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# Temporal trends and recent correlates in sedentary behaviours in Chinese children

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## Abstract

**Background:** Sedentary behaviours (television, video and computer) are related to health outcomes independent of physical activity. Few studies have examined trends and correlates of sedentary behaviours among youth in developing nations. The current study is to examine temporal trends in sedentary behaviours and recent correlates of screen use in Chinese children during a period of economic transition.

**Methods:** Secondary analysis of China Health and Nutrition Surveys. Cross-sectional data on sedentary behaviours including screen use among children aged 6-18 years from four surveys in 1997 (n = 2,469), 2000 (n = 1,838), 2004 (n = 1,382) and 2006 (n = 1,128). Temporal trends in screen use by socio-demographic characteristics were examined. The correlates of spending more than 2 hours per day on screen time in the most recent survey data (2006, n = 986) were analysed using survey logistic regression analysis.

**Results:** Daily screen time significantly increased in each subgroup by age, sex and urban/rural residence, with the largest increase for urban boys aged 13-18 years from 0.5 hours to 1.7 hours, and for rural boys aged 6-12 years from 0.7 hours to 1.7 hours (p < 0.0001). Daily time in both homework and extracurricular cultural activity increased significantly from 2000 to 2004 but was stable from 2004 to 2006. Boys (OR: 1.41, 95%CI: 1.09 - 1.82), having a TV in the bedroom (OR: 1.86, 95%CI: 1.15 - 3.01), having access to internet at home (OR: 1.93, 95%CI: 1.12 - 3.31) or at internet cafés (OR: 2.01, 95%CI: 1.21 - 3.34), or often watching TV with parents (OR: 2.27, 95%CI: 1.37 - 3.74) were all associated with being more likely to be high screen users (≥ 2 hours/day). While children aged 13-18 years (OR: 0.67, 95%CI: 0.46-0.97) were less likely to be high screen users. Children whose parents often have rules on their TV viewing (OR: 0.64, 95%CI: 0.37 - 1.10) were slightly but not significantly less likely to be high screen users.

**Conclusion:** This study confirms sedentary behaviour has increased over the last decade in Chinese children. Efforts to ensure Chinese youth meet screen time guidelines include limiting access to screen technologies and encouraging parents to monitor their own screen time and to set limits on their child's screen time.

**Keywords:** sedentary, screen, trends, children, adolescents, correlates, China

## Background

Concerns have been raised that sedentary behaviours among children and adolescents may displace the time available for participation in physical activity, resulting in overall lower energy expenditure [1] and that sedentary behaviours are related to chronic health outcomes independent of physical activity [2-4]. Evidence suggests that sedentary behaviours adopted during childhood track into adult life [5]. A better understanding of temporal changes and the correlates of sedentary behaviours

among young people has important public health implications in reducing sedentary behaviours before they become lifestyle norms.

The most common sedentary activity among young people is screen time (i.e., watching television (TV), DVDs, videos, and computer use) [6,7]. Because of its popularity screen time has often been used as a proxy measure of sedentary behaviour among youth however this assumption has recently been challenged [8], and there is a need to measure a range of other, non screen related sedentary behaviours to truly understand sedentaryness. To date, few studies reported other sedentary behaviours such as homework [6,7,9] and extracurricular

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cultural activity including reading, writing and drawing [7,9].

Much of the evidence on sedentary behaviours, including screen time, among young people comes from cross-sectional surveys undertaken in developed countries [7,10-13]. Conversely, little is known about sedentary behaviours among youth in developing nations, such as China, where ownership of technologies associated with sedentariness, such as televisions and computers, have dramatically increased in parallel with rapid socio-economic growth over the last decade [14]. Further, the unique Chinese culture that has high expectations on children's academic performance may influence Chinese children's sedentary behaviours differently from those behaviours of children in developed countries.

For contemporary generations of Chinese children growing up in the fastest developing nation globally there is a greater risk of exposure to more sedentary activities. For this reason ascertaining the prevalence, correlates and temporal changes in sedentary behaviours, including screen time, have become a research priority. The lack of epidemiological information on sedentary behaviours from developing nations is a significant research gap. Information from developed nations is not necessarily applicable to countries under-going social and economic transition so there is a need to examine local data to inform appropriate interventions to change modifiable behaviours, such as sedentary activities. It is important to ascertain what the correlates of screen time are among Chinese children and adolescents and whether these differ from the correlates reported among Western youth. The purpose of this study was to examine the temporal trends and correlates of sedentary behaviours among youth using data from the four most recent China Health and Nutrition Surveys.

## Methods

### Study design

The China Health and Nutrition Surveys (CHNS) are an ongoing series of cross-sectional household surveys (with a nested longitudinal cohort) conducted since 1989 in eight provinces in China with an additional province included in surveys conducted since 2000 surveys [15]. The CHNS is not nationally representative; however the provinces selected provide significant variability in geography, economic development, and health indicators, so that they may be considered to be generally representative of China. Details of the survey design have been published elsewhere [15]. Briefly, four counties within each province (1 low-, 2 middle- and 1 high-income, based on per capita income reported by the National Bureau of Statistics) were randomly selected using a weighted sampling scheme. In addition, the provincial capital city along with a lower-income city was selected. Then the township capital and three villages within the counties and urban and suburban

neighbourhoods within the cities were randomly selected. Finally, twenty households were randomly selected within each neighbourhood and all individuals within a household were interviewed by trained investigators.

The survey protocols, instruments, and the process for obtaining informed consent for this study were approved by institutional review committees of the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Food Safety, Chinese Center for Disease Control and Prevention.

### Participants

Participants aged 6-18 years in the eight provinces that consecutively participated in all four surveys in 1997, 2000, 2004 and 2006 were included in the analysis. Older children were asked survey questions directly. Parents were present for interviews with children younger than 10 years and often assisted the child with answering, or answered the questions directly as a proxy for the child.

### Measurements

Demographic information included the child's date of birth, sex, and family annual income. Per capita family annual income in Chinese currency (RMB) was obtained by dividing family annual income by household size. The per capita family annual income in each survey was inflated to values in 2009 by adjusting for consumer price index and then categorized into tertiles as high, medium and low income by urban and rural areas. Other information collected included the child's self-perceived weight status, whether there was a TV in the child's bedroom, internet access, family's rules on child's TV viewing, and parent-child TV co-viewing.

### Sedentary time

Information on children's sedentary time was collected from children aged 6-18 years for the first time in 1997. In 1997, the questionnaire asked the child to report the usual time spent watching TV/video tapes. Since 2000, time spent doing homework, and extracurricular cultural activity including reading, writing and drawing was added to the CHNS. Since 2004, new questions asked about time spent watching VCDs and DVDs, playing video games and using computer as the private ownership of these technologies increased during this period [14]. For the analysis of correlates of screen time, screen time was categorized into two groups (less than 2 hour per day and 2 hours per day or more) based on the international screen time recommendations [16,17].

### Statistical analysis

Participants are divided into two age groups (i.e. 6-12 years and 13-18 years) because they generally move into middle schools after 12 years old. The median time

spent on different sedentary activities per day in each survey was calculated by age group, sex, urban or rural residence. In each survey since 2000, the participants consist of two parts: newly recruited and those have been measured in previous surveys (i.e. nested cohort). There was no difference in the median times of sedentary activities across survey years between the newly-recruited and the nested cohort participants. Thus, median time and its trends from all participants were reported in this paper. The Kruskal-Wallis one-way analysis of variance was used to examine the difference in sedentary time between surveys in each subgroup.

In the analysis of correlates of screen time, survey logistic regression analysis was applied to account for intra-class correlation incurred by stratified multi-stage cluster random sampling, with "province" as strata variable and "county" as primary sampling unit. Stepwise elimination process was applied for model choice. Sociodemographic variables including age, sex, urban or rural residence and per capita family annual income were retained in the model. All the analyses were conducted using SAS (Version 9; SAS Institute, Cary, NC, USA).

## Results

Table 1 summarises the characteristics of the participants in 1997, 2000, 2004 and 2006. In the four surveys, there were 2,469, 1,838, 1,382 and 1,128 children, respectively. The mean ages across surveys ranged from 11.7 years to 12.0 years ( $p < 0.01$ ). There was no significant difference

in the proportion of urban or rural residence. The per capita family annual income increased from 4,389 RMB to 8,453 RMB in urban areas ( $p < 0.01$ ) and from 3,178 RMB to 5,187 RMB in rural areas ( $p < 0.0001$ ) between 1997 and 2006. The prevalence of spending more than 2 hours per day on screen time increased from approximately 10% in 1997 to approximately 40% in 2006 in both urban and rural areas ( $p < 0.0001$ ).

As shown in Table 2, median screen time increased significantly in each subgroup by age, sex and region of residence from 1997 to 2006. The most significant increase in daily screen time in urban areas was among boys aged 13-18 years from 0.5 hour in 1997 and 2000, to 1.4 hours in 2004 and to 1.7 hours in 2006 ( $p < 0.0001$ ), and in rural areas for boys aged 6-12 years daily screen time increased from 0.7 hour in 1997 and 2000, to 1.3 hours in 2004 and to 1.7 hours in 2006 ( $p < 0.0001$ ).

Table 2 also shows a significant increase in time engaged in homework and extracurricular cultural activity time from 2000 to 2006. Although significant increases were found in each subgroup by age, sex and urban or rural residence in time on homework between 2000 and 2004, the time spent on homework was stable between 2004 and 2006 in most subgroups with the exception of an overall increase among participants aged 13-18 years and urban girls aged 13-18 years. A similar universal increasing trend was found in extracurricular cultural activity between 2000 and 2004, but it was stable in all subgroups between 2004 and 2006.

**Table 1 Characteristics of the study population from 1997 to 2006: China Health and Nutrition Surveys**

	Survey year			
	1997	2000	2004	2006
<i>n</i>	2469	1838	1382	1128
Age (yrs, mean $\pm$ SD)**	11.7 $\pm$ 3.1	12.0 $\pm$ 2.9	12.0 $\pm$ 3.2	11.7 $\pm$ 3.2
Male (%)	52.5	54.0	52.6	53.1
Urban (%)	29.6	29.4	29.4	28.9
<i>Per capita family annual income (RMB<sup>§</sup>, mean <math>\pm</math> SD)<sup>†</sup></i>				
Urban**	4389 $\pm$ 3090	5806 $\pm$ 4957	6980 $\pm$ 6368	8453 $\pm$ 8570
Rural***	3178 $\pm$ 2605	3728 $\pm$ 3042	4799 $\pm$ 4781	5187 $\pm$ 7820
<i>Prevalence of screen time <math>\geq</math> 2 hrs/d (% , Urban)</i>				
Boys aged 6-12 yrs*	13.3	16.4	31.7	36.7
Boys aged 13-18 yrs***	11.2	11.1	42.9	44.3
Girls aged 6-12 yrs***	13.5	11.3	33.7	27.2
Girls aged 13-18 yrs***	9.7	8.5	25.3	34.7
<i>Prevalence of screen time <math>\geq</math> 2 hrs/d (% , Rural)</i>				
Boys aged 6-12 yrs***	9.4	11.5	30.3	46.7
Boys aged 13-18 yrs***	5.7	7.6	22.9	32.5
Girls aged 6-12 yrs***	10.2	11.6	28.4	42.3
Girls aged 13-18 yrs***	3.0	8.3	16.7	24.6

\* $P < 0.01$ . \*\* $P < 0.001$ . \*\*\* $P < 0.0001$ .

<sup>§</sup> RMB denotes Chinese currency.

<sup>†</sup>The per capita family annual income in each survey year was inflated to values in 2009 by adjusting for consumer price index.

**Table 2 Median daily hours for screen time, home work and extracurricular reading, writing and drawing among Chinese youth by sex and age from 1997 to 2006<sup>§</sup>**

	Urban				Rural			
	1997	2000	2004	2006	1997	2000	2004	2006
<i>Screen time (hrs/d)<sup>†</sup></i>								
Boys aged 6-12 yrs***	0.9	0.6	1.3	1.3	0.7	0.7	1.3	1.7
Boys aged 13-18 yrs***	0.5	0.5	1.4	1.7	0.4	0.4	1.0	1.3
Girls aged 6-12 yrs***	0.9	0.6	1.3	1.2	0.7	0.7	1.3	1.6
Girls aged 13-18 yrs***	0.5	0.5	1.2	1.3	0.3	0.4	1.0	1.1
<i>Homework (hrs/d)</i>								
Boys aged 6-12 yrs	-	0.6**	1.0	0.9	-	0.6***	1.0	1.0
Boys aged 13-18 yrs***	-	0.7	1.5	1.7	-	0.8	1.0	1.2
Girls aged 6-12 yrs***	-	0.7	1.2	1.2	-	0.6	1.0	1.0
Girls aged 13-18 yrs***	-	0.9	1.6	1.9	-	0.9	1.5	1.3
<i>Extracurricular reading, writing and drawing</i>								
Boys aged 6-12 yrs	-	0.1***	0.4	0.5	-	0.1**	0.2	0.3
Boys aged 13-18 yrs***	-	0.1	0.5	0.4	-	0.1	0.4	0.4
Girls aged 6-12 yrs	-	0.3*	0.5	0.5	-	0.1	0.0	0.3
Girls aged 13-18 yrs***	-	0.2	0.5	0.5	-	0.1	0.6	0.5

<sup>§</sup> The NPAR1WAY Procedure was used to examine the difference between survey years.

<sup>†</sup> Screen time denotes time on watching TV, videotapes in 1997 and 2000, and on TV, videotapes, VCDs, DVDs, video games, computer usage in 2004 and 2006.

\**P* < 0.01. \*\**P* < 0.001. \*\*\**P* < 0.0001.

Table 3 presents the correlates of spending more than 2 hours per day in screen time from the analysis in the most recent CHNS (i.e., 2006). Children aged 13-18 years were 33% less likely (OR: 0.67, 95%CI: 0.46-0.97) to spend more than 2 hours per day on screen behaviours compared with those aged 6-12 years. Boys were 1.41 times (OR: 1.41, 95%CI: 1.09 -1.82) more likely to exceed the 2 hour per day screen time limit compared with girls. Children with a TV in their bedrooms were 86% more likely (OR: 1.86, 95%CI: 1.15 - 3.01) to spend more than 2 hours per day on screen time than those without a TV in their bedroom. Similarly, children with access to internet at home or at internet cafés were twice as likely to exceed the 2 hour per day screen time limit as those without access to internet. Compared with those children who seldom watched TV with their parents, children who often watched TV with their parents were 2.27 times (OR: 2.27, 95%CI: 1.37 - 3.74) more likely to spend more than 2 hours per day on screen. Children whose parents often set rules about their TV viewing were 36% less likely (OR: 0.64, 95%CI: 0.37 - 1.10) to spend more than 2 hours per day on screen time compared with those whose parents seldom had rules about their TV viewing although it was not statistically significant (*P* = 0.075).

## Discussion

The findings from this study showed significant increases in screen time, homework and extracurricular cultural activity across the survey period for all ages

among boys and girls. Further, there was strong evidence to show that the prevalence of Chinese youth who exceeded the recommended screen time guideline increased significantly over the last decade. Using the most recent survey data (i.e., 2006) the study also found that the correlates of spending more than 2 hours per day on screen time were similar to those reported among Western youth. The odds of high screen time among Chinese youth were strongly associated with younger aged boys, participants with a TV in the bedroom [18-21], having access to internet at internet cafés or at home, co-viewing TV with their parents [22,23] and having no parental rules about their TV viewing [18,23-26]. Few studies have examined sedentary behaviour in Chinese youth and this study makes a unique contribution to our understanding of national trends and current correlates of sedentary behaviours and screen time among Chinese children and adolescents.

Only a few studies have assessed temporal trends in screen time [5,27,28] among children in developed nations, none from developing countries, and no studies have examined temporal trends of non screen time sedentary activities such as homework and other extracurricular cultural activities. The present analysis found a significant increase in both screen time and the proportion of young Chinese spending 2 or more hours per day on screen time over the last decade. The trends in our analysis are consistent with previous studies from developed countries [5,27] but reveal more rapid increases than previously reported. Our findings coincide with the

**Table 3 Correlates of spending more than 2 hours/day of screen time outside school in Chinese children in 2006 (n = 986)<sup>§</sup>**

	≥ 2 hrs/d (%)	Unadjusted OR	Adjusted OR
<i>Age</i>			
6-12 yrs	42.9	1.0	1.0
13-18 yrs	32.4	0.64 (0.45-0.91)	0.67(0.46-0.97)
<i>Sex</i>			
Girls	34.3	1.0	1.0
Boys	43.9	1.49 (1.17-1.91)	1.41(1.09-1.82)
<i>Region</i>			
Rural	41.9	1.0	
Urban	33.2	0.69 (0.39-1.23)	0.62(0.36-1.09)
<i>Per capita family income</i>			
Low	40.7	1.0	1.0
Medium	41.0	1.01 (0.67-1.54)	1.02(0.68-1.53)
High	36.5	0.84 (0.55-1.27)	0.84(0.56-1.26)
<i>Self-perceived weight status</i>			
Healthy weight	39.0	1.0	
Underweight	44.7	1.27(0.77-2.08)	
Overweight/obesity	33.8	0.80 (0.45-1.41)	
<i>TV in child's bedroom</i>			
No	37.6	1.0	1.0
Yes	51.7	1.77 (1.09-2.87)	1.86(1.15-3.01)
<i>Internet access in internet cafés</i>			
No	37.8	1.0	1.0
Yes	48.3	1.54 (0.91-2.60)	2.01(1.21-3.34)
<i>Internet access at home</i>			
No	38.9	1.0	1.0
Yes	44.9	1.28 (0.77-2.14)	1.93(1.12-3.31)
<i>Internet access at relative/friend's home</i>			
No	39.4	1.0	
Yes	40.0	1.03 (0.60-1.75)	
<i>Watching TV with parent(s)</i>			
Seldom	31.4	1.0	1.0
Sometimes	36.9	1.28 (0.88-1.87)	1.26(0.86-1.86)
Often	51.3	2.30 (1.44-3.69)	2.27(1.37-3.74)
<i>Family's rules about TV viewing</i>			
Seldom	41.4	1.0	1.0
Sometimes	41.3	0.99 (0.66-1.49)	1.02(0.69-1.50)
Often	30.4	0.62 (0.37-1.04)	0.64(0.37-1.10)
<i>Family ask you engage in physical activity</i>			
Don't care	39.6	1.0	
More physical activity	38.3	0.95 (0.66-1.36)	
Less physical activity	46.0	1.30 (0.65-2.60)	

<sup>§</sup> Stepwise backward elimination SURVEYLOGISTIC regression was used to model the correlates initially from a full model with all variables in the left column in the Table.

economic transitioning which is occurring in China. During this period in China there was a rapid increase in the family income, in the ownership of televisions, video players and computers [14], and in the prevalence of child obesity [29]. Two studies which have examined sedentary trends among youth, using screen time as a proxy measure, reported decreasing or stable trends in

TV time, probably because TV time was substituted by other multiple new entertainment options [28,30].

Studies in Chinese adults suggested that the decline in physical activity were associated with urbanization [31,32]. Increases in urbanization in many developing nations, including China, have associated with a rapid transition to a more sedentary lifestyle through the



acquisition of new technologies [32-34]. In countries which are undergoing rapid social transition, interventions to reduce sedentary time and to promote physical activity in different settings (school, home, transport, neighbourhood recreation facilities etc.) should be implemented to counter the negative health impact of urbanization [31,35].

Studies among Western youth in the US [36], UK [7], France [27], Canada [9] and Australia [6,13] conducted between 1999 and 2006 have reported that approximately two-thirds of youth exceed the screen time guidelines and that the average screen time among Western youth was approximately 2.5 hours per day. In Mexico City, youth watched TV for 2.4 hours per day and videos for 0.9 hours per day in 1997, respectively, with a 40% of youth exceeding the screen time guidelines [37]. Another developing country from South America, Brazil [38], reported a 2.7 hours per day of screen time among their youth in 2005-2006. These findings are in contrast to the current study findings and other findings from Asian based studies which indicate screen time is lower among youth in a range of Asian countries compared with Western and South American youth. However screen use in Asia was related to the economic prosperity of the country. For example the prevalence in this study of exceeding the screen time guideline in 2006 was between 25% - 45% with a median screen time of 85 minutes per day, consistent with a previous study in China [39], while in Vietnam the prevalence was 19.1% [40]. In developed Asian nations such as Japan [41], the prevalence of exceeding the screen time guideline was 47.1% and in Korea [42], the average youth watches television for 2.6 hours per day and an additional 2.3 hours per day on a computer. Early comparisons indicated that Filipino youth watched substantially more hours of television than did Chinese youth in 1997 ( $1.9 \pm 1.2$  vs.  $0.5 \pm 0.6$  hour/day) [43].

Of the few studies [7,9] which have examined other sedentary behaviours, such as homework, this study found that the time Chinese children reported spending on homework was much higher than the time reported by children in developed countries. In the current study, two thirds of Chinese children (64.5%) in 2006 spent one or more hours per day on homework which was three times higher than youth from Canada (22.9% in 2005-2006) [9], the UK (around 30% in 2002) [7] and Australia [6]. This difference in time on homework may due to a more academic-oriented culture in China than in Western countries, which is supported by literature report that Asian Australian children spent more time on homework than Caucasian children [9].

The decrease in the prevalence of spending more than 2 hours per day on screen time with age among rural youth in this study was inconsistent with previous

cross-sectional [13,25,26,44] and longitudinal [5,45] studies that indicated screen time increases with age. This decline with age in screen time may be explained by the unique Chinese setting in which most rural high schools are boarding schools where adolescents have limited access to screen facilities. Also, it may be because adolescents attending high schools have more extracurricular academic activities like homework and night classes, as our analysis showed that older children spent more time on homework. Also, adolescents may shift screen time to non-screen sedentary behaviours, like talking with friends and listening to music [12]. In urban areas, the proportion of children exceeding screen time guidelines shifted from younger children to older children. This may be because urban adolescents have had progressively greater accessibility to screen-based devices [25]. Consistent with previous studies [12,13,25,26,45], our study found that boys reported more hours of sedentary activity than girls [28,45]. This may be partly explained by girls taking part in more varied activities other than screen behaviours, such as homework and extracurricular cultural activities as found in our study and in previous studies [6,9].

Consistent with previous reports [20,21,46,47], this study found that the presence of a TV in the child's bedroom had a strong positive association with high screen use among children and adolescents. Access to internet at home or at internet cafés also showed a positive association with high screen use. A further analysis found that only a small proportion (4.4%) of rural children had internet access at home, indicating that the internet time of rural children may be mainly attributed to internet café usage. The strong association between these environmental factors with screen time suggests that child's screen time could be reduced by relatively simple changes such as removing the TV from the child's bedroom or limiting their access to the internet.

Although it might be unreasonable to create an electronic media-free home environment, parental rules on children's use of screen technologies may restrict the screen time of children without loss of the benefits of access to these media. Our results demonstrated that parental rules on youths' TV viewing were associated with higher screen time, although it was not statistically significant, which is consistent with previous study findings [23-26,46]. Interestingly, this association was stronger when rules were 'often' present compared with 'sometimes' present, which suggests that a threshold may exist for the intensity of rules.

Consistent with previous studies [22,26], our study found a strong positive association between parent-child co-viewing TV and the child's screen time. These findings indicate that parents may influence their child's screen behaviours through role modelling and therefore interventions that

target both child and parental TV viewing may be more effective in reducing children's screen use [26].

### Limitations and strengths

One of the strengths of this study is the large population, selected to represent Chinese youth in rural and urban China. In addition, the sampling and data collection methods were identical in each survey. Also, short intervals between surveys allowed us to carefully examine the trends in sedentary behaviours in China. One of the limitations of the study is that the cross-sectional data limits inference of causality in the analysis of correlates of high screen use. Additionally, over time the questions on the CHNS changed to reflect the emerging screen technologies in China. For example, questions on computer time were added in 2004 as household ownership of computers changed. In China there were 9.7 computers per 100 urban households in 2000, but this had increased to 33.1 computers per 100 urban households by 2004 [14]. The addition of VCD and DVD use to the questionnaire slightly lagged behind the increase in ownership of these devices in China, which moved from 7.9 in 1997 to 37.5 in 2000 per 100 urban households [14]. The overall trends in screen time between 2000 and 2004 were not influenced by this lag in introducing questions about use of VCD and DVD because of the very low proportion (14.2%) and average time of usage (0.1 hour/day) in the study population in 2000.

Another limitation is that the CHNS data is not weighted because the sampling frame was not available in 1989 when the sites were selected, thus the findings may not be generalized to the population from which the sample was drawn. However, the unweighted analysis may not change the temporal trends in the sedentary behaviours in this population considering the comparable sample characteristics of sex and region of residence between surveys and the stratified analysis by age, sex and region of residence. Finally, although non-independent samples across survey years may be not ideal for the examination of temporal trends, our analysis found similar median times and temporal trends in sedentary activities with those obtained from the separate analysis using only newly recruited participants.

### Conclusion

This study shows that sedentary behaviour and screen time increased among a large population sample of Chinese children aged 6-18 years between 1997 and 2006. This increase occurred during a time of economic and social transition, where access to screen technologies increased. It would appear that as China continues to prosper many Chinese children are potentially at risk of adopting sedentary lifestyles typically associated with Western youth. Efforts should aim to ensure Chinese

youth meet screen time guidelines, including limiting access to screen technologies and encouraging parents to monitor their own screen time and to set limits on their child's screen time.

### List of abbreviations

CHNS: China Health and Nutrition Survey; TV: Television

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### Authors' contributions

ZC performed the statistical analysis and drafted the manuscript. LH guided the statistical analysis and critically revised the manuscript. MD provided suggestions in the statistical analysis and approved the final manuscript. AB supervised the analysis and revised the manuscript. All authors read and approved the final manuscript.

### Competing interests

The authors declare that they have no competing interests.

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