST; ≤2 h/day).[3] In addition to recommendations on MVPA and sedentary behavior, Canada's 24-Hour Movement Guidelines (24-hr guidelines thereafter)[4] also provide age-specific recommendations on sleep (9–11 h for those aged 5–13 years; 8–10 h for those aged 14–17 years).

According to a global study on physical inactivity (i.e., not meeting the recommended level of PA) among adolescents (11–17 years)[5] in 146 countries, adolescents in South Korea (Korea thereafter) showed the highest prevalence of insufficient PA among girls (97.2%) and both genders combined (94.2%) in 2016. Furthermore, recent evidence consistently suggests that the proportion of Korean adolescents meeting the guidelines is extremely low. For instance, in a study examining 6-year trends of meeting the 24-hr guidelines among 372,433 adolescents,[6] 5.3%, 60.3%, and 10.2% met the PA, ST, and sleep recommendations and only 0.5–0.8% met all three recommendations within the 24-hr guidelines. On top of already low adherence to the 24-hr guidelines, the recent COVID-19 pandemic and related public health restrictions likely have exacerbated the situation, as observed in the Canadian samples[7,8] and globally.[9]

Healthy movement behaviors fluctuate over time and are influenced by varying factors within the socioeconomical modelling[10] (e.g., weather, COVID-19 pandemic and public health restrictions). Therefore, continuous monitoring and evaluation of behaviors and the sources of influence are important to better support children and adolescents to establish a healthy behavioral profile that could track into adulthood. Report Card on physical activity (PA) and related indicators has been developed for Korean children and adolescents in 2016[11] and 2018[12] as part of the global efforts led by the Active Healthy Kids Global Alliance (AHKGA), known as Global Matrix.[13–15] Briefly, Global Matrix is a biannual initiative where multi countries conduct evaluation on the PA-related behaviors of children and adolescents and related indicators to develop a Report Card based on harmonized benchmarks and grading scheme since 2014.[16,17]

Due to the COVID-19 pandemic, the development of Report Card and Global Matrix 4.0 was interrupted and delayed from 2020; however, it created a new opportunity where, if available, the comprehensive evaluation can include data from pre-pandemic and during-pandemic eras. Therefore, using data from both eras, the objective of this study was to outline the process and outcome of the 2022 South Korea's Report Card on PA for children and adolescents.

2. Methods

The development of 2022 South Korea's Report Card was conducted with the following timelines:

1. 2021 June – First leadership group meeting (subsequent monthly meetings were performed until 2022 March)
2. 2021 August – First Scientific Committee Team (SCT) meeting
3. 2021 August – 2022 February: Data analysis, evidence synthesis, and preparation
4. 2022 February: Second SCT meeting for grade assignment
5. 2022 March - October: Report Card knowledge translation materials development

2022 Report Card team consisted of a leadership group, SCT and Research Working Group (RWG). The leadership group included two Report Card leaders (JJ, YSK) and one research director (EL). SCT comprised 14 members recognized experts in this research field, including the members of the leadership group, and were responsible for providing key evidence/knowledge and the final grading of the 10 core and one additional indicators. The RWG consisted of eight members consisting of graduate students at four different post-secondary institutions in Korea and Canada. The RWG was responsible for data gathering and screening, searching government documents, data analysis, and the general operation and coordination of the research.

The 2022 Report Card included the evaluation of 10 core indicators and one additional indicator: (1) Overall PA, (2) Organized Sport and PA, (3) Active Play, (4) Active Transportation, (5) Sedentary behaviors, (6) Physical Fitness, (7) Family and Peers, (8) School, (9) Community and Environment, (10) Government, and (11) Sleep (non-core indicator). Sleep is included as an additional indicator given its relevance and importance within the 24-hr movement behavior paradigm.[2,18] Pre- and during-COVID-19 data on Overall PA, Sedentary Behavior, and Sleep were also available, thus, considered together in generating the overall grades. Detailed descriptions of the main data sources for each indicator are shown in Table 1.

Data from the Korea Youth Risk Behavior Web-based Survey (KYRBS), Korea National Health and Nutrition Examination Survey (KNHANES), Korea Community Health Survey (KCHS), and Panel Study on Korea Children (PSKC) were used. Briefly, the KYRBS, KNHANES, and KCHS are annual, nationally representative, self-administered cross-sectional surveys[19–21] collecting information on health, health-related behaviors, and influencing factors to inform health policies in Korea. KNHANES also provides household identification number that allows data users to link parent-child data. KCHS data only includes self-reported data from adults ≥18 years, therefore, only environmental data were used to inform the Report Card. PSKC is a nationally representative, proxy-reported, panel study of Korean children, parents, households, and institutions (i.e., daycare, kindergarten, school) to better understand factors influencing child health and development.[22] Given that the age group for this data was 0–7 years, only environmental data were used to inform the Report Card. Additionally, grey documents from the Korean Ministry of Culture, Sport, and Tourism, Ministry of Education, and Ministry of Health and Welfare were used to grade School and Government indicators.

2.1. Data analysis and synthesis

For indicators that were informed by survey data are described in Table 1. Data analyses were performed in four different institutions per data source and the outputs were verified by the members of the leadership group and their graduate stduents (SG, HL). Statistical coding was saved in Word or SPSS syntax file and outputs were recorded in the pre-formatted Excel sheet to facilitate collaboration. Specifically, the Excel recording sheet had 11 tabs (one tab per indicator) and each tab included the name of the indicator, definition, grading benchmarks and criteria,[23] and the table where data analysts can enter values from their output. For behavioral indicators, it was instructed to enter corresponding prevalence for both genders, then girls and boys separately, and if age-stratified analysis can be done, by age group (0–6 years, 7–12 years, 13–17 years), sample size, and average duration in minutes per day across the week, then during weekdays and weekend days, separately.

KYRBS 2018-20 data were analyzed by one member (GS) of the SCT at Yonsei University while KNHANES 2018-19 data were analyzed by two members (SH, YJ) at Seoul National University. KCHS 2018-19 data were analyzed by one member at the University of Alberta (KY–B) while PSKC 2020 data were analyzed by one member at Queen's University (EL). All outputs were verified by two members (HL, EL) at Queen's University for finalization. If inconsistencies or ambiguities were suspected, the outputs were discussed further and revised accordingly. For data analyses relevant to sedentary behavior and sleep, KYRBS survey items asked participants to record the time spent in each behavior by hours and minutes, separately for weekdays and weekend days. Therefore, all numbers were converted into minutes then weighted average for a week was calculated using the following equation: (weekday*5+weekend day*2)/7. Values were converted back to hours for sleep. All data analyses using nationally representative samples followed a complex sample procedure in IBM SPSS (version 28) and STATA.

Information needed to evaluate School and Government indicators were collected by a member (LG) at Seoul National University based on the Health-Enhancing PA (HEPA) Policy Audit Tool version 2 (PAT v2).[24] The grade assignment was conducted based on the results produced for each indicator via data collection and analyses described above in relation to grading benchmarks and rubric provided by the AHKGA and discussion among SCT members. Global Matrix 4.0 grading benchmarks for each indicator and the rubric used are available in the main Global Matrix 4.0 paper.[23] Knowledge translation materials were developed by a designer at KnowledgeWorks Studio (knowledgeWorks.studio@gmail.com) and one member at Yonsei University (OO).

3. Results

The 2022 South Korea's Report Card is the third comprehensive evaluation of PA-related indicators. The cover of the Report Card is in Fig. 1. The prevalence of behavioral indicators and sources of influence are described in Table 2 and Table 3, respectively. The final grades, in addition to the previous rounds of Report Card from 2016 and 2018 are presented in Table 4. Overall, poor or no grades due to insufficient data ("F" to "B" with three "INC"s) were observed for behavioral/individual indicators, while for the sources of influence, grades received better grades ("C-" to "A" with no "INC"s) and were improved from the previous rounds of Report Cards.

4. Discussion

4.1. Overall Physical Activity: D-

Overall PA received a “D-” grade, based on the 2018–2020 KYRBS data (n = 57,303–60,040; 12–18 years). As shown in Table 2, 20.4%, 21.4%, and 19.9% met the World Health Organization's PA recommendation (≥60 min of MVPA daily) for at least four days a week. The prevalence was almost three times higher among boys compared to girls. The Overall PA grade in Korea was “D-” in 2016, “F” in 2018, and back to “D-” in 2022. As shown in Table 4, the

Table 1
Main data sources and characteristics used to grade indicators.

Data source(s)	Age group	Sample size	Indicator(s) informed[a]
2018–2020 KYRBS	13–18 years	2018: 38,739–60,040 2019: 38,575–57,303 2020: 46,377–54,948	1, (2), 4, 5, 11
2018–2019 KNHANES	12–18 years and their parents	2018: 487-793 2019: 475-759	(1), (5), 7, (11)
2018–2019 KCHS	≥19 years	2018: 228,340 2019: 229,099	9
2020 PSKC	11–12 years	1412	(3), 9
Ministry of Education, Ministry of Health and Welfare, Ministry of Culture, Sport, and Tourism			8, 10

KNHANES: Korea National Health and Nutrition Examination Survey; KYRBS: Korea Youth Risk Behavior Web-based Survey; KCHS: Korea Community Health Survey; PSKC: Panel Study of Korean Children.

[a] Indicators: 1 = Overall Physical Activity; 2 = Organized Sport and Physical Activity; 3 = Active Play; 4 = Active Transportation; 5 = Sedentary behaviors; 6 = Physical Fitness; 7 = Family and Peers; 8 = School; 9 = Community and Environment; 10 = Government; 11 = Sleep. Indicators in brackets indicate that the corresponding survey data were considered to inform that specific indicator but not used due to insufficient data.

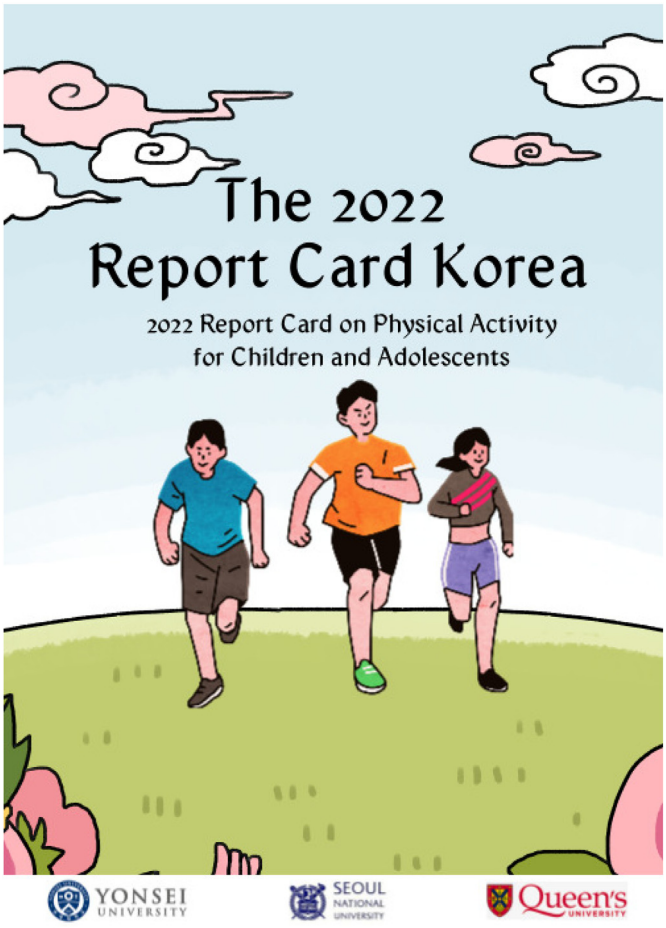

Fig. 1. Cover for South Korea's 2022 report card.

changes in the grade between 2018 and 2022 were mainly attributable to the changes in the benchmarks, from ≥60 min of MVPA daily to ≥4 d/wk when the average across the week data is not available. With such change in the benchmark, Overall PA during the pandemic received an "F" grade, indicating a negative impact of the pandemic and subsequent school closures and public health restrictions on PA.

4.2. Organized sport & physical activity: INC

In KYRBS, the only question item that is available for this indicator was in relation to participation in physical education classes only (i.e., "In the past 7 days, how many times did you actually engage in exercise at an indoor or outdoor gym?) (prevalence shown in Table 2). Due to the specificity of this item focusing on PE, SCT decided that data are insufficient to accurately reflect the overall participation in organized sport & PA of Korean adolescents. Therefore, the INC grade was given because only limited data were available to grade this indicator. Previous Report Cards graded this indicator "C-" in 2016 and "C" in 2018 (Table 4). Unfortunately, the question item (i.e., number of days participated in organized sport) directly relevant to this indicator were available up to 2016 KYRBS but removed since 2017 surveys.

4.3. Active play: INC

One data source was available that could inform the grading of Active Play. PSKC 2020 provided data on active play indoors and outdoors for ≥30 min/d among children aged 10–11 years (n = 1412). The results indicated that 24.3% and 15.5% of children engaged in active play indoors and outdoors, respectively, with marked gender differences. Specifically, boys participated in more active play than girls for both indoors (30.9% vs 17.3%) and outdoors (22.1% vs 8.6%). Due to the inconsistency with the benchmark provided by AHKGA (≥2 h/day) and the limited age group studied (10–11 years only), SCT decided that data are insufficient to accurately reflect the overall participation in active play among Korean children and adolescents. Active Play has been assigned the INC grade in all three rounds of Report Cards that Korea has participated (Table 4). Given the increasing importance of active play on overall PA and children's health and well-being,[25] developing questionnaire items relevant to active play and incorporating into national surveys is of importance for future Report Cards and for global surveillance.

4.4. Active transportation: B+

Active Transportation received a "B+" grade, same as that of 2018 Report Card, which was improved from 2016 Report Card (C+). Active Transportation was graded based on 2019 KYRBS data

Table 2
Prevalence of behavioral indicators in both genders and stratified by gender.

Indicator	Benchmark	Source	Both genders % (95% CI)	Girls % (95% CI)	Boys % (95% CI)
Overall PA	≥60 min of MVPA ≥4 d/wk	KYRBS 2018	20.4 (19.7–21.0)	10.9 (10.4–11.5)	29.1 (28.3–29.9)
		KYRBS 2019	21.4 (20.7–22.0)	11.5 (11.0–12.1)	30.5 (29.7–31.2)
		KYRBS 2020[a]	19.9 (19.3–20.5)	11.6 (11.1–12.1)	27.6 (26.8–28.4)
Organized Sport & PA	PE class ≥ once/wk	KYRBS 2018	82.8 (82.0–83.5)	78.7 (77.7–79.8)	86.5 (85.7–87.2)
		KYRBS 2019	84.2 (83.5–84.9)	80.5 (79.2–81.7)	87.6 (87.0–88.3)
Active Play	Active play ≥30 min/d	PSKC 2020 (indoor)	24.3	17.3	30.9
		PSKC 2020 (outdoor)	15.5	8.6	22.1
Active Transportation	≥10 min/d of walking ≥1 d/wk	KYRBS 2019	78.7 (78.2–79.2)	79.7 (79.0–80.3)	77.8 (77.2–78.4)
Sedentary Behaviors	≤2 h/d of recreational screen time	KYRBS 2018	29.6 (29.0–30.2)	27.9 (27.0–28.8)	31.1 (30.3–31.9)
		KYRBS 2019	27.9 (27.1–28.6)	26.6 (25.9–27.2)	32.2 (31.2–33.0)
		KYRBS 2020-Recreational[a]	20.1 (19.6–20.5)	20.1 (19.4–20.7)	20.1 (19.5–20.7)
		KYRBS 2020-Smartphone[a]	11.0 (10.5–11.6)	7.2 (6.7–7.8)	14.7 (14.0–15.4)
		KYRBS 2020-SB Total[a]	1.0 (0.8–1.1)	0.6 (0.5–0.7)	1.3 (1.1–1.5)
Sleep	9–11 h/d for 12–13 years; 8–10 h/d for 14–18 years	KYRBS 2018	14.0 (13.5–14.5)	11.1 (10.5–11.7)	16.8 (16.0–17.7)
		KYRBS 2019	14.2 (13.7–14.7)	11.1 (10.5–11.7)	17.2 (16.4–18.0)
		KYRBS 2020[a]	15.0 (14.6–15.5)	12.0 (11.4–12.6)	17.8 (17.0–18.6)
		KNHANES 2018	23.7 (19.1–29.1)	19.3 (14.0–25.9)	28.0 (22.0–34.8)
		KNHANES 2019	24.3 (19.9–29.3)	17.5 (12.6–23.7)	30.4 (24.8–36.7)

MVPA: Moderate-to vigorous-intensity physical activity; KNHANES: Korea National Health and Nutrition Examination Survey; KYRBS: Korea Youth Risk Behavior Web-based Survey; PA: Physical activity; PE: Physical Education; PSKC: Panel Study of Korean Children.

Table 3
Prevalence of the sources of influence indicators.

Indicator	Source	Parental modelling for PA % (95% CI)	
Family and Peers	KNHANES 2018	0–11 years	12–18 years
		Mother: 44.9 (39.0–50.9)	Mother: 37.8 (31.9–44.2)
		Father: 46.3 (39.9–52.8)	Father: 46.1 (38.9–53.6)
	KNHANES 2019	0–11 years	12–18 years
		Mother: 39.0 (33.9–44.3)	Mother: 36.9 (30.9–43.4)
		Father: 47.7 (40.6–54.9)	Father: 46.1 (39.0–53.3)
Indicator	Source	Measures	Satisfaction/ accessibility % (95% CI)
Community and Environment	KCHS 2018	Access to PA places	81.1 (80.8–81.3)
		Air quality	44.0 (43.6–44.3)
		Water quality	42.5 (42.2–42.8)
		Land pollution	42.4 (42.1–42.7)
		Noise	39.6 (39.2–39.9)
		Green space	56.5 (56.2–56.9)
	KCHS 2019	Neighborhood safety	80.7 (80.5–81.0)
		Neighborhood natural environment	77.5 (77.2–77.7)
		Neighborhood living environment	83.0 (82.8–83.2)
		Neighborhood public transit	74.6 (74.3–74.9)
	PSKC 2020	Accessibility to playgrounds	74.0
		Accessibility to parks	68.0
		Accessibility to walking trails	70.1
		Accessibility to indoor PA facilities	48.4
		Accessibility to outdoor PA facilities	43.6
	PSKC 2020	Satisfaction for playgrounds	61.6
		Satisfaction for parks	65.5
		Satisfaction for walking trails	66.1
		Satisfaction for indoor PA facilities	45.3
		Satisfaction for outdoor PA facilities	40.5
Indicator	Source	HEPA PAT v2 scores	
School[a]	Ministry of Education; Ministry of Health and Welfare; Ministry of Culture, Sport, and Tourism	Policy number >20; Policy breadth = 1; No. of policies with identifiable actions = 17. Proportion of policies with identified responsibilities for delivery of actions = 21/21 = 100%; Proportion of policies with identified systems for reporting delivery of actions = 21/21 = 100%; Proportion of policies with identified funding sources = 20/21 = 95.2%; Proportion of policies with identified systems for monitoring and evaluation = 16/21 = 76.2%.	
Government[a]		Policy number >20; Policy breadth = 3; No. of policies with identifiable actions >20. Proportion of policies with identified responsibilities for delivery of actions = 100%; Proportion of policies with identified systems for reporting delivery of actions = 100%; Proportion of policies with identified funding sources = 98%; Proportion of policies with identified systems for monitoring and evaluation = 83%	

HEPA PAT: Health-Enhancing Physical Activity Policy Audit Tool; KNHANES: Korea National Health and Nutrition Examination Survey; KYRBS: Korea Youth Risk Behavior Web-based Survey; PA: Physical activity; PSKC: Panel Study of Korean Children.
[a] Health-Enhancing Physical Activity (HEPA) Policy Audit Tool version 2 (PAT v2)[24] was used for evaluation.

(n = 57,303). As shown in Table 2, 78.7% of adolescents responded that they participate in walking to get to places including school, with no apparent gender differences (77.8% in boys vs 79.7% in girls). Though a relatively higher grade was assigned, it is important to note that the question item also included walking for exercise purposes; therefore, the estimate may not likely be accurate. Nevertheless, previous literature on active transportation among Korean children and adolescents (12–17 years) indicated that they engage in utilitarian walking for just over 5 hours weekly.[26] In another study,[27] it was found that Korean boys and girls (12–18 years) use active transportation for 24.6 min and 21.9 min, respectively, daily. Nevertheless, Active Transportation received the best grade among behavioral/individual indicators in three consecutive Report Cards.

Table 4
Grades for the indicators in 2016, 2018, and 2022 South Korea's Report Cards on Physical Activity for Children and Adolescents (Youth up to 2018 Report Card).

Indicator	2016 Grades	2018 Grades	2022 Grades[a]
Overall Physical Activity[a]	D-	F	D- (F[b])
Organized Sport and Physical Activity	C-	C	INC
Active Play	INC	INC	INC
Active Transportation	C+	B+	B+
Sedentary Behaviors[a]	F	D	D (F[b])
Physical Literacy	INC	NA	NA
Physical Fitness[c]	NA	D+	INC[c]
Family and Peers	INC	INC	C-
School	D	D+	A
Community and Environment	INC	INC	B-
Government	C	D	A
Sleep[a]	NA	NA	F (F[b])

Grading rubric for 2018 and 2022 Report Cards: A+ = 94%–100%; A = 87%–93%; A− = 80%-86%; B+ = 74%–79%; B = 67%–73%; B− = 60%-66%; C+ = 54%–59%, C = 47%–53%; C− = 40%-46%; D+ = 34%–39%; D = 27%–33%; D− = 20%-26%; F is <20%; INC is Incomplete data. Grading rubric for 2016 Report Card: A = 81%–100%; B = 61%–80%; C = 41%–60%; D = 21%–40%; F is ≤ 20%; INC is Incomplete data.
NA: Not applicable.
[a] Both pre- (2018-19) and during-pandemic (2020) data informed the grading of Overall Physical Activity, Sedentary Behaviors, and Sleep within the 2022 Report Card.
[b] Grade based on the COVID-19 data only is also presented in brackets.
[c] "INC" was given due to the abscence of data but newly found public data indicated an "F" grade on this indicator.

4.5. Sedentary Behaviors: D

Sedentary Behaviors received a “D” grade, same as 2018 Report Card, which was improved from 2016 Report Card (F) (Table 2). Sedentary Behaviors was graded based on 2018-20 KYRBS data, 20.1% engaging in ≤2 h/d of screen-related pursuits. In 2018 data (n = 56,617; 12–18 years), the average time spent on recreational screen time was 212.3 min/d with no differences by gender (209.3 min/d for boys vs 215.4 min/d for girls) but differences by days of the week (185.0 min/d for weekdays vs 292.8 min/d for weekend days). In 2019 data (n = 54,834; 12–18 years), the corresponding values were 198.4 min/d with no gender differences (198.5 min/d in boys vs 198.3 min/d for girls) but differences by days of the week (165.4 min/d for weekdays vs 280.5 min/d for weekend days). In 2020 KYRBS (n = 53,510; 12–18 years), the average time spent on recreational screen time was 255.5 min/d, an increase from both 2018 and 2019 KYRBS data was observed as expected due to the COVID-19 pandemic. No gender differences were observed (254.2 min/d for boys vs 256.8 min/d for girls) but differences by days of the week (229.7 min/d for weekdays vs 324.7 min/d for weekend days). Smartphone use was not considered for the grading of this indicator due to the potential overlap with recreational screen time. However, prolonged hours reported on smartphone use is a concern. Specifically, among 52,669 adolescents, the average time spent on smartphone use was 315.3 min/d, with differences by gender (285.0 min/d for boys vs 346.7 min/d for girls) and days of the week (283.5 min/d during weekdays and 393.4 min/d during weekend days). Sedentary Behaviors during the pandemic received an “F” grade, indicating a negative impact of the pandemic, which increased recreational screen time among Korean adolescents.

4.6. Physical Fitness: INC

Originally, Physical Fitness could not be graded for this round of Report Card due to the absence of updated data. However, after the SCT meeting for grading, RWG became aware of the public data source (https://www.schoolinfo.go.kr/ng/go/pnnggo_a01_l2.do) that could allow the grading of this indicator. Based on five testing categories (i.e., cardiorespiratory endurance, flexibility, muscular strength/endurance, agility, obesity), 7.3% and 4.3% of middle school (n = 1,339,073) and high school students (n = 1,270,693), respectively, achieved ≥80% of overall fitness, indicating an “F” grade based on the AHKGA's grading rubric (see footnote in Table 4). However, this grading could not be included in 2022 Report Card as the available data found after the grading assignment meeting.

4.7. Family and Peers: C-

Family and Peers was graded based on the information on parental modelling (i.e., parents meeting the WHO's PA Guidelines[1]) using the parent-child data available within the KNHANES 2018-19. Among parents of children and adolescents aged between 12 and 18 years, adherence to the Guidelines was 37.8% and 46.1%, respectively, in 2018 and 36.9% and 46.1%, respectively, in 2019. Data for parents with children aged 0–11 years are also available and presented in Table 3; however, it was not reflected in the grade of this indicator due to the age group. 2022 Report Card is the first time that provided a grade on this indicator. Corresponding KNHANES data were available for 2016 and 2018 Report Cards; however, this indicator was graded as "INC" due to limited capacity of the research team. Though the grade is not ideal, adherence to the Guidelines is higher than that of their children, which indicate that parental modelling of PA may not necessarily translate into their children's PA. This may be because of the age group studied. Older adolescents are less likely to be influenced by their parents with increasing academic workload, time spent in school, and influence of their peers and the school environment.[28,29]

4.8. School: A

School was graded based on the information available on the Ministry of Education and the HEPA tool,[24] and received an “A” grade (89.6% of success) (Table 3). The full list of policies and detailed information are available in Supplementary Table 1. The “A” grade received for the School indicator in 2022 Report Card is a significant improvement from 2016 (D) and 2018 (D+) Report Cards. However, it is important to note that the change is likely due to the use of the standardized tool that evaluates school-based policies based on quantification. Notwithstanding the high grade received, the quality of the implementation and evaluation of policies and programs is largely unknown.

4.9. Community and Environment: B-

Community and Environment received a “B-” grade based on the available data from 201819 KCHS (self-reported adult data) and

2020 PSKC (proxy-reported child data) that match part of the benchmarks provided (Table 3). Among the possible items identified from the two data sources, only relevant items to PA were selected by the SCT and used for evaluation; thus, water quality and land pollution data from 2018 KCHS data and accessibility to medical services from 2019 KCHS data were not used. 2020 PSKC provided data on parents' satisfaction and accessibility to five aspects from their home (i.e., playgrounds, parks, trails, and indoor/outdoor facilities for PA). As shown in Table 3, the percentages ranged between 39.6% to 83.0%, with respondents living in urban neighborhoods reporting higher accessibility and satisfaction. This indicator was not graded ("INC") in 2016 and 2018 Report Cards due to lack of data. In general, the built environment conducive to PA is observed to be well-equipped but factors related to climate change (e.g., air pollution, noise, lack of green space) showed concerning patterns.

4.10. Government: A

Government was graded based on the information available on three government webpages and the HEPA tool,[24] and received an "A" grade (93.8% of success) (Table 3). The full list of policies and detailed information are available in Supplementary Table 2. The "A" grade received in 2022 Report Card is a significant improvement from 2016 (C) and 2018 (D) Report Cards. However, similar to the School indicator, the improvement may likely driven by the use of the HEPA tool[24] and the quality of the implementation and evaluation of policies and programs is unknown.

4.11. Sleep: F

Sleep was a new indicator added to the evaluation for 2022 Report Card given its inclusion in the 24-hour movement behavior. Based on 2018-20 KYRBS (n = 46,475–52,928; 12–18 years), Sleep was graded as "F". As shown in Table 3, adolescents who obtained the recommended sleep duration ranged between 14.0-14.2% based on KYRBS data, with the adherence generally lower in girls compared to boys. 2018-19 KNHANES also provided data that could inform this indicator (Table 3); however, only KYRBS data were used for its representativeness and large sample size.

5. Conclusion

Overall, 2022 Report Card grades improved from 2016 and 2018 Report Cards in terms of the number of indicators graded and the grades for three indicators (Overall PA, School, Government). Furthermore, two indicators that were not graded previously due to insufficient data were given a grade (Family and Peers, Community and Environment), highlighting the successes of Korea's Report Card this round. However, it is important to mention that three indicators either remained ungraded or graded previously but ungraded this time around (Organized Sport and PA, Active Play, Physical Fitness). Future surveillance, monitoring, and evaluation of PA-related indicators should put more efforts into generating more data on these indicators. Due to the itensifying impact of climate change (e.g., air pollution) and the COVID-19 pandemic, the PA landscape has changed dramatically and will continue to change for children and adolescents in Korea. Efforts to addressing climate change and to overcome the impact of the pandemic, improving PA surveillance, monitoring, and advocacy to ultimately establish healthy lifestyle patterns among children and adolescents are warranted.

Author statement

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Appendix A. Supplementary data

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