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Results from the Hong Kong's 2022 report card on physical activity for children and adolescents

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ABSTRACT

Background/objective: This paper aimed to summarize the findings of the third (2022) Active Healthy Kids Hong Kong Report Card on Physical Activity for Children and Adolescents and evaluate the secular trends of physical activity related indicators.

Methods: Five behavioral indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, and Sedentary Behavior), three outcome indicators (Physical Fitness, Sleep, and Obesity) and four sources of influence indicators (Family and Peers, School, Community and Environment, and Government) were assigned a letter grade (ranging from A+ to F or incomplete) based on the best available evidence following a harmonized approach developed by the Active Healthy Kids Global Alliance. Data sources included published journal articles, government reports, manual searches, and personal contacts; and consisted of both pre-COVID-19 and after-COVID-19 evidence.

Results: Grades for Overall Physical Activity (D–**) and Sedentary Behavior (D) deteriorated compared to the 2018 Report Card. The other three behavioral indicators, Organized Sport and Physical Activity, Active Play, and Active Transportation, were assigned B–, D, and B+, respectively. Physical Fitness (D), Sleep (C–), and Obesity (D–) obtained the same grades as in the 2018 Report Card. School (B) and Government (C+) grades slightly improved, while Community and Environment grade (B) was stable. Family and Peers was not graded due to insufficient evidence.

Conclusions: Despite slight improvements in influence indicators, physical activity and sedentary behavior have changed unfavorably for children and adolescents in Hong Kong. Strategic investments are needed to improve adoption and implementation of effective interventions.

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1. Introduction

Globally, 4 in 5 school-aged children and adolescents did not participate in sufficient physical activity which is essential for health in 2016.¹ To tackle the global pandemic of physical inactivity, World Health Organization (WHO) endorsed a Global Action Plan on Physical Activity 2018–2030 and set up the targets of “a 10% and 15% relative reduction in the global prevalence of physical inactivity by 2025 and 2030”.² In line with the WHO's call for action, the

Government of the Hong Kong Special Administrative Region (HKSAR Government) published the document “Towards 2025: Strategy and Action Plan to Prevent and Control Non-communicable Diseases in Hong Kong” in 2018 which proposed a series of actions.³ The difficulties to meet these physical activity targets have been intensified due to restrictive measures adopted by many countries in response to the outbreak of the coronavirus disease 2019 (COVID-19) since 2020. It has been widely reported that children and adolescents have become more physically inactive and spent more time in screen use.⁴ In Hong Kong, over half of the primary and secondary school students reported decreased daily physical activities, while over 70% of primary students and nearly 60% of secondary students increased use of electronic devices for

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learning or other purposes.⁵ Multisectoral partnerships and a wide community engagement are needed to build a health-enhancing environment to support physical activity promotion.

The Active Healthy Kids Hong Kong (<https://activehealthykidshongkong.com.hk>) was established in 2015 as a knowledge translation initiative. It consists of researchers and practitioners in the area of physical activity and health. Since then, Active Healthy Kids Hong Kong Report Card on Physical Activity for Children and Adolescents (hereinafter referred to as Hong Kong Report Card) has been developed every 2–4 years to consolidate evidence-based evaluation of physical activity related indicators in Hong Kong. The first two Hong Kong Report Cards were published in 2016⁶ and 2018,⁷ together with other countries and regions participating in the Active Healthy Kids Global Alliance (AHKGA) Global Matrix 2.0⁸ and 3.0⁹, respectively. The findings affirmed a high level of physical inactivity and sedentary behavior, as well as a low physical fitness level among local children and adolescents.^{6,7} These Report Cards have been widely publicized among multiple sectors, periodically cited in local authority reports, and improved surveillance of active play and organized sport. The third (2022) Hong Kong Report Card was recently developed as part of the Global Matrix 4.0 of 57 countries and regions.¹⁰ Best available evidence of 12 physical activity related indicators were synthesized and evaluated for children and adolescents aged 6–17 years in Hong Kong. The aim of this paper was to summarize the process and results of the 2022 Hong Kong Report Card and to evaluate the secular trends between 2016 and 2022.

2. Methods

The harmonized approach suggested by the AHKGA was followed.¹¹ The Research Work Group (RWG) for the 2022 Hong Kong Report Card consisted of five core members who were instrumental for developing the 2016 and 2018 Hong Kong Report Cards.^{6,7} The RWG was responsible for consolidating and evaluating the evidence, assigning the initial grades, communicating with stakeholders, and disseminating the findings. Stakeholders involved in the 2018 Hong Kong Report Card and new stakeholders were invited by the RWG. Eventually, the stakeholder group comprised 30 members including researchers in the fields of physical education (PE) ($n = 6$), exercise science ($n = 3$), and public health ($n = 3$); health professionals ($n = 5$), educators and teachers ($n = 6$), representatives of government ($n = 1$), and non-government organizations (NGOs) ($n = 6$). These stakeholders were selected based on the representation of a particular profession, affiliation to relevant settings, and relevant academic expertise.

The 2022 Hong Kong Report Card comprised 10 common indicators included in the Global Matrix 4.0, i.e., behavioral and outcome indicators (Overall Physical Activity, Organized Sport and Physical Activity, Active Play, Active Transportation, Sedentary Behavior, Physical Fitness), and sources of influence indicators (Family and Peers, School, Community and Environment, Government), and two additional outcome indicators (Sleep and Obesity). The two additional indicators (Sleep and Obesity) were first added in the 2018 Hong Kong Report Card⁷ based on the suggestions from the stakeholders of the first (2016) Hong Kong Report Card.⁶ Peer-reviewed journal articles and reports from departments of the Government and NGOs that were published between March 2018 (after the development of the 2018 Hong Kong Report Card) and September 3, 2021. Journal articles were searched in electronic databases including MEDLINE, EMBASE, PubMed, SportDiscus, and ERIC for each indicator. The data sources meeting the following criteria were considered: (1) targeting 6-to-17-year-olds in Hong Kong; (2) relevant to at least one of the indicators; and (3) data collected within the past ten years. Data sources used in the 2018

Report Card falling within this time period were still included. Data sources shared by the stakeholders during the consultation were also reviewed. The grades were assigned according to the proportion of children and adolescents meeting the predefined benchmarks (see Supplementary File 1).^{9,12} The grade rubric was formulated by the AHKGA⁹: A + = 94%–100%; A = 87%–93%; A– = 80% to 86%; B + = 74%–79%; B = 67%–73%; B– = 60% to 66%; C + = 54%–59%; C = 47%–53%; C– = 40% to 46%; D + = 34%–39%; D = 27%–33%; D– = 20% to 26%; F = < 20%; INC = incomplete data. In addition, a “*” was added to a grade if it was based on a mix of device-measured (e.g., accelerometer) and self-reported data, whereas, a “**” was added to a grade if it was based on device-measured data exclusively.

The evidence was reviewed and discussed by the RWG and initial grades were assigned in December 2021. Eventually, a total of 38 data sources (27 journal articles, two completion reports for government funded research grants, eight government reports, and one NGO report) were used for grading. More details of these data sources including sampling methods, characteristics of the participants, and main findings can be found in the long form of the 2022 Report Card (available online at <http://activehealthykidshongkong.com.hk/>). Unweighted averages were used to determine grades on indicators where data were obtained from more than one sources. An online stakeholder consultation was conducted in January 2022 and comments from stakeholders were sought via an online survey. The stakeholders were asked whether they agreed or disagreed with the initial grades and to suggest any data sources that they thought were missed in assigning the grades. A 100% agreement on the initial grades was eventually obtained for seven indicators, while an agreement of over 90% was achieved for the other four indicators. For the School indicator, most of the stakeholders agreed to assign a grade of “B” after a thorough discussion of the best available evidence. The initial grades were subsequently audited by the AHKGA and finalized in March 2022.

3. Results

The 2022 Hong Kong Report Card is the third report card for children and adolescents in Hong Kong. For comparison, grades assigned to indicators in the 2016 and 2018 Hong Kong Report Cards are also presented in Table 1. All indicators received a letter grade except for Family and Peers, which was assigned an “INC” due to insufficient evidence. The cover page for the 2022 Hong Kong Report Card is shown in Fig. 1.

Two indicators, Physical Fitness (D, i.e., about 27%–33% of children and adolescents are estimated to reach an adequate physical fitness level) and Community and Environment (B, corresponding to succeeding with about 67%–73% of children and adolescents), received the same grades as in the 2018 and (or) 2016 Report Cards because of the same data sources used for grade assignment. Three of the five common behavioral indicators received either D–** (Overall Physical Activity) or D (Active Play and Sedentary Behavior), corresponding to succeeding with about 20%–33% of children and adolescents. Active Transportation got the highest grade of B+ (i.e., succeeding with about 74%–79% of children and adolescents) among all indicators. School (B, succeeding with about 67%–73% of children and adolescents) and Government (C+, succeeding with about 54%–59% of children and adolescents) obtained the grades slightly higher than those in the 2018 and 2016 Report Cards. The grades for Sleep (C–, succeeding with about 40%–46% of children and adolescents) and Obesity (D–, succeeding with about 20%–26% of children and adolescents) remained stable despite new data sources added.

Table 1
Grades assigned to indicators in the 2022, 2018, and 2016 Hong Kong report cards on physical activity for children and adolescents.

Indicator	2022 Grade	2018 Grade	2016 Grade
Overall Physical Activity	D–**	C–	D
Organized Sport and Physical Activity#	B–	C	C–
Active Play#	D	INC	INC
Active Transportation	B+	B+	B
Sedentary Behavior#	D	C–	C
Physical Fitness	D	D	–
Sleep	C–	C–	–
Family and Peers	INC	D–	D
School#	B	C	C
Community and Environment	B	B	B
Government#	C+	C	INC
Obesity	D–	D–	–

Note. The grade assignment for each indicator was based on the percentage of children and adolescents meeting a defined benchmark: A+ = 94%–100%; A = 87%–93%; A– = 80% to 86%; B+ = 74%–79%; B = 67%–73%; B– = 60% to 66%; C+ = 54%–59%; C = 47%–53%; C– = 40% to 46%; D+ = 34%–39%; D = 27%–33%; D– = 20% to 26%; F = < 20%; INC = Incomplete data.

** = device-measured data.

Grade was informed by a mix of before and during COVID-19 pandemic data, otherwise the grade was assigned based on the data before COVID-19.

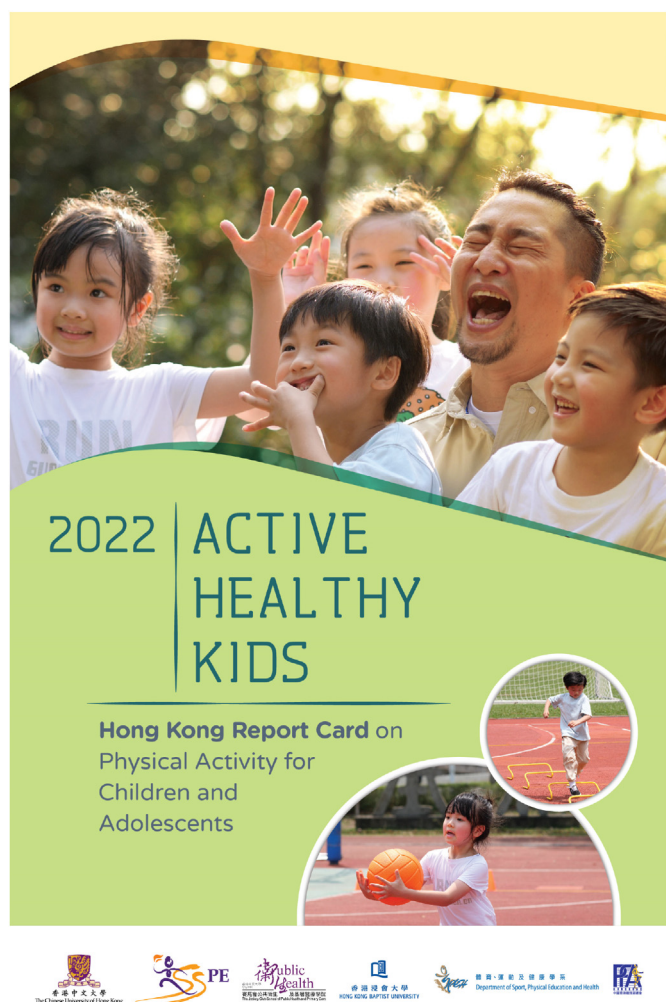


Fig. 1. Front cover of the 2022 Hong Kong report card on physical activity for children and adolescents.

4. Discussion

4.1. Overall Physical Activity: D–**

It is the first time that Overall Physical Activity was graded based

on device-based data exclusively, resulting in a “**” added to the grade. Among the 11 included references, seven reporting six independent data sources were newly added after the 2018 Report Card,^{13–19} while the other four were either old data sources used in the 2018 Report Card (hereinafter referred to as old data source)^{20,21} or new references reporting duplicating dataset.^{22,23} Two studies included secondary school students^{16,22} and the others targeted primary school children only. On average, 25% of children and adolescents met the physical activity recommendations, resulting in a D–** grade. It is worth noting that all of the above studies had data collected before the outbreak of COVID-19 pandemic. Tso et al. conducted an online survey among 29,202 parents of 2-to-12-year-olds in Hong Kong in late March 2020 and reported that 49% of children aged 6–12 years had at least 1 h of physical activity daily.²⁴ However, this study was not considered for grade assignment because details of the measurement were not provided so the quality cannot be evaluated.

4.2. Organized Sport and Physical Activity: B–

This indicator was graded based on a recent population-representative survey (*The Survey on Physical Fitness Status of Hong Kong School Pupils – Secondary Schools*) which showed that 60.1% of secondary school students aged 12–18 years participated in organized sport for at least one day per week.²⁵ The fitness survey was a repeated project commissioned by the Education Bureau (EDB) of the HKSAR Government and has been conducted every 2–5 years since 1998.²⁶ It is worth noting that the most recent fitness survey was initially planned in 2019/2020 school year. Due to COVID-19 induced school closure, however, data collection was eventually conducted across two academic years, with 64% of the data collected after school reopening in 2020/2021 school year. As a result, the findings reflected the mix of pre- and during-COVID-19 evidence. Considering the representativeness of the sample, a letter grade (B–) was assigned based on a single data source.

4.3. Active Play: D

Active Play did not receive any letter grade in the 2016 and 2018 Hong Kong Report Cards due to a lack of consensus on a robust definition and relevant evidence. To address the surveillance gap, a specific question asking active play participation was added in the recent *Survey on Physical Fitness Status of Hong Kong School Pupils*.²⁵ The results indicated that 28.6% of secondary school students

participated in active play for at least 2 h a day.²⁵ Consequently, a grade D was assigned. Similar to Organized Sport and Physical Activity, the grade for Active Play incorporated evidence collected both before and during the COVID-19 pandemic.

4.4. Active Transportation: B+

The data sources used for grading this indicator were the same with those in the 2018 Report Card and therefore, the same grade was obtained. Although two new references were found,^{22,27} they were generated from the same datasets reported in the old data source.²¹ Specifically, a citywide study conducted among 11-to-18-year-olds showed that nearly 80% of boys and girls either walked or cycled to school, while 87.7% of them had used active travel to other destinations at least once per week.^{21,22,27} Another study found that nearly half of grade 3 children with a mean age of 8.7 years walked to school at least once per week.²⁸ Although a letter grade was assigned, it should be noted that both of the projects had data collected 7–10 years ago. Thus, the most recent trend of active transportation for Hong Kong children and adolescents remains unclear. Zhang et al. found that the number of children (aged 3–11 years) and students (aged 12–25 years enrolled in primary, sedentary schools or university) using the public transportation was significantly reduced at the end of March 2020 when schools were closed in Hong Kong due to the COVID-19 pandemic.²⁹ It is plausible that long-term pandemic regulations and policies may affect travel behaviors.

4.5. Sedentary Behavior: D

The grade D was assigned based on six data sources, with four studies having data collected before the COVID-19 outbreak including one old data source^{16,30–32} and two during the pandemic.^{24,33} Although increased screen time has been commonly reported among children and adolescents during COVID-19 related lockdowns,⁴ not much difference was found in the proportions of children and adolescents meeting the recommendations of no more than 2 h of recreational screen time per day in Hong Kong. On average, 28.8% of children and adolescents met the recommendations before the pandemic,^{16,30–32} while two studies suggested that an average of 26.6% of primary school children met these recommendations between February and March 2020, i.e., three to eight weeks after school closure.^{24,33} It is plausible that the unfavorable impact would be bigger after a longer period of lockdown. According to the Thematic Household Survey conducted by the Census and Statistics Department of the HKSAR Government from June to October 2020, only 10.5% of children aged 10–14 years spent less than 1.4 h per day using the Internet.³⁴ Collectively, the RWG and stakeholders reached the consensus to assign a consolidated grade (D) for sedentary behavior, which deteriorated compared with a grade of C– in 2018 Report Card.

4.6. Physical Fitness: D

Temporal trends in physical fitness for Hong Kong adolescents from 1998 to 2015 were examined using the population-representative surveys and small declines in cardiorespiratory fitness were observed.²⁶ As described earlier, the most recent *Survey on Physical Fitness Status of Hong Kong School Pupils – Secondary Schools* was initiated in 2019/2020 school year. However, data collection was suspended after COVID-19-related school closure in early 2020. Although data collection was resumed in 2021, cardiorespiratory fitness test (9-min run/walk) was cancelled due to precautions and safety measures in view of the COVID-19 situation. As a result, same data source with the 2018 Report Card was

used to grade this indicator, i.e., “*Survey on Physical Fitness Status of Hong Kong School Pupils (Secondary Schools, 2014/15; Primary Schools, 2015/16)*”.³⁵ Briefly, according to the international norms of the relative peak oxygen uptake (VO_{2peak}),³⁶ the average percentiles achieved for VO_{2peak} were 31% for Hong Kong children and adolescents, resulting in a D grade.

4.7. Sleep: C

This indicator received a grade of C– based on eight data sources with all data collected before the COVID-19 pandemic, including one old data source,³⁰ one new reference reporting the same dataset with a previous study,²³ and six new data sources.^{16,31,37–40} Sleep duration was subjectively measured except for one study which used the activPAL determined bedtime and rise time to calculate sleep duration.¹⁶ The proportions of children and adolescents meeting the recommended sleep duration per night (9–11 h for 5-to-13-year-olds; 8–10 h for 14-to-17-year-olds)⁴¹ ranged from 31.3% to 61.8%, with an average of 45%. Variations between weekdays and weekends have been commonly observed – most of the studies reported a longer sleep duration on weekend days than that on weekday.^{37–40} Although relationship between sleep variability and children’s health has not been fully understood, some evidence supported that consistent sleep patterns throughout the week are favorably associated with social functioning.⁴² Recommendations on consistent bedtime and risetime routines, however, are not included in the benchmarks because no specific measure of sleep consistency is currently available.⁴¹

4.8. Family and Peers: INC

Despite the important role of the family in children’s physical activity,⁴³ this indicator was not assigned a letter grade due to insufficient evidence. No new data sources were found and those used for grading in the 2018 Report Card were outdated. Furthermore, similar to the previous Hong Kong Report Cards, we did not locate any evidence on peer support for physical activity. There is clearly surveillance gap on this and preferably the future surveys should include questions in alignment with the benchmarks for this indicator.

4.9. School: B

As stated in the updated “*Physical Education Key Learning Area Curriculum Guides*” developed by the EDB of the HKSAR Government in 2017, primary and secondary schools should allocate 5%–8% of total lesson time to PE at primary and junior secondary levels.⁴⁴ According to a study among 10 secondary schools, the PE lesson time ranged from 80 to 100 min per week/per cycle,⁴⁵ which was approximately 53%–83% of the amount recommended in other place.⁴⁶ Although all schools are expected to follow the policy on PE allocation, not many schools have documented active school policy. More importantly, the proportion of PE lesson time spent in MVPAs was as low as 18.5% among 26 local schools,⁴⁷ which was significantly lower than the recommendation of 50% in the U.S.⁴⁸ According to a teacher survey in 2013–2014, local schools had on average four physical activity facilities (ranging from 0 to 16) and 4.6 physical activity programs (excluding PE classes) per academic year (ranging from 0 to 20).⁴⁹

Since 2001, the Leisure and Cultural Services Department (LCSD) has implemented the School Sports Programme (SSP) for students of primary and secondary schools. In the 2018/19 school year, about 90% of schools took part in the Scheme and over 8500 programmes were organized for about 635,000 students (<https://www.info.gov.hk/gia/general/202002/26/P2020022500621.htm?fontSize=1>). To

mitigate the adverse impact of school closure during the pandemic, concerted efforts have been made to help schools manage the on-line PE classes. For instance, a project funded by the Hong Kong Jockey Club supported a range of sports initiatives for children and adolescents including teachers' training and online PE instructions (https://corporate.hkjc.com/corporate/corporate-news/english/2021-05/news_2021051101710.aspx). Collectively, a grade of B was assigned based on the above evidence and agreed by the majority of the stakeholders, showing a slight improvement from the 2018 Report Card.

4.10. Community and Environment: B

New data sources aligning with the benchmarks were not found; as a result, same data sources with the 2018 Report Card were used to grade this indicator.^{21,50} Most (60%–79%) of the parents/primary caregivers of 11-to-18-year-olds considered their neighborhood safe for their children to be physically active.²¹ In another study, parents of children aged 8–12 years reported a modest availability of sport facilities in their community, with an average score of 3.6 out of 5 received.⁵⁰ A grade of B implies a reasonably favorable environment in Hong Kong. However, having sport facilities in a safe neighborhood merely may not be sufficient to influence physical activity participation for children and adolescents. Other factors, e.g. convenience and perceived importance of the facilities may also play a certain role.⁵¹ In addition, socio-economic status (depicted by neighborhood income) seemed to moderate the associations between park environment characteristics and park-based physical activity among adolescents, that is, more safe parks were associated with more MVPA in low-income neighborhoods, but had no such influence in high-income neighborhoods, in Hong Kong.⁵²

4.11. Government: C+

To meet the committed target of reducing physical inactivity,³ the HKSAR Government has launched media campaigns in order to raise public awareness about physical inactivity (<https://www.legco.gov.hk/research-publications/chinese/essentials-2021ise17-promoting-physical-activity.htm>). To promote physical activity for schoolchildren, the Government has funded various sports programmes at schools, organized training courses for teachers, and included the WHO physical activity guidelines as a direction for developing the PE curriculum in primary and secondary schools (<https://www.info.gov.hk/gia/general/202002/26/P2020022500621.htm?fontSize=1>).

Since 2017, the HKSAR Government implemented the *Opening up School Facilities for Promotion of Sports Development Scheme* and extended the Scheme from public sector schools to schools under the Direct Subsidy Scheme in the 2018/19 school year. Since its launch, the number of participating schools has gradually increased from 12 in 2017/18 to 60 in 2019/20 school year (<https://www.info.gov.hk/gia/general/202106/02/P2021060200350.htm?fontSize=1>). As depicted in the Hong Kong Chief Executive's 2019 Policy address, more efforts are expected to be put in enhancing public open and play spaces managed by the LCSD over the next five years.

Collectively, this indicator was graded C+ given the recent improvement in the Government's commitment to providing physical activity opportunities and the resources for the implementation of physical activity promotion programs for children and adolescents. However, we acknowledge the limitation of not using the policy audit tool and the scoring rubric developed by Ward and colleagues⁵³ to grade the Government indicator. Given the lack of comprehensive evidence on the full range of policy influences in Hong Kong, it deems premature to analyze physical activity policy

quantitatively. Furthermore, long-term effectiveness of these policies and investments should be regularly monitored and evaluated.

4.12. Obesity (including overweight): D–

Two old^{49,54} and four new data sources^{16,55–57} reporting pre-COVID-19 evidence were used for grading. Using the international body mass index cut-offs for children and adolescents,⁵⁸ the reported prevalence of obesity (including overweight) ranged from 18.2% to 34.3% in Hong Kong, with an average of 24.4%. Since there is no universally accepted benchmark for obesity, the grade of D– was assigned considering the following factors: (1) similar obesity prevalence reported in other countries participating in Global Matrix 2.0 and 3.0, (2) consensus from RWG members and stakeholders, and (3) a relatively stable trend (though a slight increase) since the 2018 Report Card (an average of 22.2%). It is anticipated that Obesity indicator might receive a lower grade if robust, during-pandemic data were available. According to a news release by the Department of Health of the HKSAR Government in September 2021, the prevalence of overweight and obesity increased from 13.9% in 2019/20 to 20.2% in 2020/21 school year for primary 1–2 students; for secondary 1 students, it increased from 21.4% to 24.1%.⁵⁹ Since different criteria for defining overweight and obesity were applied in local statistics, direct comparisons between these findings should be cautious. Given the adverse impact of the COVID-19 pandemic, more efforts are needed to pursuing the target of “Halting the rise in diabetes and obesity by 2025” to tackle non-communicable diseases.³

4.13. Secular trends and influence of the COVID-19 pandemic

Five of the 12 indicators in the 2022 Hong Kong Report Card (Active Transportation, Physical Fitness, Sleep, Community and Environment, and Obesity) received the same grade as those in the 2018 Report Card. Among them, two indicators' grades (Physical Fitness and Community and Environment) stabilized because of the same old data sources used. Behavioral indicators largely deteriorated (Overall Physical Activity and Sedentary Behavior), while sources of influence indicators generally improved (School and Government). Evidence gaps in Active Play and Government have improved since 2016.

These secular trends should be interpreted with caution and are likely to be influenced by quality of evidence, timeframe of data collection, and the COVID-19 related restrictions such as school closure and home confinement. For example, only device-measured evidence was included in grading Overall Physical Activity in the 2022 Report Card, whereas, a mixed device-based and subjective measures was used in previous report cards. All of the five stabilized indicators were graded based on pre-pandemic evidence solely no matter whether new data sources were found or not after the 2018 Report Card. The potential impact of the COVID-19 pandemic is, therefore, not fully reflected in the recent grades. Interestingly, indicators that were informed by a combination of before and during pandemic evidence generally exhibit an improvement (School and Government) except for Sedentary Behavior. It may be due to the efforts enacted after the pandemic outbreak in various settings to mitigate the adverse impact on children's healthy lifestyle. Nevertheless, Chinese children and adolescents engaged in longer sedentary time, particularly screen use, after the pandemic outbreak which is similar to previous findings.⁴ Whether and how the favorable sources of influence in Hong Kong can be translated to positive behavioral changes warrant further investigation.

4.14. Strengths and limitations

The Hong Kong Report Cards are developed using a transparent, harmonized approach and based on widely accepted benchmarks of the indicators. Engagement of stakeholders in multiple sectors relevant to children's physical activity and health is another strength. Compared with the first two Hong Kong Report Cards, surveillance evidence has improved in physical activity and sedentary behavior in recent years. However, for most of the indicators there are still surveillance gaps, especially for family and peer support. In addition, surveillance studies should include evidence in alignment with the predefined benchmarks. Furthermore, the long-term influence of the COVID-19 pandemic on children's physical activity and sedentary behavior should be evaluated.

5. Conclusion

Despite generally favorable and slight improvements in influence indicators, physical activity, sedentary behavior, and health outcome indicators have not improved for children and adolescents in Hong Kong. Strategic investments are needed to improve adoption and implementation of effective interventions in multiple settings. Researchers should address the surveillance gap in family and peer support. Furthermore, physical activity and related influences should be closely monitored after the COVID-19 pandemic.

Author statement

W.Y. Huang: Conceptualization, data curation, formal analysis, methodology, writing – original draft, writing – review and editing; **S.H.S. Wong:** Conceptualization, data curation, methodology, writing – review and editing; **C.H.P. Sit:** Data curation, methodology, writing – review and editing; **M.C.S. Wong:** Data curation, methodology, writing – review and editing; **S.W.S. Wong:** Data curation, methodology, writing – review and editing; **R.S.T. Ho:** data curation, formal analysis, methodology, writing – review and editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jesf.2022.10.010>.

References

- Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child Adolesc Health*. 2020;4(1):23–35. [https://doi.org/10.1016/S2352-4642\(19\)30323-2](https://doi.org/10.1016/S2352-4642(19)30323-2).
- World Health Organization. *Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World*. 2018. Switzerland.
- Department of Health, HKSAR. Towards 2025: Strategy and action plan to prevent and control non-communicable diseases in Hong Kong. <https://www.change4health.gov.hk/en/saptowards2025/>. Accessed June 27, 2022. Accessed.
- Kharel M, Sakamoto JL, Carandang RR, et al. Impact of COVID-19 pandemic lockdown on movement behaviours of children and adolescents: a systematic review. *BMJ Glob Health*. 2022;7(1). <https://doi.org/10.1136/bmjgh-2021-007190>.
- Department of Health, HKSAR. Health status of children and adolescents in

Hong Kong under COVID-19 pandemic. https://www.chp.gov.hk/files/pdf/local_situation_covid19_en.pdf. Accessed June 27, 2022. Accessed.

- Huang WY, Wong SHS, Wong MC, Sit CH, Sum RK, He G. Results from Hong Kong's 2016 report card on physical activity for children and youth. *J Phys Act Health*. 2016;13(suppl 2):S169–S175. <https://doi.org/10.1123/jpah.2016-0302>.
- Huang WY, Wong SHS, Sit CHP, et al. Results from the Hong Kong's 2018 report card on physical activity for children and youth. *J Exerc Sci Fit*. 2019;17(1):14–19. <https://doi.org/10.1016/j.jesf.2018.10.003>.
- Tremblay MS, Barnes JD, González SA, et al. Global matrix 2.0: report card grades on the physical activity of children and youth comparing 38 countries. *J Phys Act Health*. 2016;13(suppl 2):S343–S366. <https://doi.org/10.1123/jpah.2016-0594>.
- Aubert S, Barnes JD, Abdeta C, et al. Global matrix 3.0 physical activity report card grades for children and youth: results and analysis from 49 countries. *J Phys Act Health*. 2018;15(suppl 2):S251–S273. <https://doi.org/10.1123/jpah.2018-0472>.
- Tremblay M, Barnes J, Demchenko I, et al. Active healthy Kids global alliance global matrix 4.0 – a resource for physical activity researchers. *J Phys Act Health*. 2022;19(11):693–699. <https://doi.org/10.1123/jpah.2022-0257>.
- Colley RC, Brownrigg M, Tremblay MS. A model of knowledge translation in health: the Active Healthy Kids Canada Report Card on physical activity for children and youth. *Health Promot Pract*. 2012;13(3):320–330. <https://doi.org/10.1177/1524839911432929>.
- Aubert S, Barnes J, Demchenko I, et al. Global matrix 4.0 physical activity report card grades for children and adolescents: results and analysis from 57 Countries. *J Phys Act Health*. 2022;19(11):700–728. <https://doi.org/10.1123/jpah.2022-0456>.
- Chan CHS, Ha ASC, Ng JYY, Lubans DR. Associations between fundamental movement skill competence, physical activity and psycho-social determinants in Hong Kong Chinese children. *J Sports Sci*. 2019;37(2):229–236. <https://doi.org/10.1080/02640414.2018.1490055>.
- Cheung P. School-based physical activity opportunities in PE lessons and after-school hours: are they associated with children's daily physical activity? *Eur Phys Educ Rev*. 2019;25(1):65–75. <https://doi.org/10.1177/1356336X17705274>.
- Ha AS, Lonsdale C, Lubans DR, Ng JYY. Increasing students' activity in physical education: results of the self-determined exercise and learning for FITness trial. *Med Sci Sports Exerc*. 2020;52(3):696–704. <https://doi.org/10.1249/MSS.0000000000002172>.
- Shi Y, Huang WY, Sit CHP, Wong SHS. Compliance with 24-hour movement guidelines in Hong Kong adolescents: associations with weight status. *J Phys Act Health*. 2020;17(3):287–292. <https://doi.org/10.1123/jpah.2019-0230>.
- Zheng C, Huang WY, Wong SHS. Associations of weather conditions with adolescents' daily physical activity, sedentary time, and sleep duration. *Appl Physiol Nutr Metabol*. 2019;44:1339–1344. <https://doi.org/10.1139/apnm-2019-0309>.
- Wang JJ, Baranowski T, Lau PWC, Buday R, Gao Y. Story immersion may be effective in promoting diet and physical activity in Chinese children. *J Nutr Educ Behav*. 2017;49(4):321–329. <https://doi.org/10.1016/j.jneb.2017.01.001>.
- Wang JJ, Baranowski T, Lau PWC, Chen TA, Zhang SG. Psychological correlates of self-reported and objectively measured physical activity among Chinese children—psychological correlates of PA. *Int J Environ Res*. 2016;13(10):1–12. <https://doi.org/10.3390/ijerph13101006>.
- Wong SHS, Huang WY, He G. Longitudinal changes in objectively measured physical activity differ for weekdays and weekends among Chinese children in Hong Kong energy balance-related behaviours. *BMC Publ Health*. 2015;15(1):1–8. <https://doi.org/10.1186/s12889-015-2618-0>.
- Cerin E, Sit CHP, Wong SHS, et al. *Relative Contribution and Interactive Effects of Psychological, Social, and Environmental Correlates of Physical Activity, Sedentary Behaviour, and Dietary Behaviours in Hong Kong Adolescents*. Health and Medical Research Fund; 2015. Final Report #10111501.
- Cerin E, Sit CHP, Wong SHS, et al. Relative contribution and interactive effects of psychological, social, and environmental correlates of physical activity, sedentary behaviour, and dietary behaviours in Hong Kong adolescents. *Hong Kong Med J*. 2019;25(Suppl2):S34–S39.
- Huang WY, Wong SHS. Prospective associations between weekend catch-up sleep, physical activity, and childhood obesity. *Child Obes*. 2019;15(1):40–47. <https://doi.org/10.1089/chi.2018.0158>.
- Tso WWY, Wong RS, Tung KTS, et al. Vulnerability and resilience in children during the COVID-19 pandemic. *Eur Child Adolesc Psychiatr*. 2022;31(1):161–176. <https://doi.org/10.1007/s00787-020-01680-8>.
- Physical Fitness Association of Hong Kong China. *Survey Study of Students' Physical Fitness and Their Attitudes towards Physical Education – Secondary Schools 2019/2020 & 2020/2021*. 2021.
- Poon ETC, Tomkinson G, Huang WY, Wong SHS. Temporal trends in the physical fitness of Hong Kong adolescents between 1998 and 2015. *Int J Sports Med*. 2022. <https://doi.org/10.1055/a-1738-2072>.
- Barnett A, Sit CHP, Mellecker RR, Cerin E. Associations of socio-demographic, perceived environmental, social and psychological factors with active travel in Hong Kong adolescents: the iHealth(H) cross-sectional study. *J Transport Health*. 2019;12:336–348. <https://doi.org/10.1016/j.jth.2018.08.002>.
- Huang WY, Wong SHS, He G. Is a change to active travel to school an important source of physical activity for Chinese children? *Pediatr Exerc Sci*. 2017;29(1):161–168. <https://doi.org/10.1123/pes.2016-0001>.
- Zhang N, Jia W, Wang P, et al. Changes in local travel behaviour before and

- during the COVID-19 pandemic in Hong Kong. *Cities*. 2021;112: 103139. <https://doi.org/10.1016/j.cities.2021.103139>.
30. Huang WY, Wong SHS, He G, Salmon J. Isotemporal substitution analysis for sedentary behavior and body mass index. *Med Sci Sports Exerc*. 2016;48(11): 2135–2141. <https://doi.org/10.1249/MSS.0000000000001002>.
 31. Hui SS, Zhang R, Suzuki K, et al. The associations between meeting 24-hour movement guidelines and adiposity in Asian adolescents: the Asia-Fit study. *Scand J Med Sci Sports*. 2021;31(3):763–771. <https://doi.org/10.1111/sms.13893>.
 32. Wong CKH, Wong RS, Cheung JPY, et al. Impact of sleep duration, physical activity, and screen time on health-related quality of life in children and adolescents. *Health Qual Life Outcome*. 2021;19(1):1–13. <https://doi.org/10.1186/s12955-021-01776-y>.
 33. Lau EYH, Lee K. Parents' views on young children's distance learning and screen time during COVID-19 class suspension in Hong Kong. *Early Educ Dev*. 2021;32(6):863–880. <https://doi.org/10.1080/10409289.2020.1843925>.
 34. Census and Statistics Department, HKSAR. Thematic Household survey report No. 73. Information technology usage and penetration. https://www.censtatd.gov.hk/en/data/stat_report/product/B1130201/att/B11302732021XXXXB0100.pdf. Accessed June 26, 2022. Accessed.
 35. Education Bureau, HKSAR. Surveys on 'physical fitness status of Hong Kong school Pupils'. http://www.edb.gov.hk/en/curriculum-development/klape/references_resource/fitness-survey/index.html. Accessed June 26, 2022. Accessed.
 36. Tomkinson GR, Lang JJ, Tremblay MS, et al. International normative 20 m shuttle run values from 1142026 children and youth representing 50 countries. *Br J Sports Med*. 2017;51(21):1545–1554. <https://doi.org/10.1136/bjsports-2016-095987>.
 37. Chan NY, Zhang J, Tsang CC, et al. The associations of insomnia symptoms and chronotype with daytime sleepiness, mood symptoms and suicide risk in adolescents. *Sleep Med*. 2020;74:124–131. <https://doi.org/10.1016/j.sleep.2020.05.035>.
 38. Chen SJ, Zhang JH, Li SX, et al. The trajectories and associations of eveningness and insomnia with daytime sleepiness, depression and suicidal ideation in adolescents: a 3-year longitudinal study. *J Affect Disord*. 2021;294:533–542. <https://doi.org/10.1016/j.jad.2021.07.033>.
 39. Chien CW, Cheung P, Chen CY. The relationship between sleep duration and participation in home, school, and community activities among school-aged children. *Front Neurosci*. 2019;13:860. <https://doi.org/10.3389/fnins.2019.00860>.
 40. Liu Y, Zhang J, Li SX, et al. Excessive daytime sleepiness among children and adolescents: prevalence, correlates, and pubertal effects. *Sleep Med*. 2019;53: 1–8. <https://doi.org/10.1016/j.sleep.2018.08.028>.
 41. Tremblay MS, Carson V, Chaput JP. Introduction to the Canadian 24-hour movement guidelines for children and youth: an integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metabol*. 2016;41(suppl 3). <https://doi.org/10.1139/apnm-2016-0203>. iii-iv.
 42. Becker SP, Sidel CA, Van Dyk TR, Epstein JN, Beebe DW. Intraindividual variability of sleep/wake patterns in relation to child and adolescent functioning: a systematic review. *Sleep Med Rev*. 2017;34:94–121. <https://doi.org/10.1016/j.smr.2016.07.004>.
 43. Rhodes RE, Guerrero MD, Vanderloo LM, et al. Development of a consensus statement on the role of the family in the physical activity, sedentary, and sleep behaviours of children and youth. *Int J Behav Nutr Phys Activ*. 2020;17(1):1–31. <https://doi.org/10.1186/s12966-020-00973-0>.
 44. The Curriculum Development Council, HKSAR. Physical education. Key learning area curriculum guide (Primary 1 - Secondary 6) http://www.edb.gov.hk/attachment/en/curriculum-development/renewal/PE/PE_KLACG_P1-S6_Eng_2017.pdf. Accessed June 27, 2022. Accessed.
 45. Cheung STJ. *The Impact of Bright and Dark Side Psychological Experiences in Hong Kong Secondary Physical Education*. Doctoral thesis. Hong Kong, China: The Chinese University of Hong Kong; 2019.
 46. SHAPE America. Guide for physical education policy. <https://www.shapeamerica.org/advocacy/upload/Guide-for-Physical-Education-Policy-9-23-14.pdf>. Accessed June 23, 2022. Accessed.
 47. Ha AS, Macdonald D, Pang BOH. Physical activity in the lives of Hong Kong Chinese children. *Sport Educ Soc*. 2010;15(3):331–346. <https://doi.org/10.1080/13573322.2010.493313>.
 48. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health. *Strategies to Improve the Quality of Physical Education*; 2010. https://www.cdc.gov/healthyschools/pecat/quality_pe.pdf. Accessed June 23, 2022. Accessed.
 49. Ip P, Ho FK, Louie LH, et al. Childhood obesity and physical activity-friendly school environments. *J Pediatr*. 2017;191:110–116. <https://doi.org/10.1016/j.jpeds.2017.08.017>.
 50. Wong SHS, Huang WY, Cerin E, Gao Y, Lai PC, Burnett A. Home and neighbourhood environment: association with children's physical activity and obesity-related dietary behaviour. *Hong Kong Med J*. 2016;22(suppl 6): S43–S47.
 51. Wang JJ, Wang M, Lau PWC, Ainsworth BE, He G, Gao Y. Physical activity as a mediator of the associations between perceived environments and body mass index in Chinese adolescents. *Health Place*. 2018;54:37–42. <https://doi.org/10.1016/j.healthplace.2018.09.004>.
 52. Zhang R, Zhang CQ, Lai PC, Cheng W, Schütz B, Kwan MP. Park environment and moderate-to-vigorous physical activity in parks among adolescents in a high-density city: the moderating role of neighbourhood income. *Int J Health Geogr*. 2021;20(1):1–11. <https://doi.org/10.1186/s12942-021-00289-7>.
 53. Ward MR, Tyler R, Edwards LC, Miller MC, Williams S, Stratton G. The AHK-wales report card 2018: policy measures - is it possible to "score" qualitative data? *Health Promot Int*. 2021;36(4):1151–1159. <https://doi.org/10.1093/heapro/daaa118>.
 54. Kwok MK, Leung GM, Chung TWH, Lee KKY, Schooling CM. Divergent secular trends in blood pressure and body mass index in children and adolescents in Hong Kong. *Sci Rep*. 2017;7(1):4763. <https://doi.org/10.1038/s41598-017-05133-2>.
 55. Lee PH, Lee RLT. *Smart Device Usage, Lifestyles Behaviors, Physical Fitness, and Eye Problems: A Prospective Study in Hong Kong Adolescents*. Health and Medical Research Fund; 2019. Final Report #13144041.
 56. Tung JY, Ho FK, Tung KT, et al. Does obesity persist from childhood to adolescence? A 4-year prospective cohort study of Chinese students in Hong Kong. *BMC Pediatr*. 2021;21(1):1–7. <https://doi.org/10.1186/s12887-021-02504-7>.
 57. Ho FK, So HK, Wong RS, et al. The reciprocal relationship between body mass index categories and physical fitness: a 4-year prospective cohort study of 20000 Chinese children. *Pediatr Obes*. 2020;15(9):1–9. <https://doi.org/10.1111/ijpo.12646>.
 58. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*. 2000;320(7244):1240–1243. <https://doi.org/10.1136/bmj.320.7244.1240>.
 59. Department of Health, HKSAR. Health status of children and adolescents in Hong Kong under COVID-19 pandemic. https://www.studenthealth.gov.hk/tc_chi/covid19/files/health_status_of_children_and_adolescents_in_hong_kong_under_covid_19_pandemic.pdf. Accessed June 27, 2022. Accessed.