Original article

Physical activity among Chinese school-aged children: National prevalence estimates from the 2016 Physical Activity and Fitness in China—The Youth Study

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Abstract

Purpose: This study was to present national estimates of participating in moderate-to-vigorous physical activity (MVPA) and adherence to the recommendations of 60 min/day of MVPA among Chinese school-aged children and to assess demographic differences in MVPA.
Methods: Cross-sectional analyses of data from the 2016 Physical Activity and Fitness in China—The Youth Study. Participants were 90,712 primary, junior middle, and junior high school children (boy: 47%; girl: 53%), recruited from 1204 rural and urban schools across 32 administrative provinces and regions in the Mainland of China. Main outcomes were (a) average MVPA minutes per day in the previous 7 days by self-reports and (b) percentage meeting MVPA recommendations.
Results: Average MVPA time was 45.4 min/day, with boys having more MVPA (47.2 min/day) than girls (43.7 min/day) overall and across the 3 school grade categories. About 30% of participants met MVPA recommendations, with a higher percentage of boys (32%) than girls (28%) overall and across the 3 grades categories. Urban school children outperformed rural children in terms of MVPA time. Overall, boys were more likely to meet MVPA recommendations (adjusted odds ratio (aOR) = 1.19, 95% confidence interval (CI): 1.16–1.22) compared with girls; children in higher grades (junior middle (aOR = 0.92, 95%CI: 0.87–0.98) and junior high (aOR = 0.59, 95%CI: 0.53–0.66)) were less likely to meet recommendations compared with primary school children. The odds of meeting recommendations did not differ between urban and rural children ($p = 0.07$), but urban boys were found to be more likely to meet recommendations compared with rural boys (aOR = 1.14, 95%CI: 1.06–1.19).
Conclusion: Overall, the average MVPA minutes per day among Chinese school-aged children is low, and less than one-third of them meet MVPA recommendations. These results were most evident among junior middle and junior high school children and those living rural areas.
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Keywords: Children and adolescents; Exercise; Moderate-to-vigorous physical activity; Sedentary behavior

1. Introduction

The health benefits of regular physical activity (PA) for school-aged children have been well documented, including promoting growth and development and improving physical fitness.[1-3] Current global PA recommendations call for children and adolescents to engage in at least 60 min of daily moderate-to-vigorous PA (MVPA).[3-5] However, a large proportion of school-aged children in both developed and developing countries remains insufficiently active for achieving optimal health benefits.[6-10] It is estimated that, globally, approximately 80% of adolescents (13–15 years old) are not achieving the minimum recommended guidelines for MVPA.[11]

China, the largest developing country, has experienced major changes in social, economic, and built environments after nearly 30 years of economic reforms.[12] These changes have made a significant impact on health and lifestyle as witnessed by an increased level of physical inactivity[8,13] and unhealthy weight[14,15] and decreased or unchanged levels of physical fitness[16,17] among school-aged children. In 2010, a national survey of 166,812 children found that only 22.7% engaged in any type of PA for 60 min/day.[18] Another study of

accelerometry-based MVPA among 2163 urban city children showed that only 9% of boys and 2% of girls met the recommended 60 min MVPA per day.[19] Other studies have also shown a high prevalence and increased trend of sedentary time among school children.[8,13,20]

As part of an on-going public health effort to track and evaluate PA in school-aged children, in 2016 the Physical Activity and Fitness in China—The Youth Study (PAFCTYS) was conducted. Using the PAFCTYS data, the purposes of this study are to present recent national prevalence estimates of daily MVPA and adherence to the recommended 60 min/day of MVPA among Chinese school-aged children and to assess differences in MVPA and adherence to MVPA recommendations by sex, residence locale, and school grades.

2. Methods

2.1. Study design and sampling procedure

The data were acquired from the PAFCTYS, a national survey project sponsored by the Ministry of Education of the People's Republic of China and conducted in fall 2016. The PAFCTYS employed a cross-sectional, multistage sampling design to survey PA and assess physical fitness of children and adolescents in primary, junior middle, and junior high schools from the school education system in China. The general sampling framework provides a representation in geography, economic development, and rural-urban diversity. Within this framework, target students were recruited using a 3-stage non-probability cluster sampling method described below.

In the first stage of sampling selection, from 22 provinces, 4 direct-controlled municipalities (Beijing, Chongqing, Shanghai, and Tianjin), 5 autonomous regions, and 1 Xinjiang Production and Construction Corps (an independent division within Xinjiang Uygur Autonomous Region), 4 local administrative cities were selected from each of 28 province-level units, and 8 districts were selected from each of the 4 direct-controlled municipality units. Given the expected urban–rural socioeconomic differences in our research outcomes, a selection of cities and districts was made with stratification by socioeconomic status within each urban and rural stratum. Accordingly, among the administrative cities, 1 town in a rural area and 1 district in an urban area were selected. Similarly, among direct-controlled municipalities, 4 towns in a rural area and 4 districts in an urban area were selected. For the second stage of sampling selection, 2 primary schools, 1 junior middle school, and 1 junior high school sample units were randomly recruited from a complete listing of all schools that were located within each sampling stratum (local town or district). The third stage was the selection of school grades within a sample school in which 1–2 grade classes were recruited. Among junior middle and junior high schools, student inclusion required that each grade class consist of at least 60 students (30 boys and 30 girls) whereas among primary schools, student inclusion required that each grade class consist of at least 30 students (15 boys and 15 girls). If the pre-specified grade-specific student quota was not met, additional schools within a sample town or district were recruited to achieve the planned

student enrollment number. This sampling process resulted in a range of 32 to 35 schools from each of the provinces and municipalities. Data collection took place between October and November, 2016.

The study protocol was approved by the Institutional Review Board of Shanghai University of Sport, and permission to conduct the study was obtained from the teachers and principals of the participating schools. All the children involved in the study, and their parents or guardians, were specifically advised that participation was completely voluntary. Verbal informed consent was obtained from all parents or guardians, and positive assent was obtained verbally from all the children prior to data collection. Data were collected and analyzed anonymously.

2.2. Study participants

Participants were 125,281 children from primary schools (Grades 4–6, $n = 43,863$), junior middle schools (Grades 7–9, $n = 40,978$), and junior high schools (Grades 10–12, $n = 40,440$) schools, with student ages ranging from 9 to 17 years old.

2.3. Procedures

Following a standardized survey administration protocol, trained research assistants administered the survey during pre-arranged regular school hours. Students completed the survey either online (25%) or on a paper version (75%) in a classroom setting. The purpose of the study was explained to the school physical education teachers and students prior to data collection. Children were given detailed instructions on how to fill out the survey and were provided ample time for questions.

2.4. Measures

With the exception of body height and weight, all measures used in this study were based on self-reports from surveys. Details of each measure in this study are described below.

2.4.1. PA

PA data were ascertained via 2 items adapted from the International Physical Activity Questionnaire—Short Form,[21] which has been shown to have adequate psychometric properties in Chinese student populations.[22] The 2 items record the activity of 2 intensity levels: (1) moderate activities such as leisure cycling and (2) vigorous activities such as aerobic exercise. At each school grade level, participants were asked about the frequency (number of days they performed each activity) during the past 7 days and the duration (in minutes) they were involved in performing each activity for at least 10 min duration per session. The MVPA minutes were summed from the 2 intensity levels and divided by 7 to derive the average number of minutes per day of MVPA for each child. To examine the prevalence of adherence to meeting PA recommendations, children were categorized as meeting PA recommendations if their MVPA time equaled 60 min or more per day.

2.4.2. Other measures

Sociodemographic measures included participants' sex, age, height, and body weight. Information on parent or guardian education, occupation, and family income per capita was obtained from a parent or guardian survey and was used to form a measure of family socioeconomic status (SES) using the method developed by Cirino et al.[23] Children's height was measured to the nearest 0.1 cm in bare feet whereas body weight was measured to the nearest 0.1 kg. Both of these measures were assessed using a portable instrument (GMCS-IV; Jianmin, Beijing, China). Their body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2).

2.5. Statistical analyses

The data analyses were performed using the Complex Samples option of SPSS Version 22.0 (IBM Corp., Armonk, NY, USA), which allows sampling weights and adjustments in the estimation of standard errors for statistical testing. To produce nationally representative estimates, sample weights were applied to account for the clustering effect of sampling by school. The overall data analyses proceeded in 2 steps. First, prevalence estimates of MVPA minutes per day and percentage of meeting MVPA recommendations were calculated by:

- School grades: primary schools (Grades 4–6, 9–11 years old); junior middle schools (Grades 7–9, 12–14 years old); and junior high schools (Grades 10–12, 15–17 years old)
- Sex: boys and girls
- Residence locale: urban and rural

Prevalence estimates are presented in mean and standard error. Second, differences in MVPA were analyzed by sex, school grades, and residence locales using analysis of variance. Similarly, differences in meeting PA recommendations were analyzed, using logistic regression models, by sex, school grades, and residence locales. All analyses adjusted for the children's chronological age, perceived academic burden (collected from the children's survey), and family SES. For logistic regression models, adjusted estimates (odds ratios) and their corresponding 95% confidence intervals (CIs) were reported. Tests were considered statistically significant at an overall α level of 0.05 (2-sided). Adjustments were not made for multiple comparisons.

3. Results

3.1. Sample characteristics

Of the total of 125,281 school children who participated in the survey portion of the PAFCTYS, our analyses included valid data obtained from 90,712 children (42,644 boys, 48,068 girls), with 26,677 (29.4%) in Grades 4–6, 31,472 (34.7%) in Grades 7–9, and 32,563 (35.9%) in Grades 10–12. A total of 34,569 children were excluded due to either missing or abnormal data (i.e., out of range responses) on MVPA.

Sample sizes and weighted demographic characteristics of the study participants are presented in Table 1. The average age of school children in the PAFCTYS survey was 13.2 ± 2.5 years and were primarily of Han ethnicity (>84%). School girls made up over half of the sample (53%). Residence distribution was equal (50% urban). The average BMI score of the children was 19.6 ± 3.6 kg/m²; 14.4% were classified as overweight (85%–94% BMI percentile), and 11.9% were classified as obese (≥95% BMI percentile). Family income per capita was reported to be above RMB100,000 (USD14,976 equivalent) per annum by 5% of the families and below RMB30,000 (USD4492 equivalent) by 75% of the families.

3.2. Prevalence of MVPA minutes per day and meeting MVPA recommendations

Table 2 displays descriptive information about prevalence of MVPA minutes per day and percentage of children meeting MVPA recommendations. Overall, children in the 2016 PAFCTYS reported spending an average of 45.4 min of MVPA per day, with boys engaging in more MVPA per day (47.2 min)

Table 1
Demographic characteristics of Chinese school-age children: the 2016 Physical Activity and Fitness in China—The Youth Study.

Variable	Total (n = 90,712)		School grade[a]					
			Grades 4–6 (n = 26,677)		Grades 7–9 (n = 31,472)		Grades 10–12 (n = 32,563)	
	Boy	Girl	Boy	Girl	Boy	Girl	Boy	Girl
Sample size[b]	42,644 (47.0)	48,068 (53.0)	12,325 (46.2)	14,352 (53.8)	14,769 (46.9)	16,703 (53.1)	15,550 (47.8)	17,013 (52.2)
Han ethnicity[b]	36,298 (85.1)	40,441 (84.1)	10,512 (85.3)	12,159 (84.7)	12,560 (85.0)	13,997 (83.8)	13,226 (85.1)	14,285 (84.0)
Age (year)[c]	13.3 ± 2.5	13.2 ± 2.5	10.1 ± 0.8	10.1 ± 0.8	13.0 ± 0.8	13.0 ± 0.8	16.0 ± 0.8	16.0 ± 0.8
Height (cm)[c]	158.9 ± 15.8	153.1 ± 12.4	142.1 ± 10.2	142.9 ± 10.3	160.3 ± 12.4	155.7 ± 10.6	170.7 ± 9.6	159.2 ± 10.0
Weight (kg)[c]	51.3 ± 15.7	46.3 ± 11.5	37.6 ± 10.2	36.4 ± 9.2	51.5 ± 13.3	48.0 ± 9.7	62.0 ± 12.7	52.9 ± 8.9
BMI (kg/m²)[c]	19.9 ± 3.8	19.4 ± 3.3	18.4 ± 3.6	17.6 ± 3.1	19.8 ± 3.7	19.6 ± 3.1	21.2 ± 3.6	20.8 ± 3.0
Residential location[b,d]								
Urban	20,541 (50.2)	23,054 (49.9)	6198 (52.2)	7457(53.7)	6853 (48.5)	7749 (48.4)	7490 (50.2)	7848 (48.1)
Rural	20,403 (49.8)	23,192 (50.1)	5678 (47.8)	6436 (46.3)	7288 (51.5)	8272 (51.6)	7437 (49.8)	8484 (51.9)

[a] Defined as: primary (Grades 4–6), junior middle (Grades 7–9), and junior high (Grades 10–12) schools.
[b] Data presented as n (%).
[c] Data presented as mean ± SD.
[d] n = 87,190, because 3522 children had missing information on residence identity.
Abbreviation: BMI = body mass index.

Table 2
Prevalence estimates of average MVPA minutes per day and meeting MVPA recommendations by sex, school grades, and residence locales: the 2016 Physical Activity and Fitness in China—The Youth Study.

Variable	Total (n = 90,712)	School grade[a]		
		Grades 4–6 (n = 26,677)	Grades 7–9 (n = 31,472)	Grades 10–12 (n = 32,563)
Average MVPA (min/day, mean ± SE)				
Total	45.4 ± 0.1	49.2 ± 0.3	47.7 ± 0.2	39.9 ± 0.2
Boy	47.2 ± 0.2*	49.8 ± 0.4*	49.1 ± 0.3*	43.4 ± 0.3*
Girl	43.7 ± 0.2	48.6 ± 0.4	46.4 ± 0.3	36.8 ± 0.3
Residence locale				
Urban				
Boy	49.0 ± 0.3	52.6 ± 0.6	51.8 ± 0.5	43.3 ± 0.4
Girl	44.7 ± 0.3	52.6 ± 0.5	47.4 ± 0.4	34.4 ± 0.4
Rural				
Boy	46.2 ± 0.3	47.5 ± 0.6	47.3 ± 0.5	44.1 ± 0.4
Girl	43.3 ± 0.3	44.7 ± 0.5	46.1 ± 0.4	39.5 ± 0.4
Meeting and not meeting PA recommendations (% (SE))				
Total	29.9 (0.2)	33.5 (0.3)	32.5 (0.3)	24.4 (0.2)
Boy	31.8 (0.2)*	34.1 (0.4)*	34.1 (0.4)*	27.8 (0.4)*
Girl	28.2 (0.2)	33.0 (0.4)	31.2 (0.4)	21.3 (0.3)
Residence locale				
Urban				
Boy	33.6 (0.3)[#]	36.5 (0.6)	37.3 (0.6)	27.7 (0.5)
Girl	29.0 (0.3)[#]	36.5 (0.6)	32.4 (0.5)	18.6 (0.4)
Rural				
Boy	30.6 (0.3)	32.1 (0.6)	31.6 (0.5)	28.5 (0.5)
Girl	27.9 (0.3)	29.4 (0.6)	30.6 (0.5)	24.1 (0.5)

[a] Defined as: primary (Grades 4–6), junior middle (Grades 7–9), and junior high (Grades 10–12) schools.
* $p < 0.001$, compared with girls.
[#] $p < 0.001$, compared with the counterpart rural children.
Abbreviations: MVPA = moderate-to-vigorous physical activity; PA = physical activity; SE = standard error.

than girls (43.7 min) ($p < 0.001$). Significant differences in sex were also noted across the 3 school grades, with boys consistently reporting more time than girls (Table 2). Between urban and rural settings, children attending urban schools reported spending more time on MVPA per day (46.9 min) than those attending rural schools (44.8 min) ($p = 0.003$) (data not shown).

In 2016, about 29.9% of school-aged children in the Mainland of China met MVPA recommendations, with a higher percentage observed for boys (31.8%) than for girls (28.2%) ($p < 0.001$), a pattern that is consistent across the 3 school grades. Across the urban–rural settings, children attending urban schools showed an overall higher percentage of meeting MVPA recommendations (31.3%) than those attending rural schools (29.1%) ($p < 0.001$), with urban school boys (33.6%) and girls (29.0%) showing a higher percentage of meeting the recommendations compared to their counterpart rural boys (30.6%) and girls (27.9%) ($p < 0.001$) (Table 2).

3.3. Differences in adherence to MVPA recommendations

Differences in adherence to MVPA recommendations by sex, school grades, and residence locales, analyzed using logistic regression models, are shown in Table 3. Overall, boys were more likely to meet MVPA recommendations than girls (adjusted odds ratio (aOR) = 1.19, 95%CI: 1.16–1.22). Across the 3 school grades, relative to children in primary schools, both junior middle (aOR = 0.92, 95%CI: 0.87–0.98) and junior high (aOR = 0.59, 95%CI: 0.53–0.66) school children were less

likely to meet MVPA recommendations. Some differences in sex across school grades were noted, with junior middle school boys (aOR = 0.91, 95%CI: 0.84–0.99) and high school boys (aOR = 0.62, 95%CI: 0.53–0.73) showing less likelihood of meeting the recommendations compared with boys in primary schools, and girls in junior middle (aOR = 0.94, 95%CI: 0.86–1.02) and in junior high (aOR = 0.57, 95%CI: 0.48–0.66) having lower odds of meeting the recommendations compared with girls in primary schools. The odds did not differ between children living in urban areas and those living in rural areas

Table 3
Adjusted odds ratio (95%CI) of meeting PA recommendation by sex, school grades, and residence locales.[a]

	Total	Boy	Girl
Sex			
Girl	Reference		
Boy	1.19 (1.16–1.22)		
School grade			
Primary	Reference	Reference	Reference
Junior middle	0.92 (0.87–0.98)	0.91 (0.84–0.99)	0.94 (0.86–1.02)
Junior high	0.59 (0.53–0.66)	0.62 (0.53–0.73)	0.57 (0.48–0.66)
Residence locale			
Rural	Reference	Reference	Reference
Urban	1.01 (0.89–1.12)	1.14 (1.06–1.19)	0.96 (0.69–1.18)

[a] All estimates adjusted for children's chronological age, perceived academic burden, and family socioeconomic status (SES).
Abbreviations: CI = confidence interval; PA = physical activity.

(p = 0.07). However, regardless of school grades, school boys living in urban areas (aOR = 1.14, 95%CI: 1.06–1.19) were more likely to meet the recommendations compared to the boys living in rural areas.

4. Discussion

The 2016 PAFCTYS data show a low level of MVPA among Chinese school-aged children, as evidenced by the estimated average of 45 min of MVPA per day, and about 70% of them did not engage in the recommended 60 min/day of MVPA per day. Only about one-third (30%) of Chinese school-aged children met the recommended MVPA in 2016. Overall, boys tended to spend more MVPA time, and had a higher percentage of meeting MVPA recommendations, than did girls. Across school grades, children in junior middle and junior high schools were less likely to meet the recommendations compared with children in primary schools. Although urban children had a higher level of MVPA, there was no difference in adherence to MVPA recommendations.

Analyses also show some differences among subgroups. In particular, boys and girls in junior high schools were shown to have lower odds of meeting the MVPA recommendations compared to boys and girls in primary schools, and boys in junior middle schools had lower odds of meeting the recommendations compared with boys in primary schools. Among children living urban *vs.* rural locations, urban school boys were more likely to meet the recommendations compared to school boys living in rural areas.

Over the past 2 decades, the Mainland of China has evidenced a decreasing trend in the overall level of PA among school-aged children. An early landmark study using the 1997 China Health and Nutrition Survey data shows that 72% of Chinese school-aged youth engaged in primarily in-school MVPA (median = 90–110 min/week) with little MVPA outside of school.[24] Continuing evidence of this decline has been accumulating since then. The 2010 national survey shows that an overall low proportion (22%) of Chinese school children aged 9–18 reported engaging in any kind of PA for a total of 60 min or more per day.[18] Two other studies have shown that an even lower percentage of school children living in urban cities engaged in MVPA, with 1 study reporting that only 6% of urban children aged 9–17 met the MVPA recommendations based on accelerometer data.[19] The other study reported that, by self-reports, only 12% of children living in urban areas met the MVPA recommendations.[25] Low PA levels among children have also been reported in major metropolitan cities such as Beijing[13] and Shanghai.[8]

Significant differences in the prevalence of MVPA between Chinese school boys and girls are evident. Overall, regardless of grades and residence settings, boys in the PAFCTYS reported higher levels of MVPA and were more likely to meet MVPA recommendations compared with their counterpart girls, findings that are consistent with prior Chinese-based reports,[13,18,19] studies from the United States,[26,27] and global estimates.[11] Although urban–rural differences are important in understanding disparities in PA, they are not frequently reported in China.[28] Our findings show that urban children in China were

more physically active than rural children as evidenced by a higher level of daily MVPA reported, a finding that is consistent with a previous national survey report showing higher MVPA prevalence among urban children (38%) compared with those living in rural areas (32%)[18] and that urban families in China tended to spend more time exercising than did rural families.[29] Although we did not find an overall significant urban–rural difference in adherence to MVPA recommendations, we noted a significant urban–rural difference among boys, with those living in urban areas being more likely to meet MVPA recommendations compared with boys living in rural areas. Our findings suggest low levels of MVPA among children living in rural areas where there may be limited availability of and access to playgrounds or PA facilities. Similarly, the results indicate insufficient activity levels among urban children, who have also been shown to have low levels of physical fitness[17] and high levels of sedentary behaviors.[15] Overall, the lack of congruence between the amount of MVPA and adherence to MVPA recommendations suggests that further research is needed to help understand the influences of urbanization (i.e., urban, suburban, rural) on Chinese children's PA.

4.1. Future research

Findings from this study and others[18,19,24] suggest that MVPA among Chinese school-aged children remains low, and thus it is important to continue annual school-based PA surveillance so that appropriate PA promotion and intervention strategies targeting different subgroups of the children's population can be tailored and developed. The availability of prevalence estimates on MVPA from this first PAFCTYS project provides an important opportunity for future research that focuses on examining correlates of PA in children to gain a better understanding of demographic, social, environmental, and personal factors that either facilitate or impede children's MVPA.[30] To better understand influences at different levels (i.e., schools, neighborhoods, urban and rural communities), an ecological and multilevel analysis approach is warranted to disentangle specific levels of correlates (e.g., schools, neighborhoods, urban *vs.* rural) of PA in children. Research is also needed to examine, concurrently, adherence to MVPA and screen-time recommendations, as well as to examine relationships between PA-related behaviors and health-indicators such as obesity and lipid profiles among school-aged children in the Mainland of China. These efforts will be important to create informed interventions designed to reduce sedentary time and prevent childhood obesity.

4.2. Limitations and strengths

The current study has some significant limitations. First, the data used to generate the MVPA were based on self-report. Although validated,[22] self-reported PA has often been criticized as being subject to recall bias or social desirability, which may lead to an overestimation of the actual PA when compared to data generated from objective-based measures such as an accelerometer.[31] Arguably, the use of objective measures (e.g., accelerometers) in a large-scale survey study may prove to be

logistically complex and challenging, as well as cost prohibitive. A related limitation of the study is that the PA surveys in the PAFCTYS were collected during a single season, which may not have captured seasonal variability in PA behaviors across vastly different geographic regions in China. One other limiting factor when interpreting the results is that activities in MVPA are not well delineated in terms of clearly distinguishing activities that were performed in-school or outside school settings (e.g., neighborhoods). It is possible that many MVPA behaviors reported in our estimates may be attributable to in-school activities (as was the case in other studies[13,24]) because of mandatory physical education classes in China. Future studies should separate in-school and out-of-school MVPA to better plan for specific PA promotion policies and strategies. Also, because the PAFCTYS provides national school data, the non-probability sampling used may have reduced the odds of it being truly representative of the population. Last but not least, the cross-sectional design of the PAFCTYS data limit the inference to be made about the causal relationships regarding the demographic characteristics of the population and MVPA behaviors.

Despite these limitations, the prevalence estimates from this study provide the most recent updated data on MVPA in school children, which is critical as the nation moves toward achieving the PA goals set out in *Healthy China 2030*.[32,33] Another strength is that the PAFCTYS offers a wide range of data on school children who were recruited from across the Mainland of China, thus providing insights from diverse demographic, social, and economic strata. This strengthens the representativeness of the target population, allows estimates to be made for urban *vs.* rural communities, provides opportunities for understanding disparity in PA levels and patterns among school children, and allows for the development of targeted policies for PA promotion.

5. Conclusion

The 2016 PAFCTYS data show that, overall, the average MVPA of about 45 min/day among Chinese school-aged children remains low, and less than one-third of the Chinese children met MVPA recommendations. Low prevalence in MVPA and low adherence to MVPA recommendations were most evident among children in junior middle and junior high schools and those living in rural areas.

Authors' contributions

XF performed data analysis and drafted the article; ZBC conceived of the current study, supervised all aspects of its implementation, data interpretation, and drafted the article. Both of the authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

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