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PAPER

Physical activity in Filipino youth: the Cebu Longitudinal Health and Nutrition Survey

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OBJECTIVE: To describe physical activity (PA) and inactivity levels of Filipino youth aged 14–16 y.
DESIGN: PA type and patterns were assessed in an adolescent cohort enrolled in the Cebu Longitudinal Health and Nutrition Survey.
SUBJECTS: A total of 1053 males (aged 15.6 ± 0.5 y; body mass index (BMI) = 18.6 ± 2.6 kg/m^2) and 990 females (aged 14.6 ± 0.5 y; BMI = 18.8 ± 2.4 kg/m^2).
MEASUREMENTS: PA was assessed by (1) self-reported usual PA (questionnaire); (2) 24-h objective monitoring (Caltrac accelerometer); and (3) 24 h recalls of PA during the objectively monitored time frame.
RESULTS: As measured by Caltrac, males expended 378.0 ± 164.5 kcal and females 271.0 ± 105.4 kcal. The measurement approaches employed agreed in expected ways, given the limitations of each. Together the approaches used indicated that the primary sources of PA for this population are chores and active commuting. In all, 40% of the sample walked to school, less than 1% rode a bicycle, 22% rode in/on motorized transport, and 37% used some combination of walking and motorized transport. Further, gender differences exist for type, frequency, and duration of physical activities performed by Filipino youth. Specifically, females report engaging in few leisure-time physical activities and more household chores. In total, 48% of Filipino youth report watching ≥2 h/day of television; relatively few youth (7%) report watching >4 h/day at this time. An 18% of males report no vigorous activities compared to 87% of females.
CONCLUSION: Clear gender differences in PA patterns and levels exist in Filipino adolescents. Nonsport/exercise type activities (eg chores and active commuting) currently provide a large proportion of daily activity for both males and females, however. It is anticipated that as modernization and technological advancement continue in this developing country, these primary sources of PA will decrease.
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Introduction

Obesity levels among adults and youth continue to grow to epidemic proportions worldwide.[1] As researchers, we struggle to understand the roles of physical activity (PA), inactivity, and food selection in this process. While it is becoming clear that the shift toward greater obesity evident in Western societies is shared with youth and adults from the developing world, little else is understood about their unique patterns of diet and PA.[2] For example, much of what we know about youth PA patterns is based predominantly on the experience of developed countries, limiting our ability to understand the roots of obesity trends in the rest of the world.[3] Decreases in PA are likely to play an important role in the development of overweight and obesity and a range of related health conditions, yet there is a scarcity of data on PA patterns of youth in developing countries.[4]

The Philippines is one such country in the midst of a rapid shift in diet and PA patterns that are linked with greater obesity, hypertension, and related problems among adults. Among Filipino youth, high blood pressure and other early signs of cardiovascular disease (CVD) are emerging, in

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particular among youth who have the lowest body mass index (BMI) at birth, but the highest BMI in adolescence.[5] Obesity has not emerged as a major problem yet among these Filipino youth, but the BMI trends and emergence of CVD risk factors provide a strong rationale for examining the role of PA.

Youth is a time of transition as adolescents reprise social roles (eg leave school, find employment) and begin to take on more responsibilities in preparation for adulthood. Dramatic reductions in PA during this time of transition have been well documented in developed countries; the steepest declines occur between the ages of 13 and 18 y and are greater in females than in males.[6] We do not know if the same pattern holds true in developing countries; in a country that relies on subsistence agriculture, characterized by high levels of manual labor and low mechanization, female adolescents working as maids in the city are more physically active (determined by objective monitor) than their rural counterparts charged with domestic chores and childcare tasks.[7] To better understand youth PA transition in the context of developing countries, one strategy is to examine thoroughly PA patterns at this important lifecycle threshold.

No criterion standard exists to measure PA in field settings. Self-report questionnaires are the most common method for assessing PA in large epidemiological studies of free-living individuals, primarily because of their low cost, ease of administration, and potential for nonreactivity.[8] PA recalls (eg 24-h recall) and motion sensors are considered direct measures of PA. They are not without their own biases and limitations, however. Issues related to individual recall ability and response bias (recall bias, social desirability bias) are of concern for 24-h PA recalls,[8] as are compliance issues for subjects wearing motion sensors.[9] Nevertheless, multiple field measures are useful to understand overlapping and differing aspects of PA in free-living situations. Therefore, the purpose of this paper was to describe PA and inactivity levels of Filipino youth aged 14–16 y using multiple methods of PA assessment, and to assess the concordance between the methods.

Methods

Cebu Longitudinal Health and Nutrition Survey (CLHNS)

The CLHNS is a community-based study of a 1-y birth cohort randomly selected from urban and rural communities of Metro Cebu, the second largest and most rapidly growing metropolitan area of the Philippines. The participants live in diverse communities, ranging from densely populated urban and peri-urban neighborhoods to more isolated rural villages in the mountains or on nearby islands. Originally designed as a study of infant feeding patterns, the CLHNS is part of an ongoing study of a cohort of Filipino women who gave birth between May 1, 1983 and April 30, 1984. The original sample consisted of 3080 women having single live births. At birth, the cohort was representative of births occurring in metro Cebu in a 1-y period. The cohort of children born during that period, their mothers, other caretakers, and selected siblings continue to be followed through subsequent surveys conducted in 1991–1992, 1994, and 1998–1999. A current long-term objective of the project is to follow index children through adolescence and into the childbearing years. In order to shed light on the emerging trend of increased overweight, self-report measures of index children's PA (usual and 24-h recall) and objective monitoring of energy expenditure as a result of PA were added to the survey in 1998–1999. Additional study details and a complete list of publications can be found at http://www.cpc.unc.edu?projects/cebu.

Subjects

Data were collected from 1091 male and 992 female youth 14–16 y of age. All were part of the ongoing CLHNS. Teams of trained local interviewers visited households to collect PA data. Parents or caretakers also provided a wide range of demographic, socioeconomic, and environmental data. When the 1998–1999 follow-up was initiated, it was deemed important to first collect data on all of the females, owing to their earlier pubertal maturation compared to males.

Questionnaire data were analyzed from 1053 males (aged 15.6 ± 0.5 y; BMI $= 18.6 \pm 2.6$ kg/m^2) and 990 females (aged 14.6 ± 0.5 y; BMI $= 18.8 \pm 2.4$ kg/m^2), having deleted subjects (38 males and two females) reporting unrealistically high (above the 99th percentile of distribution) total moderate (MOD) or vigorous (VIG) intensity PA levels. As a result of the delayed data collection procedure in the CLHNS, males were uniformly older than females ($t = 46.5$, $P < 0.0001$). Males were also taller (158.5 ± 6.8 *vs* 149.0 ± 5.6 cm, $t = 34.3$, $P < 0.0001$) and weighed more than females (47.1 ± 8.4 *vs* 41.9 ± 6.4 kg, $t = 14.6$, $P < 0.0001$). Subjects included in the most recent CLHNS follow-up differ in only small ways from those who were lost; initially, deaths among the cohort of single live born subjects ($n = 155$ in the first 2 y) were disproportionately among poorer, less educated households. In contrast, migrants tended to be more educated, younger, and urban. However, in several studies, no bias in estimated relationships (eg effects of nutrition on a health outcome) could be detected when using methods such as Heckman modeling.

PA data

The PA questionnaire focused on MOD (3–6 metabolic equivalents (METs)) and VIG (>6 METs) intensity PA behaviors at school and/or work, after school/work, and in personal transportation. One MET is roughly equivalent to the energy cost of sitting quietly (approximately 3.5 ml of oxygen/kg body weight/min or 1 kcal/kg body weight/h).[10] Classification of intensity levels as light (<3 METs), MOD (3–6 METs), and VIG (>6 METs) was based on a 1993 CDC-ACSM

consensus panel on PA and public health.[11] An objective measure of energy expenditure as a result of PA was obtained using a Caltrac accelerometer (Muscle Dynamics, Torrence, CA, USA). The 24-h PA recall allowed for the inspection of self-reported time use patterns.

CLHNS PA questions. Adolescents registered in school were asked a series of questions about their usual PA behaviors (type, frequency, duration), focusing on in-school and after-school physical activities (exercise/sport and non-exercise/sport), work activities, commuting mode to school, and time spent watching television. Youth attending school were asked to identify usual mode of commuting to school as: (1) walking; (2) bicycling; (3) riding a motorized vehicle; (4) a combination of 1 and 3; or (5) other. Reported time to walk to the nearest public transportation was used to calculate active commuting to school for youth reporting commuting using a combination of walking and motorized vehicle.

For respondents not registered in school, questions focused on job type, hours/week on the job, and time spent in physical activities after work (exercise/sport and non-exercise/sport). Types of activities performed were recorded verbatim and youth could volunteer as many activities as they wished. CLHNS PA questions are included in Appendix A. For all activities identified, respondents were queried about their frequency (days/week) and duration (minutes or hours/week). Frequency and duration of television watching (hours/day) were also queried. Questions about personal transportation were not asked of youth not registered in school.

Caltrac accelerometer. The Caltrac accelerometer is a small, light-weight electronic device that uses microcomputer technology to assess energy expenditure as a result of PA by monitoring vertical accelerations of the body.[12,13] Caltracs were worn in a pouch attached to a waist belt, centered over either leg. Subjects were instructed not to remove the device, except for bathing or sleeping for approximately 24 h, or until the interviewer returned the next day for retrieval. Time programmed, time retrieved, and energy expenditure as a result of PA (kcal) were recorded. Caltracs were preprogrammed as per the manufacturer's instructions for each individual by entering the subject's weight, height, age, and gender into the instrument's memory. By design, Caltrac acceleration data are converted to energy expenditure as a result of PA by a proprietary built-in computer program and displayed digitally as kcal. Unfortunately, raw movement data (eg counts) were not obtained; at the time, energy expenditure was considered the more appropriate estimate of PA.

24-h recall. A 24-h PA recall protocol was used to identify all PA performed while wearing the Caltrac. The adolescents had been advised to take note of their activities while wearing the accelerometer. The 24-h PA recall was prompted by the trained interviewers asking about segments of the day starting when the Caltrac was first worn and ending with its retrieval. Youth were encouraged to account for the full time that passed between Caltrac programming and retrieval.

Data treatment and statistical analysis

CLHNS PA questionnaire. Two researchers separately assigned each verbatim-reported activity a MET value using the updated Compendium of Physical Activities.[10] Discussion and agreement resolved differences in assigned MET values. A MET is defined as the work metabolic rate divided by the resting metabolic rate. Active commuting to school by walking/bicycling was classified as a MOD intensity PA.[10] MET values were also assigned to represent reported intensity of work activities. For example, work that required constant moving and carrying light weight (eg 5 kg) was assigned a 3-MET value.[10] Frequency and duration of reported activities were used to construct time (minutes/week) spent in MOD/VIG physical activities. Admittedly, the energy cost of activities is likely about 10% higher in children. Unfortunately, no youth-appropriate normative data are presently available.

Time spent in active commuting to school each week was computed assuming 2 trips/day, 5 days/week. Inactivity indices included no reported time in VIG activities and watching television $\geq$2 and $\geq$4 h/day. The categories of television watching were set to be congruent with a US study of television watching and body composition in youth.[14]

Questionnaire-derived PA data tend to be positively skewed with mean values biased by a few subjects performing a lot of PA and/or a large number of subjects performing little or no PA.[15] Therefore, descriptive data are presented for the proportion reporting any defined PA, and the median and interquartile range (IQR) of distribution for those reporting any of the defined activity.

Verbatim-reported activities were further classified as exercise/sport (eg basketball, running, dancing, etc) or nonexercise/sport (eg fetching water, scrubbing the floor, gardening). Median time (min/week) was determined for the proportion of youth (by gender) reporting >0 min in each exercise/sport classification. Gender differences in proportions were tested using χ^2 tests; differences in time in exercise/sport classification were tested using nonparametric (two-sided Wilcoxon rank sum) tests.

The five most frequently reported activities for each gender by school registration status were determined. For subjects not registered in school but employed, the top five most frequently reported job PA requirements were reported for each gender. Since questioning strategies differed for those not registered in school, statistical analysis was not used to test differences between school registration status or current working status.

Concordance study. Since the most complete PA questionnaire data were collected from those youth registered in

school, the concordance study of the PA questionnaire focused on the data obtained from this subgroup. Data were further reduced to include only those youth wearing the Caltrac for 22–26 h with a similar amount of time accounted for in the 24-h recall. Reported activities for the 24-h PA recall were assigned corresponding MET values following the same process used for the questionnaire. Total time in MOD/VIG activities was computed for the 24-h recalled period. Since recalled data were positively skewed, nonparametric tests were used to determine differences in time in recalled PA between genders. Energy cost of 24-h recalled MOD/VIG activities in kilocalories (kcal) was determined using individual body weight[16] and compared with Caltrac-derived kcal. Accordingly, a 40 kg youth who recalled walking for 30 min expended 70 kcal ((3.5 METs × 40 kg body weight) × (30 min/60 min)). Descriptive data (expressed as medians with IQR) for the 24-hr recall included the number of episodes and summed time (minutes) recalled for the five most frequently recalled MOD/VIG activities for each gender.

Caltrac outputs (kcal) were corrected for 24 h of observation. For example, if a subject expended 250 Caltrac-derived kcal in 23 recorded hours of wear, then it was assumed that 24-h wear would result in 260.9 kcal of energy expenditure. Since Caltrac data were normally distributed, descriptive data are presented as means ± standard deviation (s.d.). Since operation of the Caltrac accelerometer requires inputting gender, age, height, and weight data, the relationship between the Caltrac output and the normally distributed continuous variables (in this case, height and weight) was explored with Pearson product–moment correlation coefficients. Independent *t*-tests were used to determine differences in Caltrac outputs between genders. Adjusted Spearman rank order correlations were calculated between Caltrac PA kcal, 24-h recalled time in MOD, VIG, total MOD/VIG activities and total kcal expended, and PA data taken from the CLHNS questionnaire (time watching TV, time active commuting, time in MOD/VIG activities during school, time in MOD/VIG activities after school, and time in total MOD/VIG activities).

Results

Table 1 presents subjects' background and household descriptive data. Among the youth registered in school ($N=1629$), 40% (341 males and 317 females) walked to school, less than 1% (12 males and one female) rode a bicycle, 22% (170 males and 185 females) rode in/on motorized transport, and 37% (233 males and 367 females) used some combination of walking and motorized transport. Three females (representing less than 1% of the sample) reported commuting to school by some other means.

Table 2(a) and (b) displays the five most frequently reported activities performed during school or after school (for those registered in school) and at work and after work (for those not registered in school) according to the questionnaire. Chores predominate for both genders, in and out of school. Frequently reported physical activities during school were of MOD intensity or higher. Males reported marching during school whereas females reported dancing or exercise. Both genders reported working in the garden at school. Washing dishes (males and females), washing clothes (males and females), and cooking (females only) were frequently reported physical activities after school/work that were lower than MOD intensity according to the 2000 Compendium codes (2.3, 2.0, and 2.0 METs, respectively).[10] Males frequently reported playing basketball/soccer after school or work. In contrast, females did not frequently report participation in sport/exercise after school or work. Fetching water was a frequent chore reported by all youth on the questionnaire, but males reported pumping water as a separate frequently performed activity.

Table 3 presents the proportion of Filipino youth registered in school engaged in any MOD/VIG activities, specifically active commuting to school, and during and after school activities (classified as exercise/sport or not). For those who reported >0 min, Table 3 also displays median time spent in these activities. Table 4 presents median time (min/week) spent in MOD/VIG activities by Filipino youth not registered in school, stratified by gender and current working status. A greater proportion of employed males than females ($\chi^2=91.79$, $P<0.0001$) engaged in exercise/sport after work, with males spending significantly more time in these activities than females ($Z=-3.32$, $P=0.001$). Among unemployed youth not attending school, a greater proportion of males than females engaged in exercise/sport activities ($\chi^2=66.63$, $P<0.001$; test for gender differences in time in PA $Z=-1.24$, $P=0.21$). There was no gender

Table 1 Background and household characteristics of Filipino youth enrolled in the Cebu Longitudinal Health and Nutrition Survey

	% Urban vs rural	*% Currently working*	*% TV ownership*	*% Motor vehicle ownership*
Youth registered in school				
Males $N=756$	76	36	80	43
Females $N=873$	74	33	73	36
Youth not registered in school				
Males $N=297$	63	65	57	28
Females $N=117$	62	62	42	20

Table 2(a) Principal self-reported activities during school, after school or at work, after school/work by gender and school registration status (data derived from the CHNLS questionnaire)

Youth registered in school	*During-school activities*	*After-school activities*
Males $N=756$	Swept the floor 41%	Fetched water 68%
	Washed/scrubbed the floor 39%	Played basketball/soccer 66%
	Marched 28%	Washed dishes 41%
	Lifted/arranged chairs, furniture 16%	Washed clothes 38%
	Worked in the garden 14%	Pumped water 37%
Females $N=873$	Swept the floor 58%	Washed clothes 76%
	Cleaned the classroom 34%	Washed dishes 72%
	Danced 20%	Fetched water 53%
	Worked in the garden 13%	Swept the floor 51%
	Exercised 12%	Cooked 47%

Table 2(b) Frequency of 24-h recalled activities during school, after school or at work, after school/work by gender and school registration status

Youth not registered in school	*Work activities*	*After school/work activities*
Males $N=297$	*Only for currently employed N = 192*	*All*
	Moving around most of the time 26%	Fetched water 81%
	Standing up most of the time 24%	Played basketball/soccer 75%
	Sitting down most of the time 16%	Cooked 41%
	Moving around carrying 5 kg 11%	Pumped water 41%
	Squatting 8%	Washed dishes 35%
Females $N=117$	*Only for currently employed N = 73*	*All*
	Sitting down most of the time 31%	Washed clothes 84%
	Standing up most of the time 26%	Fetched water 70%
	Moving around most of the time 22%	Washed dishes 67%
	Standing up and sitting down 10%	Cooked 66%
	Squatting 7%	Swept the floor 46%

Table 3 Gender differences in the proportion of Filipino youth registered in school (males N=756, females N=873) reporting MOD/VIG activities and median time (min/week) in these activities (data derived from the CHNLS questionnaire)

	N reporting >0 min			*Median (IQR) (min/week)*		
Questionnaire variable	*Males* N *(%)*	*Females* N *(%)*	χ^2 P	*Males*	*Females*	Z P
Active commuting to school	526 (70%)	623 (71%)	0.62 0.43	70 (50–150)	50 (30–150)	1.20 0.23
During school						
Exercise/sport	473 (63%)	430 (49%)	29.06 <0.0001	180 (60–300)	75 (30–180)	−8.47 <0.0001
Nonexercise/sport	651 (86%)	824 (94%)	32.42 <0.0001	25 (10–60)	25 (13–60)	−1.34 0.18
After school						
Exercise/sport	558 (74%)	105 (12%)	640.75 <0.0001	228 (120–360)	60 (30–120)	−8.30 <0.0001
Nonexercise/sport	661 (87%)	791 (91%)	4.21 0.04	100 (50–205)	95 (45–165)	2.70 0.007

IQR, interquartile range.

difference in the proportion ($\chi^2=1.30$, $P=0.25$) of unemployed youth attending school, who participated in nonexercise/sport MOD/VIG activities, nor time in these types of activities ($Z=0.58$, $P=0.28$). There was no gender difference (for youth who were unemployed and not attending school) in nonexercise/sport MOD/VIG activities ($\chi^2=0.27$, $P=0.61$), but females reported more time in these activities ($Z=2.29$, $P=0.02$).

Table 4 Proportion of Filipino youth not registered in school (males $N=297$, Females $N=117$) reporting MOD/VIG activities and median time (min/week) in these activities, stratified by gender and current working status (data derived from the CHNLS questionnaire)

	N *reporting >0 min (%), median (IQR) (min/week)*			
	Currently employed		*Currently unemployed*	
Questionnaire variable	*Males* N = *192*	*Females* N = *73*	*Males* N = *105*	*Females* N = *44*
Work MOD/VIG activities	28 (15%), 1440 (750–2520)	0	N/A	N/A
After work				
Exercise/sport	152 (79%), 240 (120–368)	11 (15%), 90 (30–120)	93 (89%), 240 (120–360)	9 (20%), 120 (60–360)
Nonexercise/sport	173 (90%), 269 (75–900)	69 (95%), 250 (125–600)	98 (93%), 130 (75–300)	40 (91%), 283 (95–388)

N/A not applicable

Table 5 Proportion of Filipino youth meeting select inactivity indices (data derived from the CHNLS questionnaire)

	% Watching television ≥2 h/day	*% Watching television ≥4 h/day*	*% No VIG activities*
All youth			
Males $N=1053$	47	5	18
Females $N=990$	49	10	87
Youth registered in school			
Males $N=756$	49	5	16
Females $N=873$	48	9	87
Youth not registered in school			
Currently employed			
Males $N=192$	39	3	21
Females $N=73$	48	10	90
Currently unemployed			
Males $N=105$	53	10	22
Females $N=44$	64	23	91

Table 5 shows the proportion of Filipino youth meeting select inactivity indices. There were no differences in the proportion of males or females reporting watching television ≥ 2 h/day ($\chi^2=0.36$, $P=0.55$). Relatively more females reported watching television ≥ 4 h/day than males ($\chi^2=15.2$, $P<0.0001$). The proportion of females reporting no VIG PA was significantly higher for males ($\chi^2=817.89$, $P<0.0001$).

Concordance study

Data that met the inclusion criteria (22–26 h of wearing the Caltrac concurrent with the 24-h recall for PA) were available for 715 males and 831 females registered in school.

Caltrac accelerometer

The mean values for 24-h corrected Caltrac PA kcal were 378.0 ± 164.5 kcal for males and 271.0 ± 105.4 kcal for females (difference between gender, $t=15.0$, $P<0.0001$). As expected, the Caltrac-derived energy expenditure as a result of PA was correlated (Pearson product moment) with height ($r=0.35$, $P<0.0001$) and weight ($r=0.50$, $P<0.0001$) for the whole sample. Spearman rank order correlation between Caltrac PA kcal and age was also significant ($r=0.28$, $P<0.0001$).

24-h recall

Almost all (704, or 98%) of the males in the concordance study sample recalled engaging in MOD/VIG activities over the same time period that the Caltrac was worn; the median minutes of MOD/VIG activities was 118 (IQR = 68–194). A similar proportion of females (817, or 98%) recalled 95 (IQR = 50–153) min of MOD/VIG activities. The difference between genders in median recalled time was significant ($Z=5.31$, $P<0.0001$). Expressed as kcal owing to MOD/VIG activities, males expended a median of 387 (IQR = 201–691) kcal and females expended 240 (IQR = 128–409) kcal.

The five most frequently reported MOD/VIG activities in the 24-h recall, by gender, are presented in Table 6. The number of discrete episodes of PA performed and total time spent in PA over the 24-h recalled period is also presented. In the concordance study sample, 615 (86%) males reported a median of 2 (IQR = 1–3) episodes of television watching totaling 2.3 (IQR = 1.3–3.6) h/day and 644 (77%) females reported a median of 2 (IQR = 1–3) episodes of television watching totaling 1.8 (IQR = 1.0–2.8) h/day. Median time reported watching television differed significantly between genders ($Z=4.85$, $P<0.0001$).

Concordance

Spearman rank order correlations between self-reported data (24-h recall and CHLNS questionnaire) and the Caltrac PA kcals were adjusted for height and weight and computed separately for each gender. Additional adjustment for age

Table 6 Principal MOD/VIG activities of concordance study sample[a] of Filipino youth (data derived from 24-h PA recall)

Activity	N *(%)*	*No. of episodes, median (IQR)*	*Summed time in min, median (IQR)*
Males $N=715$			
Walking	679 (95)	5 (3–8)	51 (25–90)
Fetching water	310 (43)	1 (1–2)	15 (7–29)
Playing basketball/soccer	195 (27)	1 (1–1)	60 (30–95)
Pumping water	188 (26)	1 (1–2)	10 (5–15)
Tending livestock/pets	104 (15)	1 (1–2)	15 (5–30)
Females $N=831$			
Walking	765 (92)	4 (2–6)	45 (20–82)
Sweeping the floor	403 (48)	1 (1–2)	20 (10–30)
Fetching water	310 (37)	1 (1–2)	15 (10–25)
Preparing to leave for school[b]	181 (22)	1 (1–1)	10 (5–15)
Pumping water	115 (14)	1 (1–2)	10 (5–16)

IQR, interquartile range
[a]Concordance study sample: currently registered in school, wore Caltrac 22–26 h and accounted for 22–26 h on 24-h recall.
[b]Preparing to leave for school was coded as Compendium PA 05165; a 3 MET walking PA that includes getting ready to leave, shutting/locking doors, closing windows, etc.

Table 7 Spearman rank order correlation matrix for youth registered in school

	Direct measurements							
	24-h PA recall							
Indirect measurement (questionnaire)	*Minutes in MOD activity* r (P)		*Minutes in VIG activity* r (P)		*Minutes in MOD/VIG activity* r (P)		*Caltrac kcal* r (P)	
Select variables	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Time watching TV (h/day)	−0.16 (0.0001)	−0.12 (0.0004)	−0.03 (0.4696)	−0.04 (0.2196)	−0.14 (0.0002)	−0.13 (0.0003)	−0.14 (0.0003)	−0.15 (<0.0001)
Active commuting (min/week)	0.27 (<0.0001)	0.32 (<0.0001)	−0.001 (0.9775)	−0.02 (0.5632)	0.22 (<0.0001)	0.31 (<0.0001)	0.13 (0.0007)	0.16 (<0.0001)
During-school MOD/VIG activities (min/week)	0.01 (0.8354)	0.16 (<0.0001)	−0.07 (0.0523)	0.10 (0.0043)	−0.002 (0.9599)	0.17 (<0.0001)	−0.01 (0.7779)	0.10 (0.0025)
After-school MOD/VIG activities (min/week)	0.23 (<0.0001)	0.37 (<0.0001)	0.21 (<0.0001)	0.06 (0.1011)	0.31 (<0.0001)	0.37 (<0.0001)	0.19 (<0.0001)	0.17 (<0.0001)
Total MOD/VIG activities (min/week)	0.24 (<0.0001)	0.44 (<0.0001)	0.14 (<0.0014)	0.07 (0.0594)	0.31 (<0.0001)	0.44 (<0.0001)	0.19 (<0.0001)	0.22 (<0.0001)

was not necessary since age differed uniformly between genders. In males, Caltrac PA kcal correlated at $P<0.0001$ with all 24-h recall variables: minutes in MOD PA ($r=0.36$), minutes in VIG PA ($r=0.35$), minutes in MOD/VIG activities ($r=0.51$), and computed kcal for recalled time in MOD/VIG activities ($r=0.55$). Similar relationships were observed in females ($r=0.39$, 0.14, 0.41, 0.43, respectively), all significant at $P<0.0001$.

Spearman rank order correlation matrices of direct (Caltrac and 24-hour PA recall) and indirect measures (CHLNS questionnaire variables) by gender are presented in Table 7. In both genders, Caltrac PA kcal was inversely correlated with time reported watching television and positively correlated with time reported spent active commuting, in after-school MOD/VIG activities, and in total MOD/VIG activities.

Discussion

The most frequently reported physical activities according to both the PA questionnaire and the 24-h recall were chores, both during and after school. Activities related to classroom maintenance (sweeping, scrubbing, cleaning) were most frequently reported for both genders during school. Otherwise, males marched while females danced or exercised within school time. Both genders also reported working in the school garden, a feature of the Filipino school curriculum. After school/work, domestic duties predominated for both genders. These findings are consistent with other reports of developing countries where children and youth are regularly engaged in domestic tasks, especially females.[7] Only males reported frequent participation after school in sport/exercise (specifically basketball and soccer). Examined by time in activity, more males than females

participated in exercise/sport activities both during and after school.

A total of 51% of the total Filipino sample reported no VIG activities. This is compared with 36% of US high school students (grades 9–12) responding to the 1997 Youth Risk Behaviour Surveillance System (YRBSS).[17] The YRBSS focuses on participation in sport/exercise activities and includes a single question querying frequency of walking/bicycle riding at least 30 min at a time. No questions address occupation, errand, or chore-related activities. Discrepancies in prevalence estimates between these two countries may be attributed to measurement bias; leisure-time physical activities (ie sport and exercise), as we understand them in a Western context, are not common in developing countries.[7] A similarly constructed instrument (as the YRBSS) was used to survey Singapore youth about PA behaviors; prevalence estimates were not reported.[18] If youth PA patterns in the developing country of Singapore are similar to those of Filipino youth, then an instrument focusing primarily on sports and exercise would be inappropriate. The current study indicates that this conclusion is more valid for adolescent females than males. This point is consistent with a study of West African adolescent females that reported leisure-time/personal activities consisted of a shower, hobbies, eating, resting, and social activities but not sport or exercise.[7]

Filipino males reported watching television a median of 2.3 h/day, significantly greater than the 1.8 h/day reported by females. In comparison, Singapore youth engage in 2–4 h of multimedia usage daily (combined television, video, or computer) with equal viewing time patterns between males and females.[18] In the US, 67% of youth 8–16 years of age reported watching television $\geq$2 h/day;[14] 48% of Filipino youth watch television $\geq$2 h/day. Relatively few (7%) Filipino youth (with the exception of females not currently registered in school or working) watch very high levels of daily television, defined as $\geq$4 h/day. Comparatively, 26% of US youth watched $\geq$4 h/day of television.[14] Differences in measurement approaches used in studying these different countries make more direct comparisons difficult. Apparent differences may also reflect television programming relevance and appeal or cultural differences in viewing habits. For example, within Filipino communities, television ownership is not a prerequisite for television watching as people may gather at the home of whoever has a television. Regardless, such high levels of inactive leisure pursuits are of concern. In the US, children who watch $\geq$4 h/day of television have a greater BMI and greater body fat than children who watch less than 2 h/day.[14] It will be important to follow international trends in PA and obesity, as television ownership peaks and relevant and appealing programming increases over time.

Caltrac-derived energy expenditure as a result of PA was largely modulated by gender, weight, and height in this relatively homogenous sample with respect to age. This finding is consistent with the results of a doubly labeled water study in an ethnically diverse sample that included youth from Guatemala;[19] energy expenditure attributed solely to PA in that study was *positively* related to weight, and both fat and fat-free mass. A review of several cross-sectional studies[20] emphasizes that obese children are less physically active compared to nonobese peers, but that a difference in total energy expenditure is less apparent owing to confounding by body weight. Since energy expenditure is not synonymous with PA,[21,22] validation in this study reflects concordance between measures of different constructs with overlapping or shared dimensions. Relationships between the various methods of PA assessment used were statistically significant and in the expected direction, lending confidence to the validity of the questionnaire used. The primary caveat to interpretation is that correlation is affected by sample size; with very large samples small correlation coefficients will be statistically significant.

Interestingly, walking was the most frequently reported PA according to the 24-h recall, but not on the questionnaire. This discrepancy is likely because of the perceived salience of walking activities relative to the time frame questioned. The 24-h recall asked youth to list details of every PA (physical or not) engaged in over 1 day in recent memory. For example, if a respondent indicated that s/he ''walked to fetch water and pumped it,'' three separate physical activities would be coded (walk, fetch water, pump water). In contrast, the questionnaire asked what types of *physical* activities were typically performed over a usual week. Thus, implicit in fetching water was walking and pumping. Walking was not specifically queried on the questionnaire other than with regard to active commuting to school. Regardless, walking (in all its forms) is considered the least reliably recalled PA assessed by self-report.[23–25] This is another example of the potential benefit of combining objective monitoring devices that are sensitive to walking with self-report methods of PA. PA data may be better interpreted from both perspectives.

It is anticipated that as modernization and technological advancement continue in this developing country, the primary sources of PA (chores and active commuting) will decrease. Unless there is a concomitant increase in leisure-time activities, a rise in the prevalence of obesity is expected. Halting modernization is not a likely option for prevention. More viable approaches include implementing policies that facilitate a healthy amount of daily incidental PA (eg public transportation policies, walkable communities, car taxes) in addition to promoting attractive active leisure-time alternatives (eg community and cultural events, school physical education, parks and greenspaces). Such strategies may be of most importance to Filipino females who currently participate in relatively few active leisure-time activities.

In summary, assessed using a multi-method approach and consistent with international understanding,[26] gender differences exist for type, frequency, and duration of physical activities performed by Filipino youth. The primary sources of PA for this population are chores and active commuting.

These types of activities are likely to decrease as modernization continues. The impact of changes in youth PA patterns and relevant health outcomes will continue to be studied longitudinally in this developing country as attempts are made to understand how these PA patterns change with the transition to adulthood and how they relate to obesity and other health problems.

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Appendix

Cebu Longitudinal Health and Nutrition Survey (CLHNS) 1998–1999 youth PA questionnaire. Select questions.

How do you travel to school?
- Walk
- Ride bicycle
- Ride motorized vehicle (car, jeepney, bus, tricycle, etc)
- Combination of 1 and 2
- Others, specify

How long does it take you to travel to school?
- Number of minutes

During school days, do you have any PA like sports, games, gardening etc?
- Yes/No

What kind of school activities did you participate in during the last month?
- Listed verbatim from memory

How many times per week did you participate in these activities (for each identified)?
- Daily
- Once a week
- 2 times a week
- Three times a week
- 4 times a week

How long do these activities (for each identified) usually last?
- Number of minutes

Do you usually participate in any PA after school (or during the week if not during school) or on weekends: like basketball, volleyball, fetching water, doing laundry, etc.
- Yes/no

What kind of activities do you participate in?
- Listed verbatim from memory

How many times per week did you participate in these activities (for each identified)?
- Daily
- Once a week
- 2 times a week
- Three times a week
- 4 times a week

How long do these activities (for each identified) usually last?
- Number of minutes

How many hours each week do you spend watching television either at home or elsewhere?
- Number of hours

Are you currently working for pay, in cash or in kind, or in a family farm or business?
- Yes
- No

Is your job done sitting or standing in one place? Does it involve lifting and moving objects or other forms of heavy physical labor?
- Sitting down most of the time
- Standing up most of the time
- Moving around most of the time
- Standing up and sitting down
- Moving around and carry 5 kilos
- Squatting
- Sikad (delivery on a non-motorized tricycle)
- Climbing
- Driving