Special Issue

Physical activity and sedentary behaviour among children and adolescents with intellectual disabilities during the COVID-19 lockdown in China

Y. Q. Yuan,1 J. N. Ding,2 N. Bi,3 M. J. Wang,4 S. C. Zhou,5 X. L. Wang,6 S. H. Zhang,7 Y. Liu8,9 & G. Roswal10

1 College of Sports and Health, Shandong Sport University, Jinan, China
2 Department of Physical Education, Fujian Agriculture and Forestry University, Fuzhou, China
3 School of Sports and Physical Education, Shandong Sport University, Rizhao, China
4 School of Chinese WuShu, Shandong Sport University, Rizhao, China
5 School of Physical Education, Shanxi University, Taiyuan, China
6 Graduate School, Harbin Sport University, Harbin, China
7 Department of Physical Education, China Disabled Persons’ Federation, Beijing, China
8 Department of Physical Education, Shandong Jianzhu University, Jinan, China
9 Department of Physical Education, Shandong University of Traditional Chinese Medicine, Jinan, China
10 School of Health Professions and Wellness, Jacksonville State University, Jacksonville, AL, USA

Abstract

Background In the wake of the COVID-19 pandemic, preliminary research has reported a significant decline in physical activity (PA) and an increase in sedentary behaviour (SB) among typically developed children and adolescents. Limited research has looked at the current situation of PA and SB during this pandemic among children and adolescents with intellectual disabilities (ID). This study investigated the situations about PA and SB among school-aged children and adolescents with ID on China’s mainland during the COVID-19 outbreak.

Methods In total, 837 parents of children and adolescents (ages 6–18 years) with ID from 15 special education schools of Shandong Province in China were recruited through convenience sampling in the study. Parents reported PA and SB among children and adolescents with ID through the Children’s Leisure Activities Study Survey-Chinese version (CLASS-C) online questionnaires.

Results From parents’ reports, Chinese children and adolescents with ID participated in approximately 10 min of moderate-to-vigorous physical activity, and engaged in approximately 530 min of SB every day. Meanwhile, only 17.4% of children and adolescents with ID were able to achieve the recommendation of 60 min of daily moderate-to-vigorous physical activity and 76.1% of

Correspondence: Yang Liu, Department of Physical Education, Shandong Jianzhu University, Jinan, Shandong, China.
Tel: +86-186-1557-2895 (e-mail: liuyang19@sdjzu.edu.cn)
Glenn Roswal, School of Health Professions and Wellness, Jacksonville State University, Jacksonville, AL, USA.
Tel: +1-256-452-0452 (e-mail: groswal@gmail.com)

© 2021 MENCAP and International Association of the Scientific Study of Intellectual and Developmental Disabilities and John Wiley & Sons Ltd
children and adolescents with ID spent more than 2 h on SB per day. Additionally, the problems of decrease PA and excessive SB were more prominent in older adolescents with ID compared with younger children with ID.

Conclusion In China, the low level of PA and high level of SB is particularly evident in children and adolescents with ID during the outbreak of COVID-19. The great majority of children and adolescents with ID did not meet the recommended amount of PA while undergoing excessive SB under the long-term home quarantine environment. Therefore, immediate attention and great effort should be made to deal with this severe situation among this vulnerable population in the mainland of China.

Keywords children and adolescents, COVID-19, intellectual disabilities, physical activity, sedentary behaviour

Background

In March 2020, COVID-19 was declared a global public health crisis by the World Health Organization (WHO) (WHO 2020a). By February 2021, the pandemic had reached 192 countries and territories, infecting over 99 million people worldwide with more than 2.1 million deaths (John Hopkins University 2020). Governments enacted a number of restrictions, such as putting cities on lockdown, implementing travel warnings/bans and cancellations, calling off large public gatherings and events, and cancelling schools in an effort to restrict the spread of the COVID-19 (Chen et al. 2020).

Under the impact of the COVID-19, the daily lives of children and adolescents have been changed (Moore et al. 2020). Approximately 1.5 billion children and adolescents worldwide participated in online courses attributed to school closures (Couzin-Frankel et al. 2020). The school closures, along with other additional socio-behavioural adaptations (e.g. quarantining, social distancing and telecommunicating), are impacting the lifestyle activities of children and adolescences (Bates et al. 2020). Preliminary evidence shows that social restrictions required to reduce COVID-19 transmission have decreased engagement in physical activity (PA) (Guerrero et al. 2020; Moore et al. 2020; Zenic et al. 2020) and increased sedentary behaviour (SB) among children and adolescents (Margaritis et al. 2020; Vanderloo et al. 2020).

The PA and SB are of particular significance in promoting children and adolescent health. Numerous studies have shown that PA and SB are considered separate and independent risk factors for health among children and adolescents (Tremblay et al. 2011; Carson et al. 2016; Shen et al. 2020). It is necessary to note that even those who comply with recommendations for moderate-to-vigorous physical activity (MVPA) may not be shielded from the health detriments of participating in prolonged SB (Salmon et al. 2011; Mitchell and Byun 2014). An insufficient MVPA, in conjunction with a high level of SB may expose children and adolescents with intellectual disabilities (ID) to health threats (e.g. heart disease, diabetes and other chronic diseases) (Liu et al. 2020), and in turn, such worsened health conditions would further decrease PA levels and prolong SB. In addition, inadequate PA and excessive SB among children and adolescences could result in an increased risk of health consequences (e.g. overweight/obesity and type II diabetes) (Physical Activity Guidelines Advisory Committee 2008). Moreover, these unhealthy behaviour patterns in childhood and adolescence are likely to continue into adulthood (Physical Activity Guidelines Advisory Committee 2008).

The WHO released the WHO 2020 guidelines on physical activity and sedentary behaviour in November 2020 in an attempt to promote physical and mental health benefits for children and adolescents. WHO suggests that children and adolescences between 5 and 17 years meet the recommendation of at least 60 minutes of MVPA while limiting SB to under 2 h every day (WHO 2020b). Furthermore, children and adolescents can obtain additional health-related benefits from concurrently increasing MVPA and limiting SB (Shen et al. 2020).

The latest research revealed that Chinese typically developed (TD) children and adolescents’ PA levels had decreased and SB had increased since the outbreak of COVID-19 (Xiang et al. 2020). Data in China indicate that only 29.5% of children and adolescences with ID met the recommended amount of PA before the COVID-19 pandemic (Liu et al. 2020). Compared with their TD peers, Chinese children and
adolescents with ID have insufficient levels of PA and a lower standard-reaching rate of MVPA (Liu et al. 2020). Considerable evidence has shown that PA has positive effects on the physical and psychosocial health of children and adolescents with ID (Kapsal et al. 2019). Despite the fact that SB research on children and adolescents with ID is in the early stages, studies by Esposito et al. (2012) and Phillips et al. (2011) showed that children and adolescents with ID experience adverse health disparities, which possibly was associated with high levels of SB. It is a concern that such lifestyle activities as PA and SB among children and adolescents with ID may also have been substantially impacted by the nationwide prolonged school closures in China during the COVID-19 pandemic. All children and adolescents with ID no longer attend school and their classroom lessons are replaced by online learning at home, which reduces opportunities to engage in PA and increases possibility of SB. Under such a situation, PA and SB among children and adolescents with ID are significant concerns.

Although we cannot predict when the pandemic will end, we can take effective measures aimed at this vulnerable population by responding proactively to reduce the potential health risks associated with public health emergencies. Thus, a better understanding of the current situation of PA and SB during this pandemic among children and adolescents with ID could be a helpful and valuable resource for establishing targeted policies and designing effective interventions to mitigate potential harm during future pandemics. However, at the current time, information on PA and SB among children and adolescents with ID in China has been scarce. Therefore, we explored this aspect during this critical period.

Methods

Study design

This study involved a descriptive cross-sectional study using an online parent-reported questionnaire survey administered between 16th and 30th April 2020, after all special education schools in China were closed in January 2020 in an effort to curb the spread of COVID-19. In an attempt to make the parent reports more reflective of actual rather than perceived behaviour, specific trainings with detailed instructions on how to complete the survey were given to parents organised by the researchers through the ZOOM platform before they completed the questionnaires. Moreover, these participating parents were provided ample time for any questions during the training period.

Study participants

All the participants were parents or legal guardians of children and adolescents with ID from 15 special education schools of Shandong Province in China. Additionally, the inclusion criteria of the parents or legal guardians were as follows: (1) their child’s age was between 6 and 18 years; (2) he or she did not exhibit coexisting autism, cerebral palsy, and sensory disabilities; and (3) their child could walk independently. For the ID severity of children and adolescents, this study classified children and adolescents according to the Second National Sampling Survey on Disability as mild [intelligence quotient (IQ) of 55–70], moderate (IQ of 40–54), severe (IQ of 25–39), or profound (IQ of less than 25) (China Disabled Persons’ Federation 2006). Children and adolescents were assigned to three age groups, 6 to 12 years, 13 to 15 years, and 16 to 18 years, which corresponded to the typical age range for the primary, middle and high schools respectively in the Chinese school education system (Ministry of Education of the People’s Republic of China 2018). The reasons for using the specific inclusion criteria for the children and adolescents with ID are as follows: (1) the age of the children and adolescents with ID enrolled in special education schools in China is between 6 and 18 years; (2) this study focused on children and adolescents with ID only; (3) to minimise the confounding of data, the children and adolescents who carried coexisting autism, cerebral palsy and sensory disabilities were excluded from the present study; and (4) children and adolescents with ID who were unable to walk independently have limited physical activity participation.

Procedures

With the assistance of the Shandong Provincial Disabled Persons’ Federation, as well as several municipal disabled persons’ federations, the principals in 15 special education schools were contacted and were willing to take part in this study.
Through the help of headmasters and teachers from special education schools, eligible children and adolescents with ID were sent informed consent to their parents or legal representatives via the WeChat app (Chinese social media mobile application software). Among them, the parents who agreed to participate in the research completed the online questionnaire through the Wenjuanxing questionnaire platform (http://www.wjx.cn). This platform is a widely used system for posting and collecting online questionnaire data in China (Zhang et al. 2020). A total of 837 parents completed the questions of the online survey. Each parent reported on one child. The completion time of the online questionnaires was approximately 50–60 min.

Measures

Physical activity and sedentary behaviour

The Children’s Leisure Activities Study Survey-Chinese-version (CLASS-C) questionnaire was applied in assessing PA and SB of Chinese children and adolescents with ID. The CLASS-C questionnaire has good reliability and validity, and it is widely used in China (Li et al. 2011). In addition, the difference of measurement between the CLASS-C questionnaire and the wearable motion detectors (e.g. accelerometry) was not statistically significant (Li et al. 2011). In this study, it possesses sound reliability (Cronbach’s α = 0.766). The CLASS-C questionnaire included two sections, namely, the personal demographic part and regular participation in PA and SB during weekdays (Monday to Friday) and weekends (Saturday and Sunday). Personal demographic information was collected regarding the child’s gender, date of birth and ID level. The questionnaire includes a checklist of 24 physical activities and a checklist of eight sedentary activities, respectively (Li et al. 2011). For PA children enrolled, information about the frequency and duration of participation on weekdays and weekends was recorded. For each of the SB in which the children participated, data were collected to estimate the time spent on SB during weekdays and weekends. The intensity for each activity was classified according to the latest version of the Youth Compendium of Physical Activities (Butte et al. 2018). Based on the American College of Sports Medicine’s recommended criteria for PA intensity, this study classified PA with metabolic equivalent (MET) values in the range of 3–6 as MVPA and PA with MET values >6 as vigorous-intensity physical activity (VPA) (Hootman 2009).

Statistical analyses

All analyses were performed using SPSS software (version 25.0). The normality of PA and SB variables was checked by the Kolmogorov–Smirnov test. PA and SB differences in gender, age and ID level were tested in binary logistic regression models. Prevalence estimates and odds ratio (OR) from the logistic regression models with their corresponding 95% confidence interval (CI) were presented. The statistical significance was considered as the values of $P < 0.05$.

Ethics approval

The study was approved by the ethical committees of researcher’s institution in China. The parents of children and adolescents with ID provided participatory consent to the data collection. All data were treated confidentially.

Results

Demographic characteristics

Overall, parents provided data about 837 children and adolescents with ID in relation to their PA and SB. Of this number, 65.8% (551) were boys and 34.2% (286) were girls. They ranged in age from 6 to 18 years, with an average age of 12.50 (SD = 3.21). In addition, 42.3% (354) were moderate ID, 40.0% (335) were severe ID and 17.7% (148) were profound ID (Table 1).

Physical activity and sedentary behaviour during the COVID-19 period

Daily minutes of MPVA and SB among children and adolescents with ID during the COVID-19 period are shown in Table 2. Children and adolescents with ID participated in about 10 min of MVPA and engaged in approximately 527 min of SB per day.

Table 3 shows the detailed prevalence estimates of MVPA and SB among children and adolescents with ID by gender, age and ID levels. Overall, only 17.4% of children and adolescents with ID were able to achieve the recommendation of 60 min of daily
MVPA and 76.1% reported adherence to more than 2 h of SB per day.

Logistic regression model results indicated that there were statistically significant differences in the prevalence estimates of MVPA by age. Compared with the 6–12 year old and 13–15 year old groups, the 16–18 year old group was less likely to meet the MVPA recommendation (OR = 0.560, \( P < 0.05 \)) (Table 4).

On the prevalence of SB, a similar pattern of findings was found from the logistic regression model results, with no statistically significant differences in the estimates of SB between gender group and ID levels group. However, compared with the 6–12 year old group, the 13–15 year old and 16–18 year old groups were more likely to spend a considerable amount of time in SB (OR = 1.505, \( P < 0.05 \); OR = 1.626, \( P < 0.05 \), respectively) (Table 4).
Discussion

This research focused on the physical activity and sedentary behaviour among children and adolescents with ID in China during the COVID-19 pandemic. Data were collected in April 2020 when unprecedented and effective quarantine measures were in place to prevent the nationwide spread of COVID-19. The regular PA of Chinese children and adolescents was inevitably interrupted by months of school closures and the suspension of public events (Chen et al. 2020). The results of this study indicated that the levels of PA among Chinese children and adolescents with ID do not meet the recommended MVPA, with more than 80% of the participants failing to reach the daily recommendation. Of note, most children and adolescents with ID engaged in only 10 min of MVPA per day, which has decreased compared with the results (37.1 min of MVPA per day) of a previous study completed before the COVID-19 pandemic (Liu et al. 2020). In addition to showing a worrisome level of reduced MVPA, not surprisingly, high levels of SB have also been observed in children and adolescents with ID. Results found the amount of time spent in SB among Chinese children and adolescents with ID was more than 8 h/day, which was higher than Chinese TD contemporaries in the context of the COVID-19 outbreak (Xiang et al. 2020). This result is consistent with the findings of studies from Agiovlasitis et al. (2020) and Esposito et al. (2012) that revealed that the children and adolescents with ID seem to have higher levels of SB than the general population of peers.

Several factors may underline the low PA levels and high SB levels among children and adolescents with ID during the pandemic. First of all, the role of social policies in times of COVID-19 is significant in China. The effective control of the pandemic has benefited from the immediate prevention and control strategies implemented by the Chinese government. Inevitably, however, another problem has arisen. For example, social restrictions, including remote learning and ‘shelter-at-home’ recommendations, have made it difficult for children and adolescents with ID to participate in PA. As a result, children and teenagers with ID no longer have access to school-related PA such as physical education, recess or walking to/from school. Closed local public parks, sports leagues, playgrounds and trails also impede the possibility of engaging in community-based PA. Additionally, comfortable home-based learning environments with easy access to electronic devices (e.g. smartphones, pads and laptops) may have enhanced SB accessibility for children and adolescents with ID. It is likely that long-term shelter-at-home measures lead to reduced PA and increased SB among children and adolescents with ID that adversely affect immune function and raise the risk of chronic problems. Avoiding sitting for a long time, increasing movements while sitting or taking brief activity breaks to disrupt prolonged periods of sitting might be a simple and effective strategy to reduce SB and stay physically active for children and adolescents with ID at home.

Second, all the special education schools in China had suspended in-person school sessions during the pandemic period. However, in order to make sure that the normal learning progress of the students with ID was not affected, a few special education schools implemented the online education model. Physical education (PE) classes were offered online in different formats as well as other courses. The PE teachers adopted various technologies such as Tencent, Wechat, DingDing or Zoom platforms to have live courses, make pre-recorded curriculums or send daily home-based PA resources to children and adolescents with ID. Online teaching is quite different from traditional teaching in the classroom. Compared with the traditional means, online teaching has advantages such as convenience, speed, anytime and anywhere (Zheng and Zhu 2020). But online teaching has drawbacks as well. Reduced teacher–students and students–students interaction and weakened targeting and timeliness of supervision and guidance make it difficult to guarantee the teaching effectiveness. Furthermore, when children and adolescents with ID are in the home environment, some PA cannot be carried out due to limitations of facilities and equipment, which to a certain extent may limit the diversity of PA, especially related to MVPA programmes. It is worth mentioning that, except for PE courses, other curriculums still require students to learn in a sedentary seated position. In order to avoid the hidden health hazards caused by continuous sitting in one position for a prolonged period of time (e.g. cardiovascular disease, diabetes and some cancers), several special education schools have adopted a series of measures, such as reducing the length of the course and setting breaks between courses, to encourage
children and adolescents with ID to take advantage of every chance to stand up and walk for a while.

Third, the role of the family in promoting PA among children and adolescents with ID is an issue that cannot be ignored. As the first/primary guardians of their children, parents play a vital role in the development of children’s behavioural habits. Parents’ perceptions of the health benefits of PA and the harmful effects of SB will influence their own behaviour, which in turn will have a subtle impact on their children’s behaviour. Findings from Mactavish and Schleien (2004) and Grandisson et al. (2012) studies highlighted that parents who could create good sports atmospheres at home and regularly encourage, support and guide their children to participate in PA would increase the motivation and initiative to perform PA among children and adolescents with ID. Thus, it is time for parents to be aware of the need to prioritise PA time for their children and themselves, because they may not have easy access to PA opportunities as usual during this unexpected time. This would be beneficial not only for periods of ongoing pandemics but also other critical times in order to help their children improve their health status or gain their own health-related benefits.

In our study, stratified analyses indicated that prevalence estimates differed by age. Among the three age groupings, students 16–18 years old tended to be less likely to meet the MVPA guideline than students 6–12 years old and 13–15 years old. It was also observed that the SB of older adolescents (ages 13–15 years and ages 16–18 years) with ID were worse than younger children (ages 6–12 years) with ID. COVID-19 restrictions appeared to have more significant influence on the PA and SB of older teenagers with ID compared to younger children. This situation is in line with other studies that tracked PA and SB among TD peers during the COVID-19 lockdown in the United States of America and Spain (Dunton et al. 2020; Lopez et al. 2020). Previous studies have revealed that although PA typically declines and SB rises as children get older (Treuth et al. 2009; Harding et al. 2015; Dalene et al. 2017; Dunton et al. 2019), the COVID-19 pandemic may be hastening these developmental changes. The fact that the negative effects of the lockdown were more pronounced among older age groups with ID is alarming. This may be explained by the curriculum arrangement. The higher the grade level, the fewer the number of PE courses that were scheduled in the special education school curriculum. The main focus on curriculum setting for students 16 years and older with ID are professional or vocational skills, including cooking, sewing, painting and gardening (Zhao et al. 2006). Furthermore, Agiovlastitis et al. (2020) suggested that older age seems associated with higher levels of SB in children and adolescents with ID. In comparison with TD children and adolescents, age might be a moderator for disability effects, with decreased physical and behavioural abilities in peers with ID having a greater influence on PA as they grew older and the capability gap between these groups widened (Barr and Shields 2011). As school administrators, they should be informed of this situation, so targeted PA online programmes for older students with ID can be taken into account to counteract the negative impact in putative future scenarios where long-term confinements are needed. Besides, the strategies to ensure PA continues to be scheduled in online classes for students in all age groups, and the inclusion of health promotion and disease prevention education for parents and the child on benefits of PA and the risks of SB should be taken into consideration by policy maker from school.

We did not observe an association between PA/SB and gender among children and adolescents with ID during the COVID-19 outbreak. Research prior to the pandemic indicated that boys with ID had a significantly higher time in MVPA than girls with ID (Suzuki et al. 1991; Whitt-Glover et al. 2006; Queralt et al. 2016) due to physiological differences in the choice of PA between boys and girls. PA patterns are not equal by gender (Rodriguez-Larrad et al. 2021). Boys normally tend to experience higher levels of PA when they use more play area and equipment (Anthamatten et al. 2014), while girls usually display a higher enjoyment with walking, creative tasks, sitting, hiding and relaxing (Hyndman and Chancellor 2015). A similar trend occurs in organised activities during childhood, with boys more often participating in organised and high physically intense activities than girls (Marques et al. 2016). However, our result showed that boys with ID and girls with ID present no differences in prevalence. One possible explanation can be that during the COVID-19 pandemic, children and adolescents with ID no longer went to schools. Many regular physical activities (e.g. playing football,
jogging or other organised activities) for boys are forbidden in this special situation due to limitations in space, facilities, lack of organisation from teachers or interaction with peers. Given these findings, it was hypothesised that boys with ID might be more susceptible to home confinement and that therefore their PA levels would change.

This study did not find a relationship between PA/SB and ID level. This may be related to the distribution of participants with ID in special education schools. At present, special education schools in China serve students with moderate ID and severe ID, while students with mild ID generally enter inclusive classes in mainstream schools and students with profound ID often receive home delivery services (Liu et al. 2020). The subjects of this study were primarily students with moderate and severe ID, and the sample size of each ID level was unbalanced. Consequently, it may have some influence on the results of the study. Follow-up research should examine this topic using samples with balanced groups of participants with different levels of ID.

The current study had some potential limitations. First, it used convenience sampling in the Shandong Province in China, which is not representative of all children and adolescents with ID on China’s mainland, and the results might not be generalised broadly. Moreover, children and adolescents with ID in rural areas were not recruited for this study. It is unknown whether there is a clear disparity in PA and SB between rural children and adolescents with ID and those living in urban areas during the pandemic period. A study performed by Zenic et al. (2020) asserted that TD adolescents living in urban environments faced a greater reduction in PA levels than rural areas, which attributed to the fact that rural environments were likely to offer more outdoor space for PA engagement while adhering to measures of social distance. Thus, a more representative sample of children and adolescents with ID from different geographic regions on the mainland of China is needed in the future to increase the generalisability in the country. Second, it should be noted that the measures of PA and SB were obtained during the short observation time of 2 weeks. In order to capture trends in PA and SB over time, a prospective study on the same population of children and adolescents with ID after the pandemic period will need to be conducted. Third, from the life-cycle perspective, it has been shown that persons with ID often experience premature ageing (Mckenzie et al. 2017) and therefore might begin showing symptoms of the disease earlier. Moreover, ID puts individuals at a higher risk of dying earlier in life than the general population (Thomas Jefferson University 2021). This cross-sectional descriptive study was unable to predict the relationship between early levels of PA/SB and health condition (e.g. premature ageing)/disease risk. As a result, follow-up studies are recommended to explore the long-term outcomes of early low levels of PA and high levels of SB. Finally, notwithstanding the aforementioned limitations, this study provides invaluable information on PA and SB status among the ID population in China during the COVID-19 pandemic.

Conclusion

Overall, the results of this study highlighted the fact that Chinese children and adolescents with ID participated in less PA and engaged in more SB during the pandemic. Therefore, to minimise the detrimental effects of the COVID-19 pandemic on the health of children and adolescents with ID, governments, schools, communities and parents need to be aware of the severe situation and apply more effective health behaviour response measures, especially in case of a repeated or intermittent lockdown.

Acknowledgements

We are indebted to all special education schools from Shandong Province in China’s mainland for their cooperation and contributions. All parents of boys and girls who voluntarily participated in this study are highly appreciated, and we wish them and their child the best of luck.

Conflict of interest

No conflicts of interest have been declared by the authors.

Data availability statement

The data that support the findings of this study are available on request from the first author. The data
are not publicly available due to privacy or ethical restrictions.

**Ethics approval**

The study was conducted in conformity with the Declaration of Helsinki and its protocol and pre-approved by the ethical committee of Shandong Sport University, China (SDTYXY20200125R). The parents of the students provided participatory consent to the data collection. All data were treated confidentially.

**Source of funding**

This study were financially supported by the MOE (Ministry of Education in China) Project of Humanities and Social Sciences (No. 18YC890026) and Shandong Social Science Planning Project (No. 18CQXJ47).

**References**

Agiovlasitis S., Choi P., Allred A. T., Xu J. & Motl R. W. (2020) Systematic review of sedentary behaviour in people with Down syndrome across the lifespan: a clarion call. *Journal of Applied Research in Intellectual Disabilities* **33**, 1–14.

Anthamatten P. J., Brink L., Kingston B., Kutchman E. & Nigg C. (2014) An assessment of schoolyard features and behavior patterns in children’s utilization and physical activity. *Journal of Physical Activity and Health* **11**, 564–73.

Barr M. & Shields N. (2011) Identifying the barriers and facilitators to participation in physical activity for children with Down syndrome. *Journal of Intellectual Disability Research* **55**, 1020–33.

Bates L., Zieff G., Stanford K., Moore J., Kerr Z., Hanson E. *et al.* (2020) COVID-19 impact on behaviors across the 24-hour day in children and adolescents: physical activity, sedentary behavior, and sleep. *Children* **7**, 138–47.

Butte N. F., Watson K. B., Ridley K., Zakeri I. F., McMurray R. G., Pfeiffer K. A. *et al.* (2018) A youth compendium of physical activities: activity codes and metabolic intensities. *Medicine and Science in Sports and Exercise* **50**, 246–56.

Carson V., Hunter S., Kuzik N., Gray C. E., Poitras V. J., Chaput J. P. *et al.* (2016) Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied Physiology, Nutrition, and Metabolism* **41**, S240–65.

Chen P. J., Mao L. J., Nassig G., Harmer P., Ainsworth B. & Li F. Z. (2020) Returning Chinese school-aged children and adolescents to physical activity in the wake of COVID-19: actions and precautions. *Journal of Sport and Health Science* **9**, 322–4.

China Disabled Persons’ Federation (2006) *Working Manual for the Second National Sampling Survey on Disabled*. Hua Xia Press, Beijing.

Couzin-Frankel J., Vogel G. & Weiland M. (2020) School openings across globe suggest ways to keep coronavirus at bay, despite outbreaks. Available at: https://www.sciencemag.org/news/2020/07/school-openings-across-globe-suggest-ways-keep-coronavirus-bay-despite-outbreaks

Dalene K. E., Anderssen S. A., Andersen L. B., Steene-Johannessen J., Ekelund U., Hansen B. H. *et al.* (2017) Secular and longitudinal physical activity changes in population-based samples of children and adolescents. *Scandinavian Journal of Medicine and Science in Sports* **28**, 161–71.

Dunton G., Do B. & Wang S. (2020) Early effects of the COVID-19 pandemic on physical activity and sedentary behavior in children living in the U.S. *BMC Public Health* **20**, 1351–64.

Dunton G. F., Yang C. H., Zink J., Dzubur E. & Belcher B. R. (2019) Longitudinal changes in children’s accelerometer-derived activity pattern metrics. *Medicine and Science in Sports and Exercise* **52**, 1307–13.

Esposito P., Macdonald M., Hornyk J. & Ulrich D. (2012) Physical activity patterns of youth with Down syndrome. *Intellectual and Developmental Disabilities* **50**, 109–19.

Grandisson M., Têtreault S. & Freeman A. R. (2012) Enabling integration in sports for adolescents with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities* **25**, 217–30.

Guerrero M., Vanderloo L., Rhodes R., Faulkner G., Moore S. & Tremblay M. (2020) Canadian children’s and youth’s adherence to the 24-h movement guidelines during the COVID-19 pandemic: a decision tree analysis. *Journal of Sport and Health Science* **9**, 313–21.

Harding S. K., Page A. S., Falconer C. & Cooper A. R. (2015) Longitudinal changes in sedentary time and physical activity during adolescence. *International Journal of Behavioral Nutrition and Physical Activity* **12**, 1–7.

Hootman J. M. (2009) 2008 physical activity guidelines for Americans: an opportunity for athletic trainers. *Journal of Athletic Training* **44**, 5–6.

Hyndman B. & Chancellor B. (2015) Engaging children in activities beyond the classroom walls: a social–ecological exploration of Australian primary school children’s enjoyment of school play activities. *Journal of Playwork Practice* **2**, 117–41.

John Hopkins University (2020) Coronavirus COVID-19 global cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University. Available at: https://www.arcgis.com/apps/opsdashboard/index.html#/bda75947474f0d402994423467ba8e85ce6

© 2021 MENCAP and International Association of the Scientific Study of Intellectual and Developmental Disabilities and John Wiley & Sons Ltd
Kapsal N., Dicke T., Morin A., Vasconcellos D., Maíano C., Lee J. et al. (2019) Effects of physical activity on the physical and psychosocial health of youth with intellectual disabilities: a systematic review and meta-analysis. *Journal of Physical Activity and Health* 16, 1–9.

Li H. Y., Chen P. J. & Zhuang J. (2011) Revision and reliability validity assessment of Children’s Leisure Activities Study Survey. *Chinese Journal of School Health* 3, 268–70.

Liu Y., Yuan Y. Q., Wang M. J., Han F. Y., Wen G. J., Zhang J. Z. et al. (2020) The level of physical activity among children with intellectual disability in Jinan. *Chinese Journal of School Health* 41, 136–9.

Lopez R., López-Sánchez G. F., Casajus J. A., Calatayud J. & Smith L. (2020) Health-related behaviors among school-aged children and adolescents during the Spanish Covid-19 confinement. *Frontiers in Pediatrics* 8, 573–84.

Mactavish J. B. & Schleien S. J. (2004) Re-injecting spontaneity and balance in family life: parents’ perspectives on recreation in families that include children with developmental disability. *Journal of Intellectual Disability Research* 48, 123–41.

Margaritis I., Houdart S., Ouadrah R. E., Bigard X. & Duché P. (2020) How to deal with COVID-19 epidemic-related lockdown physical inactivity and sedentary increase in youth? Adaptation of Anses’ benchmarks. *Archives of Public Health* 78, 52–8.

Marques A., Ekelund U. & Sardinha L. B. (2016) Associations between organized sports participation and objectively measured physical activity, sedentary time and weight status in youth. *Journal of Science and Medicine in Sport* 19, 154–7.

Mckenzie K., Ouellette-Kuntz H. & Martin L. (2017) Applying a general measure of frailty to assess the aging related needs of adults with intellectual and developmental disabilities. *Journal of Policy and Practice in Intellectual Disabilities* 14, 124–8.

Ministry of Education of the People’s Republic of China (2018) Education law of the People’s Republic of China. Available at: http://en.moe.gov.cn/Resources/Laws_and_Policies/201506/122150626_191385.html

Mitchell J. A. & Byun W. (2014) Sedentary behavior and health outcomes in children and adolescents. *American Journal of Lifestyle Medicine* 8, 173–99.

Moore S., Faulkner G., Rhodes R., Brussoni M., Chulak-Bozzer T., Ferguson L., et al. (2020) Impact of the COVID-19 virus outbreak on movement and play behaviours of Canadian children and youth: a national survey.

Phillips A. C., Holland A. J. & Tatjana A. (2011) Assessment of objectively measured physical activity levels in individuals with intellectual disabilities with and without Down’s syndrome. *PLoS ONE* 6, 28618–25.

Physical Activity Guidelines Advisory Committee (2008) Physical activity guidelines advisory committee report. Washington, D.C.

Queralt A., Vicente-Ortiz A. & Molina-Garcia J. (2016) The physical activity patterns of adolescents with intellectual disabilities: a descriptive study. *Disability and Health Journal* 9, 341–5.

Rodriguez-Larrad A., Mañas B. A., Labayen I., González-Gross M., Espin E. A., Aznar S. et al. (2021) Impact of COVID-19 confinement on physical activity and sedentary behaviour in Spanish university students: role of gender. *International Journal of Environmental Research and Public Health* 18, 369–83.

Salmon J., Tremblay M., Marshall S. & Hume C. (2011) Health risks, correlates, and interventions to reduce sedentary behavior in young people. *American Journal of Preventive Medicine* 41, 197–206.

Shen H. J., Yan J., Hong J. T., Clark C., Yang X. N., Liu Y. et al. (2020) Prevalence of physical activity and sedentary behavior among Chinese children and adolescents: variations, gaps, and recommendations. *International Journal of Environmental Research and Public Health* 17, 66–84.

Suzuki M., Saitoh S., Tasaki Y., Shimomura Y., Makishima R. & Hosoya N. (1991) Nutritional status and daily physical activity of handicapped students in Tokyo metropolitan schools for deaf, blind, mentally retarded, and physically handicapped individuals. *The American Journal of Clinical Nutrition* 54, 1101–11.

Thomas Jefferson University (2021) After old age, intellectual disability is greatest risk factor for death from COVID-19, study finds. Available at: https://www.sciencedaily.com/releases/2021/03/210305123809.htm

Tremblay M. S., Leblanc A. G., Kho M. E., Saunders T., Larouche R., Colley R. C. et al. (2011) Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *The international journal of behavioral nutrition and physical activity* 8, 1–22.

Treuth M. S., Baggett C. D., Pratt C. A., Going S. B., Elder J. P., Charneco E. Y. et al. (2009) A longitudinal study of sedentary behavior and overweight in adolescent girls. *Obesity* 17, 1003–8.

Vanderloo L. M., Carsley S., Aglipay M., Cost K. T. & Birken C. S. (2020) Applying harm reduction principles to address screen time in young children amidst the COVID-19 pandemic. *Journal of Developmental and Behavioral Pediatrics* 41, 335–6.

Whitt-Glover M. C., O’Neill K. L. & Stettler N. (2006) Physical activity patterns in children with and without Down syndrome. *Pediatric Rehabilitation* 9, 158–64.

WHO (2020a) Coronavirus disease (COVID-19) pandemic: WHO characterizes COVID-19 as a pandemic. Available at: https://www.who.int/emergencies/diseases/novelcoronavirus-2019/events-as-they-happen

WHO (2020b) WHO guidelines on physical activity and sedentary behaviour. Available at: https://apps.who.int/iris/handle/10665/336656

Xiang M., Zhang Z. & Kuwahara K. (2020) Impact of COVID-19 pandemic on children and adolescents’
lifestyle behavior larger than expected. *Progress in Cardiovascular Diseases* **63**, 531–2.

Zenic N., Tair R., Gilic B., Blazevic M. & Sekulic D. (2020) Levels and changes of physical activity in adolescents during the COVID-19 pandemic: contextualizing urban vs. rural living environment. *Applied Sciences* **10**, 3997–4011.

Zhang X. X., Zhu W. F., Kang S. F., Qiu L. K., Lu Z. J. & Sun Y. L. (2020) Association between physical activity and mood states of children and adolescents in social isolation during the COVID-19 epidemic. *International Journal of Environmental Research and Public Health* **17**, 7666–78.

Zhao X. H., Pan L. & Yao J. (2006) The perspective and practice of vocational education for students of sixteen and over with intellectual disabilities. *Chinese Journal of Special Education* **1**, 41–6.

Zheng T. & Zhu X. (2020) Comparing the effects of online teaching during the COVID-19 pandemic and traditional teaching in surgical nursing. *Accepted 7 October 2021*