

Cross-sectional comparison of physical activity and inactivity patterns in Chinese and Filipino youth

C. Tudor-Locke,* B. E. Ainsworth,† L. S. Adair,‡ S. Du,§ N. Lee‡ and B. M. Popkin‡

*Walking Research Laboratory, Department of Exercise and Wellness, Arizona State University East, Mesa, AZ,

†Prevention Research Centre, Department of Epidemiology and Biostatistics, Department of Exercise Science, Norman J. Arnold School of Public Health, University of South Carolina, Columbia, SC,

‡Carolina Population Center and School of Public Health, Department of Nutrition, University of North Carolina, Chapel Hill, NC, USA, and

§Institute of Nutrition and Food Safety, Chinese Centers for Disease Control and Prevention, Beijing, China.

Accepted for publication 30 November 2005

Abstract

Background To compare and contrast youth physical activity (PA) and inactivity patterns in two developing Asian countries: the Philippines and China.

Methods Comparative analysis of 1997–1999 Cebu Longitudinal Health and Nutrition Survey and the 1997 China Health and Nutrition Survey, large-scale surveys that included questions on type, frequency and duration of: commuting mode to school, sports/exercise in and outside of school, select sedentary activities and chores.

Results Filipino data included 760 males and 872 females aged 14–16 years. The comparable Chinese sample consisted of 202 males and 197 females. Active commuting is proportionately high in both countries (70–71% in the Philippines vs. 77–90% in China), although commuting by bicycling is rare in the Philippines (<1%) vs. China (≈35%). Patterns of school sport/exercise participation differ between countries by gender; more Filipino males report school sport/exercise than females (63 vs. 49%) vs. China, where more females participate than males (75 vs. 69%). Sport/exercise outside of school is proportionately low (6–12%) for youth from both countries with a single exception: 74% of Filipino males participate in extra-curricular sport/exercise. Although a higher percentage of Filipino youth report watching television >4 h/day (<10%) vs. Chinese youth (<1%), both are lower than comparable US reports.

Conclusion In the Philippines, continued modernization augurs a decrease in local primary PA sources (chores and active commuting). In China, where youth already are not expected to perform chores, shifts to more passive commuting modes (i.e. increased motorized transportation) are anticipated.

Keywords

behaviour, exercise, schools, students

Correspondence:

Catrine Tudor-Locke, PhD,
FACSM, Department of
Exercise and Wellness,
Arizona State University
East Campus, 7350 East
Unity Ave. Mesa, AZ
85212-0180, USA
E-mail:
tudor-locke@asu.edu

Introduction

In recent years, nutrition and policy research of youth in the developing world has shifted focus from poverty and malnutrition to overweight and obesity epidemics set against social and economic transitions (Popkin & Doak 1998; World Health

Organization 1998). Profound reductions in energy expended because of changes in physical activity (PA) and inactivity patterns likely contribute to these altered public health priorities (Popkin 2002). As an example from a developed country, only 55.7% of youth were enrolled in a physical education class in 2003, only 28.4% attended daily physical education class and

only 39.2% were actually physically active during class (Centers for Disease Control & Prevention 2004). Further, transportation surveys indicate a 37% decline in the number of walking or bicycle trips made by children between 1977 and 1995 (McCann & DeLille 2000). Specifically, the 1995 US Nationwide Personal Transportation Survey (Federal Highway Administration 1997) indicated that approximately half of American school children were chauffeured to school in privately owned vehicles. In contrast, relatively few studies exist that focus on youth PA and inactivity patterns in developing countries (Benefice 1998; Schmidt *et al.* 1998; Tudor-Locke *et al.* 2003a), and no study has yet compared different developing countries.

Self-reported PA and inactivity data were collected from similarly aged adolescents (14–16 years of age) in the Philippines in 1998–1999 and in China in 1997 as part of ongoing surveys of youth living in urban and rural settings. Combined, these data provide an inimitable opportunity to compare and contrast PA and inactivity patterns unique to each society. Therefore, the purpose of this comparative paper is to examine similarities and differences in PA and inactivity patterns in these two developing Asian countries.

Methods

Data sources and participants

The Cebu Longitudinal Health and Nutrition Survey (CLHNS) is a longitudinal study of a 1-year birth cohort of index children born between 1 May 1983 and 30 April 1984 in the Metropolitan Cebu area of the Philippines. The index children and their families live in a range of urban and rural settings. The CLHNS study design and sampling details are available at <http://www.cpc.unc.edu/dataarch/iprimary/cebu.html> or from Adair and colleagues (2001). When the 1998–1999 follow-up was conducted, data were first collected on all females (owing to their earlier pubertal maturation compared with males). The CLHNS subsample for this comparative included 409 14-year-old and 463 15-year-old females in 1998 who were attending school. In 1999, corresponding data were collected from 350 15-year-old and 410 16-year-old males who were attending school. These data represent 87% of the female, and 70% of the male total CLHNS sample (including those not attending school).

The China Health and Nutrition Survey (CHNS) is a large-scale, nationally representative, longitudinal survey designed to examine how Chinese social and economic changes have affected population health and nutrition. A multistage, random cluster process was used to draw the study sample from eight provinces (Guangxi, Guizhou, Heilongjiang, Henan, Hubei,

Hunan, Jiangsu and Shandong) that vary with regards to geography, economic development, public resources and health indicators. Study design and sampling strategy details are available at <http://www.cpc.unc.edu/projects/china/home.html> or from Popkin and colleagues (1993). The CHNS collected data from 1620 females and 1817 males aged 6–18 years of age in 1997. Comparable to the Filipino data, there were 105 14-year-old and 92 15-year-old females, and 108 15-year-old and 94 16-year-old males attending school who contributed data in 1997.

The decision to include only those youth attending school was based on the need for comparable activity data: both surveys collected information with respect to school days, but only the CLHNS asked separately about both school and non-school days. Urban or rural residence was determined according to standards developed by each country. Therefore, the definitions and meanings of urban and rural residence vary between countries. In both countries, household ownership of a television or a motor vehicle was collected as an indicator of socio-economic status and of access to sedentary behaviours.

Self-reported PA

Both the CLHNS and the CHNS were administered during an interview process that included direct measures of height and weight. Comparable questions were administered that focused on *usual* PA and inactivity (i.e. in a day, in a week) in terms of type, frequency and duration of: commuting mode to school (by motorized vehicle, bicycle, or walking), PA during school and outside of school (sports/exercise), select sedentary activities (i.e. those common to both questionnaires) outside of school (watching television/videos, reading/writing/drawing, etc., or playing board/video games which we call sitting games herein) and outside of school. Filipino adolescents were also asked about chores during school (e.g. sweeping and mopping the floor) as this frequently was a part of their school day (i.e. it is considered part of their training and is inspected and may be graded by teachers as part of school conduct). They were also given another commuting mode option: a combination of walking and riding a motorized vehicle. This extra alternative reflects the nature of transportation in the Philippines. Specifically, Filipinos typically walk to public transportation stops, ride in Jeeps (modified with bench seating) to another stop, and walk the remaining distance to their destinations. Youth in both countries not attending school (Philippines 30% vs. China 29%) were only asked about PA and chores outside of school and are not a focus in this analysis. Specific questions used have been discussed in previous publications (Tudor-Locke *et al.* 2003a,b) and are available at the websites indicated above.

These questions exhibit statistically significant relationships in the expected direction with objectively monitored PA (Tudor-Locke *et al.* 2003a).

Each activity was assigned a metabolic equivalent (MET) value using the updated Compendium of Physical Activities (Ainsworth *et al.* 2000). The Compendium was developed to facilitate common intensity coding of PA records, logs and surveys; it has received widespread acceptance in exercise science and public health fields (Ainsworth *et al.* 2000). A MET is the ratio of work metabolic rate to resting metabolic rate and therefore communicates its intensity. PAs herein were considered moderate to vigorous (MOD/VIG; ≥ 3 METs) and inactive pursuits were considered light (LIGHT; < 3 METs) based on a 1993 Centers for Disease Control and Prevention/American College of Sports Medicine consensus panel on PA and public health (Pate *et al.* 1995). Admittedly, the metabolic cost of PAs is about 10% higher in children. At the present time, however, no youth-specific normative data are available for the comprehensive activities asked in this questionnaire.

Frequency and duration of reported activities were used to construct time (min/week) spent in PA and inactivity. The proportion of youth engaging in any (> 0 min) of each reported PA and inactivity was computed. Watching television was analysed as both a continuous variable (h/day) and a categorical variable. Specifically, watching television 0 h/day, < 2 h/day, 2–4 h/day and > 4 h/day were used as inactivity indices, comparable to a US study of television watching and body composition in youth (Anderson *et al.* 1998).

A one-way ANOVA was used to determine differences in age and body mass index (BMI) (after checking for normality) across the four country-by-gender groups (i.e. Filipino males, Filipino females, Chinese males, Chinese females). Time spent watching television was skewed and was log transformed (after adding 0.5 to zero values) prior to analysis by ANOVA. Post hoc

Duncan tests were examined in the event of a significant omnibus F level. Chi-squared tests were used to examine country and gender differences in categorical variables. SAS release 8.02 was used for these analyses. An alpha level of $P < 0.05$ was set to evaluate significance.

Results

Table 1 presents subjects' descriptive characteristics. Males of both countries were significantly older than females ($F = 685.6$, $P < 0.001$). Between country differences were not significant. Chinese males and females had significantly higher BMIs compared with their Filipino counterparts ($F = 6.54$, $P < 0.001$); there were no significant gender differences in BMI in either country. A significantly larger proportion of Filipino youth resided in urban settings compared with Chinese youth ($\chi^2 = 318.9$, $P < 0.0001$); there were no gender differences. Filipino youth reported less household television ownership ($\chi^2 = 36.4$, $P < 0.0001$) than Chinese youth, but more household motor vehicle ownership ($\chi^2 = 93.6$, $P < 0.0001$). Filipino males were more likely to report household television ownership ($\chi^2 = 11.97$, $P < 0.0005$) and motor vehicle ownership ($\chi^2 = 8.35$, $P < 0.01$) than Filipino females. There were no significant differences between Chinese males and females with regards to household television ($\chi^2 = 0.1$, $P = 0.80$) or motor vehicle ownership ($\chi^2 = 1.86$, $P = 0.17$).

The proportion of youth in both countries reporting any (> 0 min) of various MOD/VIG activities is presented in Table 2. Chinese youth (specifically females compared with males; $\chi^2 = 12.3$, $P < 0.001$) more frequently reported active commuting behaviours than Filipino youth ($\chi^2 = 26.2$, $P < 0.001$). Figure 1 shows that a higher percentage of Chinese youth bicycled to school. Although it appears that more Filipino than Chinese youth were commuting to school by motor vehicle and

Table 1. Descriptive characteristics of Filipino and Chinese youth

	Philippines		China	
	Males <i>n</i> = 760	Females <i>n</i> = 872	Males <i>n</i> = 202	Females <i>n</i> = 197
Age (years)	15.5 \pm 0.5†	14.5 \pm 0.5	15.5 \pm 0.5†	14.5 \pm 0.5
BMI (kg/m ²)	18.6 \pm 2.7*	18.7 \pm 2.3*	19.4 \pm 2.4	19.3 \pm 3.2
% Urban vs. rural	76*	74*	29	28
% TV ownership	80*†	73*	90	90
% Motor vehicle ownership	43*†	36*	16	11

Values are means \pm SD unless otherwise indicated.

*Indicates significant differences between countries for the same gender.

†Indicates significant differences between genders within the same count.

BMI, body mass index.

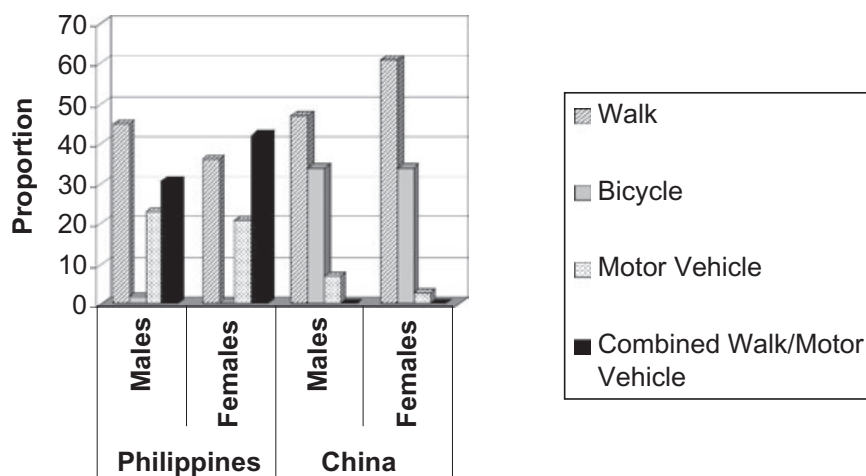


Figure 1. Proportion of Filipino and Chinese youth using different commuting modes.

Table 2. Percentage reporting any (>0 min) of moderate to vigorous activities

	Philippines		China	
	Males n = 760	Females n = 872	Males n = 202	Females n = 197
Active commuting to school	70*	71*	77†	90
During school sport/exercise	63†	49*	69	75
Before/after school sport/exercise activities	74*†	12*	12†	6
Before/after school chores	87*†	91*	13†	36

*Indicates significant differences between countries for the same gender.

†Indicates significant differences between genders within the same county.

not by walking, this is likely confounded somewhat by the fact that Chinese youth were not asked about commuting using a combination of walking and motorized vehicle. Less than 1% of Filipino youth commuted to school by some other mode (not depicted in Fig. 1).

Chinese youth reported engaging in any sport/exercise activities during school more frequently than Filipino youth (Table 2; $\chi^2 = 34.6$, $P < 0.0001$). The gender difference was significant in the Philippines ($\chi^2 = 30.3$, $P < 0.0001$), but not in China ($\chi^2 = 1.66$, $P = 0.20$). Table 2 also indicates that a higher proportion of Filipino youth engaged in sport/exercise outside school compared with Chinese youth ($\chi^2 = 142.8$, $P < 0.001$). In addition, a higher proportion of Filipino males engaged in sport/exercise outside school compared with Filipino females ($\chi^2 = 644.2$, $P < 0.0001$); a similar gender difference was significant in Chinese youth ($\chi^2 = 4.1$, $P < 0.05$). A substantial proportion of Filipino youth performed MOD/VIG chores outside of school. These activities were not as common among Chinese youth (between country $\chi^2 = 745.5$, $P < 0.0001$). Within country, gender differences were also significant (Philippines $\chi^2 = 4.4$, $P < 0.05$; China $\chi^2 = 26.6$, $P < 0.0001$).

Table 3. Percentage reporting any (>0 min) of select sedentary activities

	Philippines		China	
	Males n = 760	Females n = 872	Males n = 202	Females n = 197
Television/video watching	97*†	93*	59	68
Reading/writing/drawing	81*†	92*	64	72
Sitting games	63*†	19*	10	7

*Indicates significant differences between countries for the same gender.

†Indicates significant differences between genders within the same country.

Ninety-four per cent of Filipino females and 86% of Filipino males reported MOD/VIG chores during school (gender difference $\chi^2 = 31.9$, $P < 0.001$); this question was not applicable to Chinese youth as they do not do chores in school.

Filipino youth watched significantly more hours of television daily compared with Chinese youth (1.9 ± 1.2 vs. 0.5 ± 0.6 h/day; $F = 326.4$, $P < 0.0001$ based on log transformed data). No gender differences were significant within countries. Figure 2 displays the proportion of Filipino and Chinese youth watching select levels of daily television. Table 3 presents the proportion of youth in both countries who report engaging in any (>0 min)

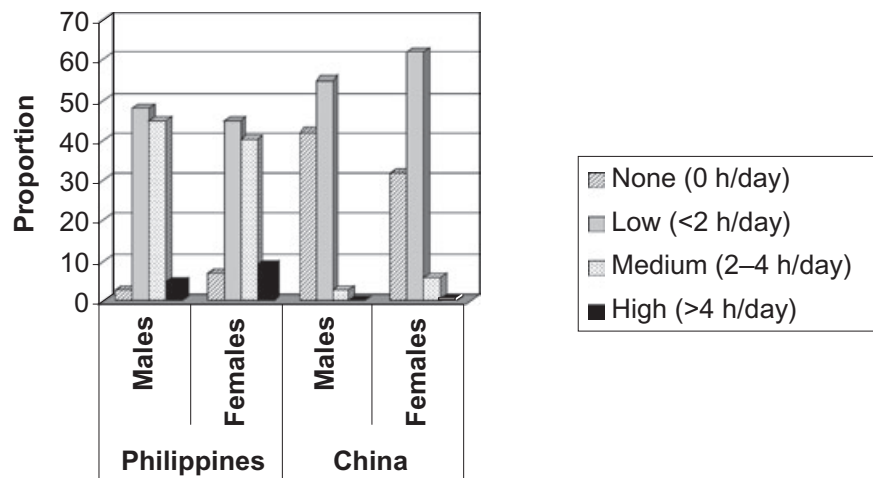


Figure 2. Proportion of Filipino and Chinese youth watching select levels of daily television.

of television watching, reading/writing/drawing, or sitting games (i.e. playing board/video). A larger proportion of Filipino youth reported watching any television compared with Chinese youth ($\chi^2 = 417.6$, $P < 0.0001$). Filipino males more frequently reported watching any television compared with their female counterparts ($\chi^2 = 13.3$, $P < 0.001$). The difference between genders in China was not statistically significant ($\chi^2 = 3.52$, $P = 0.058$). A larger proportion of Filipino youth vs. Chinese youth reported any reading/writing/drawing ($\chi^2 = 76.7$, $P < 0.0001$). The gender difference was significant in the Philippines ($\chi^2 = 41.7$, $P < 0.0001$), but not in China ($\chi^2 = 3.09$, $P = 0.08$). More Filipino youth reported playing sitting games compared with Chinese youth ($\chi^2 = 136.6$, $P < 0.0001$). There was a gender difference in the Philippines ($\chi^2 = 338.0$, $P < 0.0001$), but not in China ($\chi^2 = 1.35$, $P < 0.25$).

Discussion

This comparative analysis revealed important similarities and differences in youth PA and inactivity patterns in these two developing Asian countries. In contrast to Chinese youth, Filipino youth are more likely to live in urban settings, owing to the initial study design which over-sampled urban communities. Although household motor vehicle ownership in both countries is much less than in the USA, where at least 91% of households owned at least one vehicle in 1990 (Pickrell 1997), motor vehicle ownership is higher in the Philippines than in China. In contrast, household television ownership is higher in China than in the Philippines. Paradoxically, television viewing behaviours are higher in the Philippines compared with China. We have previously noted that such seemingly contradictory differences may reflect local divergence in television program-

ming relevance/appeal or cultural differences in viewing habits (Tudor-Locke *et al.* 2003a). For example, television ownership is not a necessary condition for viewing in the Philippines. Instead people will gather to watch television together at households that own sets. In the Philippines, less than 10% of youth watch television >4 h/day. In China, less than 1% watch this much daily television. The relatively high proportion of Chinese youth watching <2 h/day may reflect a tacit cultural expectation and/or the inability to fit more into already busy schedules. In contrast, $\approx 25\%$ of US youth watch a comparable amount of television daily (Eisenmann *et al.* 2002).

Active commuting to school is still relatively common (i.e. 70–90%) in both Asian countries, particularly for Chinese female youth. We have yet to fully understand these gender differences and are examining them further in qualitative studies. Walking (solely or as in the Philippines, combined with public transportation) remains an important mode of commuting to school. Less than 1% of Filipino youth ride a bicycle to school, however, compared with $\approx 35\%$ of Chinese youth, reflecting differences in ownership, terrain and adequate storage facilities appropriate for bicycle transit. In addition, there appears to be a cultural deterrent to female cyclists in the Philippines; that is, it is considered loosely 'unladylike' (Fernan 2000). For example, mandatory wearing of skirts as school uniforms may dissuade females from riding bicycles. In comparison, US surveys indicate that as few as 10–19% of American school children walk to school (Federal Highway Administration 1997; CDC 2002), and only 2.4% of trips to school <2 miles are made by bicycle (Federal Highway Administration 1997).

Approximately 49–75% of youth in these two countries report engaging in sport/exercise in school. Interestingly, the patterns of participation differ between countries by gender;

more Filipino males report school sport/exercise than females (63 vs. 49%) vs. China, whereas females report more than males (75 vs. 68%). As stated previously, in the USA (where physical education is not mandatory in high school) only 28.4% of high school youth attended daily physical education class (Centers for Disease Control & Prevention 2004). Approximately 52% report participating in school sport teams (outside of physical education class), however (Pate *et al.* 2000). Philippine elementary and high school curricula include physical education as mandated by the Department of Education. Typically, the schools schedule about 40–60 min/week of physical education. However, not all students engage in sports/exercise every time. Physical education requirements in China vary enormously by province and city and county. In general, academic pressures in China have been eroding the time and activity levels of physical education for the past 15 years.

With regards to sport/exercise outside of school, few Chinese or Filipino female youth participate in such activities compared with their male counterparts. Apart from this, proportionately more male Filipino youth engage in sport/exercise outside of school compared with Chinese male youth. In the USA, ≈29% of youth participate in sports both during school and outside school; a further 11% only engage in sports outside of school (Pate *et al.* 2000).

Chores are considered potential contributors to overall energy expenditure (Ainsworth *et al.* 2000), and it is apparent from the comparisons herein that usual performance of chores differs between these two countries. Specifically, Chinese youth do not typically carry out chores outside of school (although a higher percentage of Chinese females report chores than males), especially when compared with Filipino youth. Filipino youth also typically fulfil chore obligations at school. This is not the case for Chinese youth. Although carrying out chores in school was not asked of Chinese youth, non-performance of such activities was known *a priori* and therefore considered a redundant angle of query. As another basis of comparison, a US survey of children's time used included 9- to 12-year-olds; 88% reported performing household work (Hoffert & Sandberg 2001), comparable with Filipino youth herein. It is unlikely, however, that American children are engaged in common chores as physically demanding as those routinely taken on by Filipino youth (e.g. fetching and pumping water, or washing clothes without aid of modern appliances) (Tudor-Locke *et al.* 2003a).

Despite common perceptions of heavy homework loads in China as a result of pressure to excel in school (Sharma 1997; Wei 2000), the Filipino youth more frequently reported study-related sedentary activities (i.e. reading/writing/drawing). We

were not able to separate leisure-time reading/writing/drawing from homework obligations; however, so there is a potential for misclassification bias with regards to purpose of these sedentary activities. It is also important to keep in mind that gender differences in the Philippines are affected by the sample selection criteria: boys enrolled in school are of higher socioeconomic status than girls enrolled in school. Regardless, advanced education is generally viewed as a pathway to economic security in both countries. In China where university entrance is restricted, youth are compelled to sustain a high level of scholastic achievement (Wei 2000). Similar to the values reported in Table 3, ≈77% of US high school seniors in 1998 reported any time on homework (Choy 2001). However, Chinese youth engage in study-related sedentary activities a median of 420 min/week (Tudor-Locke *et al.* 2003b), whereas ≈40% of US 17-year-olds in 1999 took less than 1 h/day to complete assigned homework, or did not do it at all (Choy 2001). The other sedentary activity queried, sitting games, was a more common activity for Filipino youth. China currently has a very active bootlegged video game market that has made these more available recently. Further, a large number of computer parlors and video game parlors have emerged in both countries; in the Philippines these games are even available in some small 'sari-sari' (sundry items) stores. These trends portend a dramatic difference in sitting games in both countries in future surveys. Unfortunately, there is a lack of published international data about these types of sedentary activities so other comparisons cannot be made.

Youth is a time of transition to adult roles and responsibilities. In both countries we can anticipate that PA performed during school will be eventually exchanged for more sedentary work roles (Popkin *et al.* 1993; Popkin 1998; Tudor-Locke *et al.* 2003a). In the Philippines, continued modernization augurs a decrease in local primary PA sources (chores and active commuting). In China, where youth already are not expected to perform chores, but they do spend a great deal of time in study-related sedentary activities, shifts to more passive commuting modes (i.e. increased motorized transportation) are also anticipated (American Association of State Highway and Transportation Officials 1999; Hook & Ernst 1999). In both countries, it is likely that television viewing habits will continue to increase and approximate those in the USA (Anderson *et al.* 1998) as household television ownership increases and as accessible and appealing programming increases. For example, satellite television (e.g. multiple channels that offer an array of reality-based shows, prime-time dramas, game shows and product advertisements) was only recently introduced widely to China (Granitsas 2002). Excess television watching has been consistently associ-

ated with youth overweight and obesity in cross-sectional studies (Anderson *et al.* 1998; Hernandez *et al.* 1999; Crespo *et al.* 2001; Dowda *et al.* 2001; Eisenmann *et al.* 2002) and at least one randomized controlled trial (Robinson 1999) supports a causal relationship between television viewing habits and obesity. It is possible that the association between television watching and youth overweight and obesity is due to excessive snacking behaviours (Gorely *et al.* 2004; Adair & Popkin, 2005). At this time, snacking is an inconsequential behaviour in China but may indeed change with the planned television programming changes mentioned above (Waller *et al.* 2003).

The limitations of this study include those commonly associated with self-reported data (i.e. recall and subjectivity bias), failure to capture habitual activity outside those specifically queried (e.g. outside the school year) and ultimately the reliance on cross-sectional data precluding causal conclusions. Assumptions about intensity of activity performed based on assigned Compendium of Physical Activity values include the fact that individual differences in energy expenditure for the same activity might be large and may or may not be close to the presented Compendium value (Ainsworth *et al.* 2000). In addition, although questions were similar and responses could be duly compared, translations required for local administration may have influenced responses. Indeed, it was necessary to ask different questions about transportation alternatives and chores between countries. Further, only a limited selection of sedentary activities could be compared between countries; these do not necessarily reflect the universe of sedentary activities and conclusions are necessarily restricted to those specific ones queried on both countries. For this reason, we specifically avoided summing the select sedentary activities and making inferences about differences in overall sedentarism. Despite these limitations, these questions have been previously validated (Tudor-Locke *et al.* 2003a). Specifically, self-reported time in MOD/VIG activities correlated ($r = 0.51$ for males and 0.41 for females) with accelerometer-derived energy expenditure owing to PA (Tudor-Locke *et al.* 2003a). Self-reported participation in MOD/VIG activities in terms of time or even frequency is typically highly skewed (Welk *et al.* 2000), and the precision obtained by self-report is often suspect. Treating participation as a categorical variable (any vs. none) is a generally accepted approach for surveillance and comparison purposes.

Although these findings are based on large samples, generalizations are necessarily limited to youth attending school and more representative of higher socio-economic status in their country. The Chinese data are drawn from a nationally representative sample. In contrast, the Filipino data are based on a regional study with an over-sampling of an urban population

(Metro Cebu shares many characteristics with other urban areas in the Philippines including Manila). Further, reducing these data sets to represent only those youth in school produces select samples that differ in indicators of socio-economic status from the greater relevant populations, therefore limiting generalizability. Regardless, combining these different data sets provided a unique opportunity to compare and contrast PA and inactivity patterns in two distinct societies.

Overall energy balance is a delicate poise between intake and output. The output side is in turn affected by both PA and inactivity; these behaviours are not necessarily extremes on the same continuum but distinct yet interrelated behaviours that are both affected negatively by societal industrial, technological and economical transitions. Although this comparative study was purely descriptive, it provides a foundation from which to speculate about potential interventions. In the Philippines, continued modernization bodes a decrease in local primary PA sources (chores and active commuting). In China, where youth already are not expected to perform chores, but they do spend a great deal of time in study-related sedentary activities, shifts to more passive commuting modes (i.e. increased motorized transportation) are anticipated. To combat this threatening milieu of decreasing PA and increasing inactivity in Asian youth, prudence dictates that health promotion endeavours should concentrate on promoting both MOD/VIG leisure-time and school activities, and public transportation policies that advocate continued reliance on more active forms of commuting. Concomitantly, it is important to consider means of discouraging excess time spent in inactive pursuits such as television viewing. Regardless, these distinct societal patterns of youth PA and inactivity, and their impact on obesity trends, will continue to be studied longitudinally with subsequent administrations of both the CLHNS and the CHNS.

References

- Adair, L. S., Kuzawa, C. W. & Borja, J. (2001) Maternal energy stores and diet composition during pregnancy program adolescent blood pressure. *Circulation*, **104**, 1034–1039.
- Adair, L. S. & Popkin, B. M. (2005) Are child eating patterns being transformed globally? *Obesity Research*, **13**, 1281–1299.
- Ainsworth, B. E., Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., O'Brien, W. L., Bassett, D. R., Schmitz, K. H., Emplaincourt, P. O., Jacobs, D. R. & Leon, A. S. (2000) Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise*, **32** (Suppl. 9), S498–S504.
- American Association of State Highway and Transportation Officials. (1999) Bikes in transit: China, France, and Carribean. *AASHTO International Transportation Observer*, Spring, 2.

- Anderson, R. E., Crespo, C. J., Bartlett, S. J., Cheskin, L. J. & Pratt, M. (1998) Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. *Journal of the American Medical Association*, 279, 938–942.
- Benefice, E. (1998) Physical fitness and body composition in relation to physical activity in prepubescent Senegalese children. *American Journal of Human Biology*, 10, 385–396.
- CDC (2002) School transportation modes – Georgia, 2000. *MMWR Morbidity and Mortality Weekly Report*, 51, 704–705.
- Centers for Disease Control and Prevention. (2004) Participation in high school physical education – United States, 1991–2003. *MMWR Morbidity and Mortality Weekly Report*, 53, 844–847.
- Choy, S. P. (2001) *Condition of Education* (NCES 2001–072): Office of Educational Research and Improvement.
- Crespo, C. J., Smit, E., Troiano, R. P., Bartlett, S. J., Macera, C. A. & Andersen, R. E. (2001) Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988–1994. *Archives of Pediatrics and Adolescent Medicine*, 155, 360–365.
- Dowda, M., Ainsworth, B. E., Addy, C. L., Saunders, R. & Riner, W. (2001) Environmental influences, physical activity, and weight status in 8- to 16-year-olds. *Archives of Pediatrics and Adolescent Medicine*, 155, 711–717.
- Eisenmann, J. C., Bartee, R. T. & Wang, M. Q. (2002) Physical activity, TV viewing, and weight in U.S. youth: 1999 Youth Risk Behavior Survey. *Obesity Research*, 10, 379–385.
- Federal Highway Administration. (1997) *Our Nation's Travel: 1995 NPTS Early Results Report*. U.S. Department of Transportation, Washington, DC, USA.
- Fernan, R. (2000) Manila makes way for bikeways, but for whom? *Sustainable Transport*, 11, 15.
- Gorely, T., Marshall, S. J. & Biddle, S. J. (2004) Couch kids: correlates of television viewing among youth. *International Journal of Behavioral Medicine*, 11, 152–163.
- Granitsas, A. (2002) Murdoch's new signal to China: bringing U.S.-style TV fare to world's biggest market. *Wallstreet Journal*, 4 August 2002, A17.
- Hernandez, B., Gortmaker, S. L., Colditz, G. A., Peterson, K. E., Laird, N. M. & Parra-Cabrera, S. (1999) Association of obesity with physical activity, television programs and other forms of video viewing among children in Mexico city. *International Journal of Obesity and Related Metabolic Disorders*, 23, 845–854.
- Hoffert, S. L. & Sandberg, J. F. (2001) How American children spend their time. *Journal of Marriage and the Family*, 63, 295–308.
- Hook, W. & Ernst, J. (1999) Bicycle use plunges: the struggle for sustainability in China's cities. *Sustainable Transport*, 10, 6–7.
- McCann, B. & DeLille, B. (2000) *Mean Streets 2000: Pedestrian Safety, Health and Federal Transportation Spending*. Centers for Disease Control and Prevention, Columbia, SC, USA.
- Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G. W., King, A. C., Kriska, A., Leon, A. S., Marcus, B. H., Morris, J., Paffenbarger, R. S., Patrick, K., Pollock, M. L., Rippe, J. M., Sallis, J. & Wilmore, J. H. (1995) Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association*, 273, 402–407.
- Pate, R. R., Trost, S. G., Levin, S. & Dowda, M. (2000) Sports participation and health-related behaviors among US youth. *Archives of Pediatrics and Adolescent Medicine*, 154, 904–911.
- Pickrell, D. S. & P. (1997, 1999) *Trends in Personal Motor Vehicle Ownership and Use: Evidence from the Nationwide Personal Transportation Survey*. Paper presented at the Nationwide Personal Transportation Survey Symposium, Bethesda, Maryland.
- Popkin, B. M. (1998) The nutrition transition and its health implications in lower-income countries. *Public Health Nutrition*, 1, 5–21.
- Popkin, B. M. (2002) An overview on the nutrition transition and its health implications: the Bellagio meeting. *Public Health Nutrition*, 5, 93–103.
- Popkin, B. M. & Doak, C. M. (1998) The obesity epidemic is a worldwide phenomenon. *Nutrition Reviews*, 56, 106–114.
- Popkin, B. M., Keyou, G., Zhai, F., Guo, X., Ma, H. & Zohoori, N. (1993) The nutrition transition in China: a cross-sectional analysis. *European Journal of Clinical Nutrition*, 47, 333–346.
- Robinson, T. N. (1999) Reducing children's television viewing to prevent obesity: a randomized clinical trial. *Journal of the American Medical Association*, 282, 1561–1567.
- Schmidt, G. J., Walkuski, J. J. & Stensel, D. J. (1998) The Singapore Youth Coronary Risk and Physical Activity Study. *Medicine and Science in Sports and Exercise*, 30, 105–113.
- Sharma, Y. (1997) Homework pushes mothers into violence. *Times Educational Supplement*, 4224, 24.
- Tudor-Locke, C., Ainsworth, B. E., Adair, L. S. & Popkin, B. M. (2003a) Physical activity in Filipino youth: the Cebu Longitudinal Health and Nutrition Survey. *International Journal of Obesity and Related Metabolic Disorders*, 27, 181–190.
- Tudor-Locke, C., Ainsworth, B. E., Adair, L. S., Du, S., & Popkin, B. M. (2003b) Physical activity and inactivity in Chinese school-aged youth: the China Health and Nutrition Survey. *International Journal of Obesity*, 27, 1093–1099.
- Waller, C. E., Du, S., & Popkin, B. M. (2003) Patterns of overweight, inactivity, and snacking in Chinese children. *Obesity Research*, 11, 957–961.
- Wei, H. (2000) Growing up under pressure. *Beijing Review*, 43, 18–21.
- Welk, G. J., Corbin, C. B. & Dale, D. (2000) Measurement issues in the assessment of physical activity in children. *Research Quarterly for Exercise and Sport*, 71 (Suppl. 2), 59–73.
- World Health Organization. (1998) *Obesity: Preventing and Managing the Global Epidemic – Report of a WHO Consultation on Obesity*. World Health Organization, Geneva, Switzerland.