Daily Physical Activity Among Children Between Ethnic Han and Mongolians in China

PENGYU DENG*1), BATU BAO*2), TIANSHUO XU*3), HISASHI NAITO*1)

*1) Graduate School of Health and Sports Science, Juntendo University, Chiba, Japan, *2) Huhhot University for Nationalities, Inner Mongolia Autonomous Region, China, *3) Jiaxing Vocational Technical College, Jiaxing, China

Background: China is a multi-ethnic country, different ethnic groups due to genetic, living environment and conditions, eating habits, and these had great differences in the growth and development of children. Moreover, the ethnic Mongolian was one of the largest ethnic minorities beside the ethnic Han in China. An important strategy in order to achieve healthier body composition is to encourage a lifetime physical activity (PA) participation in overweight or obese children. The purpose of this study was to investigate whether Chinese children are less physically active than children by weight status from the different ethnic.

Methods: This was a cross-sectional study conducted in 2013. A total of 133 children enrolled in primary school in Huhhot (35 children) and Loudi (98 children), a city in north and south China, aged 9-10 years (mean age 10.5 ± 0.2), respective. The children consisted of normal-weight children (NW) or overweight/obese children (OW/OB) who determined by BMI according to working group of obesity in China out-offs. Daily PA was quantified by daily step and the time in PA measured using a uniaxial accelerometer (Lifeecorder (LC)). Furthermore, LC determined the time spent in light, moderate and vigorous physical activity (MVPA), corresponding to < 3 metabolic equivalent (METs), 3-6 METs and > 6 METs, respectively.

Results: The prevalence of overweight/obesity was 42.8% (boys: 43.6%, girls: 41.8%) for mid-size city (MS) children, and 40.0% (boys: 37.5%, girls: 42.1%) for Inner Mongolia Autonomous Region children (IMAR), respectively. The daily PA outcomes (steps, total PA time and moderate-to-vigorous PA) declined in weekend than weekdays in both NW children and OW/OB children (p < 0.05). Significant gender differences were found in all segments. Time spent in MVPA did significant differ by ethnic in both boys and girls during the weekdays and weekends (weekdays: 75.3 ± 26.2 (MS) vs. 52.7 ± 14.3 min/day (IMAR) for boys and 57.3 ± 16.5 (MS) vs. 37.7 ± 10.3 min/day (IMAR) for girls; weekends: 55.9 ± 24.7 (MS) vs. 37.7 ± 15.1 min/day (IMAR) for boys, and 44.6 ± 15.9 (MS) vs. 31.7 ± 15.8 min/day (IMAR) for girls, respectively, p < 0.05).

Conclusion: Our finding suggests that the changes in PA, predominantly in the quantity and intensity of activity, are related to weight status in children, independent in different ethnic. Results also indicate the urgency of PA promotion among all children, but especially girls and the ethnic Mongolia children.

Key words: children, ethnic, weight status

Introduction

The important of physical activity (PA) in promoting healthy growth and development in school-aged children has been well-documented1). Despite well-established PA benefits, few school-aged children engage in adequate PA during school days2,3). Particularly, racial/ethnic minority children from families classified in the low socioeconomic status, compared to their counterparts, generally show lower levels of PA and higher levels of sedentary behaviors (e.g., watching television,
playing a video or computer game)\textsuperscript{4}, which may be linked to the higher prevalence of overweight and obesity observed in this high-risk group\textsuperscript{5}. Because obesity often is seen as an imbalance between energy intake and expenditure, differences in diet and PA behaviors impact racial/ethnic disparities in the prevalence of obesity and related conditions\textsuperscript{6}.

The increasing trend of childhood obesity has appeared globally\textsuperscript{7}. About 10\% of 5-17 years old children have been overweight worldwide, and 2-3\% were obese\textsuperscript{8}. The same increasing trend of childhood obesity has also happened in China, which has caused significant direct medical costs\textsuperscript{9}\textsuperscript{10}. In 2014, it was estimated that 23\% and 14\% of Chinese school age boys and girls were obese, respectively, representing an estimated 35 million individuals\textsuperscript{9}.

Childhood overweight or obesity is a serious public health challenge\textsuperscript{11} and the proportion of overweight and obesity high in many countries\textsuperscript{11}\textsuperscript{12}. This is of great concern since childhood obesity is associated with a higher risk of adult obesity\textsuperscript{11}\textsuperscript{13} as well as impaired health later in life\textsuperscript{14}. There is evidence of an inverse relationship between weight status and PA in children and adolescents. Previous studies had evidence for a BMI increases were associated with declines in moderate to vigorous PA (MVPA) in longitudinal studies\textsuperscript{15}. Therefore, the World Health Organization recommends that children and adolescents aged 5-17 years should accrue at least 60 min of moderate to vigorous PA (MVPA) daily. Data of the Chinese “2014 National Physical Fitness and Health Surveillance” showed that 76.2\% (167,761 out of 220,159 participants) of students in school failed to meet the recommendation\textsuperscript{3}.

China has the largest population of people in the world, and the Inner Mongol Autonomous Region has a population of 23.84 million. Han Chinese occupy 80.6\%, and Mongolian people are 72.0\% out of 19.4\% of ethnic minorities in China. Several studies have investigated the pattern of PA on children were either overweight or obese, however, the prevalence of obesity vary widely in different regions, none have focused on the association between ethnic-specificity and weight status in Chinese children. The reason for the ethnic heterogeneity in physical activity is not clear. Genetic factors have been considered a major influence, with a thrifty genotype hypothesis starring in utero\textsuperscript{16}. Research into the association between ethnicity and children’s PA in various countries has reported differing results, ranging from children of ethnic minority background being more active\textsuperscript{17}\textsuperscript{18}, or less active than their contemporaries from the ethnic majority\textsuperscript{17}\textsuperscript{19}. These variations suggest that the relation between children’s ethnic background and PA is dependent not only on the national context but also on the measures used for quantifying PA.

This study investigated the association between children’s ethnic background and their daily amount of general PA. However, to our knowledge, no study has examined patterns of PA among Chinese children from ethnic minorities, by gender and weight status.

This investigation is to examining the objective and variations in the difference of PA by gender, ethnicity and weight status. Patterns of PA across the week were not examined and it is difficult to know if these differences were attributable to lack of opportunity or to inherent differences that may prevent increase in PA.

**Methods**

1. **Participants**

Cross-sectional data were collected from a 143 of children aged 9-11 years attending primary schools from Inner city and Inner Mongolia region in China. These schools have 8-10 classes in each grade, and two glasses were selected from the school to participate in this study in 2014. (71 boys and 62 girls, mean age: 10.6 ± 1.0 years). The subjects provided informed consent, in line with a research protocol adhering to the Declaration of Helsinki, which was approved by the ethics committee of Juntendo University.

2. **Anthropometrics data**

All anthropometric data were collected by trained staff under supervision of the school nurse in 2013. Height and body weight were measured using a portable stadiometer and portable digital scale (TCS-200-RT, YaoYi, Shanghai, China), respectively. Height was measured to the nearest 0.1 cm without shoes, and body weight was measured to the nearest 0.1 kg in ligh underwear.
BMI was calculated by the following standard equation: BMI = weight in kg/height squared in meters. Weight status (i.e., normal weight and overweight/obese weight) was determined according to the age- and gender-specific cut-offs of the Working Group on Obesity in China (WGOC).20

3. Physical activity

We measured PA using uniaxial Kenz EX AC (Lifecorder, Suzuken Co., Ltd, Nagoya, Japan; 60 g). Each child attached the AC to the waist and wore it from the time they got up in the morning until they went to bed. They were instructed to wear the AC from a Monday to Sunday, providing seven consecutive days of data. Previous studies examining the validity of AC data when the monitor was worn at the waist have reported good validity (correlation coefficients 0.66-0.89), and have proposed cut-off values for different activity intensities.21 According to the scale, distinctions were made regarding degrees of intensity (intensity levels 1-3, 4-6, and 7-9), with light (LPA, AC intensity levels of 1-3 and 1.5-2.9 METs), moderate (MPA, AC intensity levels of 4-6 and 3.0-5.9 METs) and vigorous (VPA, AC intensity levels of 7-9 and > 6.0 METs).22 We recorded crude step counts to estimate activity levels, and the time spent in MVPA (> 3.0 METs) was calculated as the sum of the MPA and VPA minutes. Total PA (TPA) = LPA + MPA + VPA for each day. Moreover, if the AC data were not detected for 1 h, this period was regarded as non-wear time. AC analyses were based on a minimum of 10 hours of data per day and at least 2 weekdays and 1 weekend day.23

4. Statistical analysis

Analyses were performed using SPSS, version 22.0 software (SPSS Inc, Chicago). Three-way analysis of variance (ANOVA) was used to investigate differences in each PA outcome among children by gender (boys and girls) and weight status (NW and OW/OB) and children from different ethnic (Inner city and Inner Mongolia). If significant differences in physical characteristic, PA outcomes, were identified by ANOVA, the Bonferroni post hoc tests were used to determine their significance. The differences in percentages of achieving the WHO recommendations were compared across weight status and ethnicity groups using chi-squared test for categorized variables and analysis of variance test for normally distributed variables. The results were given as means ± S.D, and the levels of significance was set at p < 0.05.

Results

A total of 157 children received written information to participate. 14 children were excluded from data analysis for: monitor fault (n = 6), insufficient data (n = 8). The final sample consisted presented only on 31 children from Inner Mongol Autonomous Region, and 90 children from Han people. Demographic data are provided in Table-1.

1. Prevalence of overweight and obesity

The prevalence of overweight and obesity in inland children was consistent with overweight and obesity data from the WGOC, however, Inner Mongolia children had high prevalence of obesity

| Table-1  | Demographic characteristics of the children |
|----------|------------------------------------------|
|          | Inland China | Mongolia in China |
|          | Boys | Girls | Boys | Girls | Boys | Girls | Boys | Girls |
| Age (years) | 10.1 ± 0.4 | 10.0 ± 0.3 | 9.9 ± 0.5 | 9.9 ± 0.5 | 11.1 ± 0.3 | 11.2 ± 0.4 | 11.0 ± 0.4 | 11.2 ± 0.4 |
| Height (cm) | 144.6 ± 6.1 | 144.3 ± 5.6 | 144.9 ± 6.8 | 142.9 ± 5.7 | 142.0 ± 5.2 | 144.0 ± 6.2 | 153.1 ± 7.0 | 150.2 ± 6.5 |
| Weight (kg) | 40.3 ± 7.1 | 36.6 ± 5.2 | 45.0 ± 6.6 | 38.1 ± 5.7 | 34.8 ± 4.2 | 47.2 ± 6.2 | 45.2 ± 12.8 | 36.5 ± 5.9 |
| BMI (kg/m²) | 19.2 ± 2.4 | 17.5 ± 1.4 | 21.3 ± 1.6 | 18.6 ± 2.2 | 17.2 ± 1.3 | 20.5 ± 1.7 | 19.0 ± 4.1 | 16.1 ± 1.5 |

BMI: body mass index
than inland China and National data from WGOC\(^9\) (Table-2).

2. Daily steps

The daily steps for children by weight status and ethnicity in both weekdays and weekends are presented in Figure-1. Inner Mongolia boys were had significantly less daily steps than Inland boys in both weekdays and weekends (p < 0.05), but no differ between Inner Mongolia and Inland girls.

OW/OB children had significantly less daily steps than NW children in both Inland and Inner Mongolia on weekdays and weekends (p < 0.05).

Moreover, daily steps were significantly lower on weekends between Inner Mongolia and Inland children by weight status (p < 0.05).

3. Moderate to vigorous physical activity

The time spent at MVPA for children by weight status and ethnicity in both weekdays and weekends are presented in Figure-2. Inner Mongolia boys were had significantly less the time spent at MVPA than Inland boys in both weekdays and weekends (p < 0.05), but no differ between Inner Mongolia and Inland girls.

OW/OB children had significantly less the time spent at MVPA than NW children in both Inland and Inner Mongolia on weekdays and weekends (p < 0.05).

Moreover, the time spent at MVPA was also significantly lower on weekends between Inner Mongolia and Inland children by weight status (p < 0.05).

4. Achieving WHO recommended

The proportion of children achieving the WHO recommended of MVPA levels, by gender, ethnicity and weight status were presented in Table-3. In total, 40.9% and 12.3% of children achieved the recommended PA on each of the week in both Inland city and Inner Mongolia region. A high proportion of boys met the recommendations than girls (Inland city: 54.6% vs. 26.8%; Inner Mongolia: 21.9% vs. 2.7%). A higher proportion of NW

Table-2 The prevalence of overweight and obesity for children in both Inland and Mongolia in China

|          | Inland China | Mongolia of China |
|----------|--------------|-------------------|
| Overweight | 31.0         | 13.0              |
| Obesity  | 13.0         | 24.0              |

|          | Inland China | Mongolia of China |
|----------|--------------|-------------------|
| Overweight | 37.0         | 26.0              |
| Obesity  | 12.0         | 16.0              |

\(\%\)

![Figure-1](image)

![Figure-2](image)
Children met the WHO recommendations than OW/OB children in both Inland and Inner Mongolia in China (Inland: 42.4% vs. 39.4%; Inner Mongolia: 14.0% vs. 12.5%).

**Discussion**

This study focused on the influence of having ethnic minority background on children’s PA by weight status in China. The finding that the Inner Mongolia region children engaged in lower PA than Inland region children in both boys and girls. In addition, children from ethnic minority background had lowers PA in both weekdays and weekends of additional note is that these primary school age girls and OW/OB children are already much less physically active than boys and normal children in both Inland and Inner Mongolia region.

Very few studies, none of them China, have used objective measures of PA to address the question of whether ethnicity is associated with the amounts of PA among children by weight status. In an American setting, children of ethnic Mexican–American background have been found to be less PA than children from an Anglo-American background while another small American study found no clear association between ethnicity and children’s PA. A large British study observed that children from a South Asian background were less PA than children from a European background while children from an African–Caribbean background tended to be more active. Overall therefore the association between ethnic background and children’s daily amounts of PA seems dependent on the national and regional context as well as the specific ethnic group analyzed.

Studies have found both high activity levels in Han children, but we found that Inner Mongolia region children had lower participation in structured PA than Inland region children. We were also able to demonstrate important differences among

|                  | NW  | OW/OB |
|------------------|-----|-------|
| **Boys**         |     |       |
| Inland China     | 31.0| 13.0  |
| Mongolia of China| 13.0| 24.0  |
| **Girls**        |     |       |
| Inland China     | 37.0| 26.0  |
| Mongolia of China| 12.0| 16.0  |

NW: normal weight; OW/OB: overweight/obese weight

Table 3 The proportion of children achieving WHO recommended MVPA levels, by gender, ethnicity and weight status
children from ethnic backdrops, especially varying levels of different types of PA.

In addition, although the average time spent in MVPA during weekdays was above the WHO recommendation, children only had 26.6% (Inland city: 40.9% Inner Mongolia: 12.3%) of weekends. This gap clearly leaves room for improvement in the weekends to provide additional opportunities increasing PA during weekends. The important contribution of weekends PA to total amounts of MVPA has been well described, but it is difficult to explain the ethnic differences. It is tempting to speculate on the cultural and environmental reasons for these weekends' differences, but further work does need to be carried out so that effective ethnically sensitive strategies to increase PA can be developed. Rowlands suggested that targeting frequent short bouts of different activity intensities even day rather than increasing the duration of activity bouts may be one such strategy to minimize compensatory changes. School seem to provide good opportunity to be physically active, but work need to focus on translating this to active choices outside of school for all children. Future research examining correlates of meeting WHO recommendation should explore this finding further.

Many potential factors may account for differences in PA behaviors across ethnic minority background. One factor is length of time in the Chinese and degree of acculturation to Chinese lifestyle. For example, studies have found that acculturation to the Chinese is association with unhealthy diets. The other factor was home and neighborhood environments may play a role in disparities due differential access to foods and activity resources. In addition, food insecurity (lack of access to enough nutritious food) may be associated with poorer dietary quality. Studies also support the role of differences in parenting practices and styles on disparities in lifestyle behaviors. Finally, social support for certain dietary and PA behaviors may also vary by ethnicity.

The present study has several limitations worth noting. Frist, the cross-sectional design limiting conclusions regarding causation and effect associations between weight status and PA in children by difference ethnicity. Another limitation is this study was restricted to a single public elementary school in an Inland and Inner Mongolia area in China, and thus, caution is need when generalizing the results to other schools with different characteristics. Its findings on the influence of ethnicity can therefore best be applied to other China suburban children sharing the same type of institutions and general childhood circumstances.

Conclusion

Our finding suggests that the changes in PA, predominantly in the quantity and intensity of activity, are related to weight status in children, independent in different ethnic. Results also indicate the urgency of PA promotion among all children, but especially girls and the ethnic Mongolian children.

References

1) Pate RR, Davis MG, Robinson TN, et al. American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee); Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing: Promoting physical activity in children and youth: a leadership role for schools: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. Circulation, 2006; 114: 1214–1224.
2) Troiano RP, Berrigan D, Dodd KW, Mässé LC, Tâlert T, McDowell M: Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc, 2008; 40: 181–188.
3) Wang ZH, Dong YH, Song Y, Yang ZP, Ma J: Analysis on prevalence of physical activity time < 1 hour and related factors in students aged 9–22 years in China, 2014. Zhonghua Liu Xing Bing Xue Za Zhi, 2017; 38: 341–345.
4) Trost SG, McCoy TA, Vander Veur SS, Mallya G, Duffy ML, Foster GD: Physical activity patterns of inner-city elementary schoolchildren. Med Sci Sports Exerc, 2013; 45: 470–474.
5) Ogden CL, Carroll MD, Kit BK, Flegal KM: Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. JAMA, 2012; 307: 483–490.
6) Crawford PB, Story M, Wang MC, Ritchie LD, Sabry ZI: Ethnic issues in the epidemology of childhood obesity. Pediatr Clin North Am, 2001; 48: 855–878.
7) Wang Y, Monteiro C, Popkin BM: Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. Am J Clin Nutr, 2002; 75: 971–977.
8) Verstraeten R, Roberfroid D, Lachat C, et al: Effectiveness of preventive school-based obesity interventions in low- and middle-income countries: a systematic review.
9) Wang S, Dong YH, Wang ZH, Zou ZY, Ma J: Trends in overweight and obesity among Chinese children of 7–18 years old during 1985–2014. Zhonghua Yu Fang Yi Xue Za Zhi, 2017; 51: 300–305.

10) Chen CM: Overview of obesity in Mainland China. Obes Rev, 2008; 9 Suppl 1: 14–21.

11) World Health Organization. Available online: http://www.who.int/dietphysicalactivity/childhood/en/ (accessed on 8 June 2016).

12) Ng M, Fleming T, Robinson M, et al: Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet, 2014; 384: 766–781.

13) Singh AS, Mulder C, Twisk JW, van Mechelen W, Chinapaw MJ: Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev, 2008; 9: 474–488.

14) Ruiz JR, Castro-Piñero J, Artero EG, et al: Predictive validity of health-related fitness in youth: a systematic review. Br J Sports Med, 2009; 43: 909–923.

15) Deng P, Ichinoseki-Sekine N, Zhou L, Naito H: Changes in physical activity and weight status of Chinese children: A retrospective longitudinal study. Jpn J Phy Fitness Sports Med, 2016; 5: 247–256.

16) Prentice AM, Hennig BJ, Fulford AJ: Evolutionary origins of the obesity epidemic: natural selection of thrifty genes or genetic drift following predation release? Int J Obes (Lond), 2008; 32: 1607–1610.

17) Duncan JS, Schofield G, Duncan EK: Pedometer-determined physical activity and body composition in New Zealand children. Med Sci Sports Exerc, 2006; 38: 1402–1409.

18) Hassapidou M, Papadopoulou SK, Frossinis A, Kaklamani LS, Tzotzas T: Sociodemographic, ethnic and dietary factors associated with childhood obesity in Thessaloniki, Northern Greece. Hormones (Athens), 2009; 8: 53–59.

19) Owen CG, Nightingale CM, Rudnicka AR, Cook DG, Ekelund U, Whincup PH: Ethnic and gender differences in physical activity levels among 9–10-year-old children of white European, South Asian and African–Caribbean origin: the Child Heart Health Study in England (CHASE Study). Int J Epidemiol, 2009; 38: 1082–1093.

20) Li H, Ji CY, Zong XN, Zhang YQ: Body mass index growth curves for Chinese children and adolescents aged 0 to 18 years. Zhonghua Er Ke Za Zhi, 2009; 47: 493–438.

21) Puyau MR, Adolph AL, Vohra FA, Butte NF: Validation and calibration of physical activity monitors in children. Obes Res, 2002; 10: 150–157. (in Chinese)

22) Hikihara Y, Sasayama K, Okishima K, et al: The difference of relationships between physical activity variables and physical fitness in children and adolescents: with special reference to amount and intensity of physical activity. Jpn J Phys Fitness Sports Med. 2007; 56: 327–339.

23) Trost SG, McIver KL, Pate RR: Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc, 2005; 37: S531–S543.

24) Sallis JF, McKenzie TL, Elder JP, et al: Sex and ethnic differences in children’s physical activity: Discrepancies between self-report and objective measures. Pediatr Exerc Sic, 1998; 10: 277–284.

25) Sun M, Gower BA, Nagy TR, Trowbridge CA, Dezenberg C, Goran MI: Total, resting, and activity-related energy expenditures are similar in Caucasian and African–American children. Am J Physiol. 1998; 274: E232–237.

26) Gidlow CJ, Cochrane T, Davey R, Smith H: In–school and out–of–school physical activity in primary and secondary school children. J Sports Sci, 2008; 26: 1411–1419.

27) Rowlands AV: Methodological approaches for investigating the biological basis for physical activity in children. Pediatr Exerc Sic, 2009; 21: 273–278.

28) Zhai F, He Y, Wang Z, Hu Y: Status and Characteristic of dietary intake of 12 minority nationalities in China. J Nutr China; 36: 539–541. (in Chinese)

29) Galvez MP, Hong L, Choi E, Liao L, Godbold J, Brenner B: Childhood obesity and neighborhood food–store availability in an inner–city community. Acad Pediatr, 2009; 9: 339–343.

30) Rosas LG, Harley K, Fernald LC, et al: Dietary associations of household food insecurity among children of Mexican descent: results of a binational study. J Am Diet Assoc, 2009; 109: 2001–2009.

31) Dave JM, Evans AE, Pfeiffer KA, Watkins KW, Saunders RP: Correlates of availability and accessibility of fruits and vegetables in homes of low-income Hispanic families. Health Educ Res, 2010; 25: 97–108.

32) Frenn M, Malin S, Villarruel AM, et al: Determinants of physical activity and low–fat diet among low income African American and Hispanic middle school students. Public Health Nurs, 2005; 22: 89–97.