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PAPER

Physical activity and inactivity in Chinese school-aged youth: the China Health and Nutrition Survey

C Tudor-Locke[1]*, BE Ainsworth[2,3], LS Adair[4], S Du[5] and BM Popkin[4]

[1]*Department of Exercise and Wellness, Arizona State University East, Mesa, AZ, USA;* [2]*Prevention Research Centre, Norman J Arnold School of Public Health, University of South Carolina, Columbia, SC, USA;* [3]*Department of Epidemiology and Department of Exercise Science, Norman J Arnold School of Public Health, University of South Carolina, Columbia, SC, USA;* [4]*Department of Nutrition, Carolina Population Centre and School of Public Health, University of North Carolina, Chapel Hill, NC, USA; and* [5]*Institute of Nutrition and Food Safety, Chinese Centers for Disease Control and Prevention, Beijing, China*

OBJECTIVE: To describe physical activity (PA) and inactivity levels and patterns in Chinese school children (aged 6–18 y).
DESIGN: PA and inactivity were assessed in a youth cohort enrolled in the China Health and Nutrition Survey (CHNS) in 1997.
SUBJECTS: A total of 1423 males (11.5 ± 3.2 y) and 1252 females (11.5 ± 3.3 y).
MEASUREMENTS: PA and inactivity were assessed by self-reported usual activity (questionnaire). Children under 10 y were assisted by parents.
RESULTS: Approximately 84% of Chinese youth actively commute to school for a median of 100–150 min/week. A total of 72% engage in in-school moderate/vigorous (MOD/VIG) PA for a median of 90–110 min/week. Relatively few children (≈8%) participate in any MOD/VIG PA outside of school. A total of 72% engage in study-related activities outside of school for a median of 420 min/week. Only 8% of Chinese school children, regardless of gender, watch television ≥2 h/day; less than 1% watch ≥4 h/day. Chores related to housework are not a part of life for Chinese school children; fewer than 20% performed these tasks.
CONCLUSION: Chinese youth are unique compared to those in other developing countries because they do not perform household chores. Instead, they are under pressure to achieve scholastically. Participation in MOD/VIG PA outside of school is almost nonexistent. Current television watching habits are relatively low compared to developed countries and walking/biking is a common form of commuting. The descriptive analysis herein represents the foundation upon which future longitudinal studies of PA in this population will be based.
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Keywords: sports; exercise; active commuting; television; transportation

Introduction

Within the accelerating worldwide obesity epidemic is a growing subepidemic of youth classified as overweight and/or obese.[1] This trend is apparent even in developing countries, where over- and undernutrition can paradoxically coexist.[2] Factors contributing to the epidemic include social and economic transitions that elicit profound shifts in nutrition and physical activity (PA).[3] In particular, decreased PA associated with the transition to urban living and technological improvements is likely to play an important role in the obesity epidemic (and related health conditions), yet there is a paucity of data on youth PA patterns in developing countries.[2] PA surveillance in developed countries has focused primarily on sport/exercise either during or before/after school and often has neglected the intuitively important contributions of active commuting behaviors and chores that are more likely a part of everyday life in the youth of developing countries. Likewise, we know little about physical inactivity patterns (eg television watching, studying, or passive games) of youth in developing countries.

China represents one developing country currently experiencing rapid changes in health and nutrition that are linked to political and social reforms initiated more than 20 y ago.[4] Although the prevalence of overweight is relatively low in Chinese youth (4% in Chinese adolescents in 1993),[5] it is considered an emerging problem.[6] The purpose of this paper was to describe PA and inactivity levels and patterns in Chinese youth (aged 6–18 y of age and

*Correspondence: Dr C Tudor-Locke, Department of Exercise and Wellness, Arizona State University East, 7001 E Williams Field Road, Mesa, AZ 85212, USA.
E-mail: Tudor-Locke@asu.edu
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attending school). The descriptive analysis herein represents the foundation upon which future longitudinal studies of PA in this population will be based.

Methods

Study design

The China Health and Nutrition Survey (CHNS) is a longitudinal survey (with data currently available from 1989, 1991, 1993, and 1997) that was originally designed to examine how the social and economic transformation of Chinese society (and national and local implementation of health, nutrition, and family planning policies and programs) has affected health and nutritional status of its population. The study sample was drawn from eight provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, and Shandong) that vary substantially in geography, economic development, public resources, and health indicators. A multistage, random cluster process was used to draw the surveyed sample. Counties in the eight provinces were initially stratified by income (low, middle, and high) and a weighted sampling scheme was used to randomly select four counties in each province. The provincial capital and a lower income city within each province were selected. In addition, the township capital and three villages within the counties were randomly selected. Finally, within each city, urban and suburban neighborhoods were randomly selected. Additional details about the study design and sampling strategies are available at the World Wide Web site for the China Health and Nutrition Survey (http://www.cpc.unc.edu/projects/china/home.html) or from Popkin *et al*.[4]

Subjects

The 1997 CHNS survey collected data from 1817 males and 1620 females aged 6–18 y. The analysis herein is focused on 1440 (79%) males (age = 11.5 ± 3.2 y) and 1262 (78%) females (age = 11.5 ± 3.3 y) registered in school.

Anthropometric data

Height and weight were measured directly by trained health workers who followed standard protocols similar to the National Health and Nutrition Examination Survey (NHANES) protocol developed by the National Center for Health Statistics in the USA. Weight in lightweight clothing was measured to the nearest 0.1 kg and height was measured to the nearest 0.1 cm. Body mass index (BMI) was calculated as weight in kg/(height in meters)^2. All data collection staff took part in interobserver reliability testing as part of training.[5] Complete anthropometric data were obtained during a physician-conducted physical examination from 1442 males and 1265 females; BMI for males was 18.0 ± 7.1 kg/m^2 and 18.1 ± 9.4 kg/m^2 for females.

Physical activity and inactivity data

CHNS PA and inactivity data were collected from youth 6–18 y of age for the first time in 1997. Older children were asked survey questions directly. Parents were present for interviews with children younger than 10 y of age[7] and often assisted the child with answering or answered the questions directly as a proxy for the child. For youth registered in school, survey questions focused on physical activities inside and outside school hours (sports/exercise), commuting mode to school (by motorized vehicle, bicycle, or walking), and inactive pursuits outside of school hours (watching television/videos, reading/writing/drawing, or playing board/video games). For all activities identified, respondents were queried about their duration (eg hours and minutes per week or per day). Youth were also asked about their contribution to family income (through family-run gardening/farming/livestock care or small business/commercial ventures) and about chores including housework (eg cleaning, cooking, laundry) and childcare duties. Youth aged 16–18 y of age were queried about gainful employment outside family businesses.

Data treatment and statistical analysis

Background and household characteristics of the sample included the proportions reporting urban *vs* rural dwelling, and household television, motor vehicle, and bicycle/tricycle ownership. The proportions classified as overweight and as obese were determined using sex- and age- (mid-year) appropriate BMI cutpoints established by the National Center for Health Statistics (http://www.cdc.gov/growthcharts).

Reported activities were assigned metabolic equivalent (MET) values using the 'Compendium of Physical Activities'.[8] Metabolic rate at rest is classified as 1 MET; a 3 MET activity requires three times the energy expenditure at rest. An average MET value was imputed for categories of activities (eg gymnastics, team sports, track and field, and other activities). (In actuality, the energy cost of activities may be approximately 10% higher in children. Unfortunately, a youth-appropriate compendium of physical activities was not available at the time of these analyses.) Categories of sport/exercise were considered moderate to vigorous (MOD/VIG; ≥3 MET) and categories of sedentary activities were considered light (LIGHT; <3 MET), based on a 1993 CDC-ACSM consensus panel on PA and public health.[9] Active commuting to school by bicycle (4 MET) or by walking (3 MET) was also considered a moderate-intensity activity. Time spent active commuting to school each week was calculated by multiplying reported time for a round trip by 5 days/week. Consultation with our Chinese collaborators indicated that the seemingly incongruent examples in the 'other activities' category (eg board games, martial arts, and boxing) all represented light activities performed informally by youth; that is, martial arts and boxing are not structured, regimented activities as we understand them to be in a

Western context. This category was accordingly coded. We were also informed that it is not typical for Chinese children under 12 y to ride a bicycle by themselves; those under 12 y reporting commuting to school by bicycle likely rode on their parent's bicycle and therefore were not given active commuting credit. The age 12 y was also used to stratify analyses by age group (ie <12 and ≥ 12 y of age). This age cut point is defensible since Chinese children also leave primary school and enter middle school at this time.

Descriptive statistics were calculated after evaluation of the distributions to identify and remove outliers (above the 99th percentile of distribution) for total reported time in MOD/VIG PA (sum of in-school, outside school, and active commuting). Questionnaire-derived PA data are typically positively skewed with mean values biased by a large number of subjects performing little or no PA or relatively few subjects performing a lot of PA.[10] Descriptive statistics herein are therefore presented as the proportion reporting any defined PA and the median and interquartile range (IQR) of distribution of time (min/week) for those reporting any of the defined activity. Gender and age group (ie <12 and ≥ 12 y of age) differences in proportions were tested using χ^2 tests. Differences in time in PA classifications were tested using nonparametric (two-sided Wilcoxon rank sum) tests.

Sedentary activities included sitting watching television/videos (1 MET), sitting reading/writing/drawing (1 MET), and sitting games (1.5 MET). Inactivity indices included watching television ≥ 2 and ≥ 4 h/day. These categories of television watching were set to be comparable to a US study of television watching and body composition in youth.[11] Descriptive statistics were again presented as the proportion reporting any and the median and IQR of distribution of time (min/week) for those reporting any of the defined activity.

Performance of chores (gardening/farming/livestock care, housework, childcare) was not queried in a similar manner necessary to comparably construct accumulated duration; however, the proportion reporting any of these activities was explored. Engagement in gainful employment was only asked of those youth aged 16–18 y of age (Chinese government prohibits employment of youth younger than 16 y); the proportion reporting any is reported. All statistical analyses were conducted using SAS Version 8.01. Significance was set at an alpha level of $P<0.05$.

Results

The analysis data set of Chinese school children contained 1423 males (11.5 ± 3.2 y) and 1252 females (11.5 ± 3.3 y), having deleted 17 males and 10 females lying above the 99th percentile of distribution for total reported time in MOD/VIG PA. Complete anthropometric data were available for 1215 males (BMI $= 17.8 \pm 7.6$ kg/m^2) and 1058 females (BMI $= 17.9 \pm 10.2$ kg/m^2). A total of 5% of males and 4% of females were classified as overweight; 5 and 6% were, respectively, classified as obese. There were no significant gender differences in age, BMI, or the proportion classified as overweight or obese. Table 1 presents subjects' background and household descriptive data.

Table 1 Background and household characteristics of school-aged youth surveyed in the 1997 China Health and Nutrition Survey

	% urban vs rural	*% TV ownership*	*% motor vehicle ownership*	*% bicycle/tricycle ownership*
Males, $N=1423$	25	91	17	79
Females, $N=1252$	25	90	15	79

Table 2 presents the proportion of Chinese school children who engaged in any MOD/VIG PA and the time (min/week) expended (for those reporting any) for each gender by age group. Active commuting and MOD/VIG PA during school contributed the most to daily PA for both males and females, regardless of age group. There was no difference in the proportion reporting any active commuting or reporting time spent active commuting between genders within age groups. Significant age group differences were apparent for both genders, however. This was not explained solely by differences in commuting by bicycling; older age groups also more frequently reported walking and spending more time commuting to school by walking (data not shown, $P<0.001$). Fewer older school children engaged in MOD/VIG PA during school and for shorter accumulated durations compared with the younger age group. Females also engaged in shorter durations of MOD/VIG PA during school compared to males. Relatively few Chinese school children engaged in any MOD/VIG PA outside of school. There were no gender differences in the proportions reporting any time in this activity but there were significant differences between age groups; there was a slightly larger proportion of older males and females who engaged in MOD/VIG PA outside of school. Despite apparent differences in time in these activities, no gender or age group differences were statistically significant.

Table 3 presents similar descriptive information with regard to sedentary activities. Only 8% of Chinese school-aged youth, regardless of gender, watch television ≥ 2 h/day; less than 1% watch ≥ 4 h/day. Significant age group differences were found for the proportion reporting any time spent, and accumulated weekly time spent, watching TV/videos or reading/writing/drawing. Relatively few youth engage in sitting games (which include playing video games). Still, Chinese female youth more frequently reported engaging in sitting games and for longer accumulated weekly time.

Less than 2% of males and females reported any gardening/farming/livestock care activities and less than 1% reported assisting with small business/commercial ventures related to family income. A total of 11% of males and 20% of females reported any chores related to housework. Less than

Table 2 MOD/VIG activities in Chinese youth registered in school

		Youth registered in school			
		% reporting >0 min		*Median (IQR)[a] (min/week)*	
MOD/VIG activity variable	*Age group (y)*	*Males*	*Females*	*Males*	*Females*
Active commuting to school	<12	642/758 85%	572/657 89%	100 (50–150)	100 (50–150)
	≥12	513/665[b]*** 77%	480/595[b]** 83%	150[b]**** (80–200)	150[b]**** (80–200)
During school MOD/VIG activities	<12	555/758 73%	494/657 75%	100 (60–160)	90[b]* (60–130)
	≥12	458/665[b]* 69%	405/595[b]** 68%	110[b]*** (80–180)	100[c]**, [b]** (60–165)
Before/after school MOD/VIG activities	<12	60/758 8%	30/65[c]* 5%	120 (68–240)	165 (70–240)
	≥12	79/665[b]* 12%	42/595[c]**, [b]* 7%	180 (60–270)	128 (90–180)

*$P<0.05$, **$P<0.01$, ***$P<0.001$, ****$P<0.0001$.
[a]Computed for only those reporting any (>0 min).
[b]Significant difference between age groups within gender.
[c]Significant difference between genders within age group.

Table 3 Sedentary activities before/after school in Chinese youth registered in school

		Youth registered in school			
		% reporting >0 min		*Median (IQR) (min/week)*	
Sedentary activity variable	*Age group (y)*	*Males*	*Females*	*Males*	*Females*
TV/video watching	<12	620/758 82%	505/657[a]* 77%	420 (180–600)	420 (180–600)
Reading/writing/drawing	≥12	412/665[b]**** 62%	376/595[b]**** 63%	360[b]* (180–480)	360[b]** (180–480)
	<12	595/758 79%	516/657 79%	420 (210–600)	420 (210–600)
	≥12	425/665[b]**** 64%	389/595[b]**** 66%	420[b]**** (240–780)	420[b]**** (300–720)
Sitting games	<12	92/758 12%	58/657[a]* 9%	135 (70–225)	180[a]* (60–240)
	≥12	70/665 11%	43/595[a]* 7%	120 (60–240)	170[a]* (60–240)

*$P<0.05$, **$P<0.01$, ***$P<0.001$, ****$P<0.0001$.
[a]Significant difference between genders within age group.
[b]Significant difference between age groups within gender.

1% of Chinese youth reported childcare duties. Less than 2% of Chinese youth 16–18 y of age and registered in school reported gainful employment.

Discussion

The most frequently reported MOD/VIG PA for Chinese youth includes active commuting and in-school activities. Although a decreased proportion of older youth reported engaging in these activity types, the median accumulated weekly time spent on these activities is higher compared to younger children. Relatively few males and even fewer females participate in any MOD/VIG PA outside of school.

Commuting mode to school is likely influenced by a number of factors including (1) distance to school; (2) cost; (3) economic circumstances of the family; (4) availability of motorized transport (either household owned or public

transit options), and (5) specific to China, whether the youth is of an accepted age to ride a bicycle independently. Currently, a relatively low proportion (15–17%) of households in this study owned a motorized vehicle; this is likely to change as urbanization continues. In contrast, in the USA where motorized transportation is ubiquitous, a recent report of school transportation modes in Georgia indicated that fewer than 19% of school-aged children who lived ≤ 1 mile from school walked to school the majority of days of the week and almost 42% were chauffeured to school in a private vehicle.[12] Household ownership of motorized transportation has been associated with obesity in Chinese adults (both men and women) and acquisition of a motorized vehicle increased the odds of becoming obese over an 8 y time period in men.[13] Active commuting behaviors have also been associated with reduced cardiovascular risk factors in a municipal sample of Chinese adults.[14–16]

A great proportion (approximately 72%) of the sample surveyed participated in MOD/VIG PA during school. The survey did not distinguish between activities performed during structured physical education classes, other organized activities (eg intramural sports during lunch breaks), or informal activities during recess or lunch breaks. In comparison, 21–22% of American youth participate regularly in physical education class.[17,18] Although reported accumulated time in MOD/VIG PA during school was relatively high, it is likely an overestimation produced from recalling structured time periods and not necessarily representative of completely active time. In US schools, elementary school children were engaged in MOD/VIG PA less than 9% of physical education class time.[19] These findings and others[20] suggest that accumulated time in PA during school may actually be less than reported by Chinese youth as well.

High levels of television watching have been associated with youth overweight and obesity in cross-sectional studies.[11,21–24] The consistency, strength, and specificity of these associations suggest that television viewing may lead to weight gain in at least some youth. At this time, evidence from longitudinal studies is lacking, however, and we know of only one randomized controlled trial to reduce children's television viewing habits.[25] That study reported significant decreases in indicators of adiposity (eg BMI, triceps skinfold thickness, waist girth, and waist-to-hip ratio) thus providing additional evidence of a causal relationship between television viewing habits and obesity.[25] Additional prospective studies are warranted to confirm causation. Chinese youth, however, do not watch television/videos to the extent observed in other countries despite the relatively high levels (90–91%) of household television ownership reported herein. In the US, 65–67% of youth 8–16 y of age reported watching television ≥ 2 h/day.[11,23] In the Philippines (another developing country where household television ownership is 73–80%), 48% of youth watch television ≥ 2 h/day[26] compared with 8% herein. Between-country differences may reflect regional television programming relevance and appeal or cultural differences in viewing habits. American-style satellite television (eg 30+ channels and programming that includes game shows, reality-based shows, primetime dramas, and product advertisements) has only recently been introduced on a large scale to China.[27] In 1997, almost none of the Chinese households surveyed had access to such contemporary television programming. We therefore anticipate that overweight and obesity will increase in Chinese youth as television watching behaviors increase in response to this new wave of mass-appeal broadcasting and consumer marketing. CHNS data from 2000, 2003, and 2006 will likely reveal important shifts in behavior and important health outcomes. Additional data will include type of television channels available to and preferred by youth.

The proportion of Chinese youth reporting reading/writing/drawing appears comparable to television/video watching, although older age groups appear to be spending more accumulated weekly time in the former activity. Unfortunately, there is little published international data about other forms of inactivity (eg studying or passive games) to compare these findings to. Youth in China are under great pressure to perform well in school, and heavy homework loads are typical.[28,29] A university education is seen as the only path to a good job and the pressure to succeed scholastically begins early since university entrance is restricted.[28] Providing a good education is also valued in Chinese society and parental care of children includes time devoted to assisting with homework.[30]

Our estimates of accumulated time in various activities did not include time spent in gainful employment or performing chores. Very few youth are employed, however, and chores related to housework (chores at school were not queried) are not a part of life for Chinese youth (as stated previously, fewer than 20% performed these tasks). The Chinese government prohibits employment of youth younger than 16 y of age, and the availability of job opportunities for older adolescents is limited and restricted by administrative requirements that discourage workplaces from hiring temporary or short-term workers. Chinese women take on all household responsibilities in part to free children to focus on scholastic achievement.[28] In contrast, the primary source of PA for Filipino youth is chores (eg cleaning, fetching water, laundry), both at school and at home.[26] Performance of domestic tasks is also common in other developing countries, especially for adolescent females.[31,32] For example, Russian girls aged 6–13 y spend 4–10 h/week in housework whereas Russian boys spend 4–5 h/week in these activities.[32] This suggests that China is unique and does not follow anticipated patterns of time use in this regard, at least for youth. A caveat to interpretation is that gardening/farming/livestock care was only queried with regard to contribution to family income; however, it is possible that more youth are involved in these types of activities for immediate family consumption. Regardless, such activities are seasonal and are not typically performed by youth. Instead, parents and adults in the community actively discourage any work/chores or other activities that might interfere with their

expected role as students. The surprisingly low proportion of Chinese youth performing childcare duties is a direct reflection of the fact that national birth control policies have limited family size[33] and, therefore, childcare opportunities. In all, we do not consider the determination of accumulated time in various activities to be problematic.

The strength of this study is that it is based on a large eight-province nationwide representative survey that has been administered over several years, subjected to stringent quality control strategies, and involves international collaborators. The extensive database uniquely includes measures of inactivity as well as PA. The cross-sectional findings herein, however, are based on a single year of data collection and therefore limit causal inference. Further, parents necessarily assisted younger children (<10 y of age) with the survey or provided a proxy report of children's PA habits. Although proxy reports have been questioned with regard to validity, proxy reports are practical approaches for large study populations and permit researchers to avoid recall biases associated with the cognitive limitations of young children.[34]

As Chinese youth transition to adult roles and responsibilities, time spent in MOD/VIG PA currently pursued during school will be exchanged for increasingly sedentary employment options.[3,4] As modernization and technological advancement continue in this developing country, it is likely that commuting patterns will also shift to more passive forms (ie increased use of motorized transportation alternatives). Already public busses have replaced bicycles as the primary means of transportation for urban dwellers.[35] These changes portend an increased prevalence of overweight and obesity (and obesity-related conditions) in Chinese youth as they transition to adulthood. Against this backdrop of decreasing PA and increasing inactivity, it appears that health promotion efforts should focus on public transportation policies that encourage continued reliance on more active forms of commuting, promote increased participation in leisure-time MOD/VIG PA, and attempt to cap time spent in inactivity (eg studying, watching television, and playing passive games). Unfortunately, it appears that a strong foundation of involvement in leisure time MOD/VIG PA is not currently nurtured in Chinese youth, especially in females, and that the competing societal pressure to excel at school will not be soon relieved. Perhaps most threateningly, recently introduced mass television programming improvements foreshadow an amplified obesity epidemic.

In summary, in-school activities and active commuting represent the most important forms of MOD/VIG PA of Chinese youth. In-school activities are susceptible to parental and societal pressures for academic success manifested in education policy changes and to the transition to adult roles and responsibilities. Active commuting behaviors are especially susceptible to transportation policies that favor more passive forms of commuting with increased modernization and affluence. Participation in leisure-time MOD/VIG PA is currently underutilized by Chinese youth as an alternative form of health-related activity. Although television viewing is relatively low, this is expected to change dramatically in future years. And although overweight and obesity rates are relatively low for the moment, there is evidence that they are also increasing over time.[36] Doubtless, the social and economic transformation of Chinese society will continue to impact the health and welfare of its populace. The concomitant impact of changes in youth PA and inactivity patterns and their impact on obesity trends will continue to be studied longitudinally in China with subsequent administrations of the CHNS.

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