

# RELIABILITY AND VALIDITY OF THE VIETNAMESE VERSION OF THE PREGNANCY PHYSICAL ACTIVITY QUESTIONNAIRE (PPAQ)

Erika Ota<sup>1</sup>, Megumi Haruna<sup>1</sup>, Hideki Yanai<sup>2,3</sup>, Motoi Suzuki<sup>2,3</sup>, Dang Duc Anh<sup>4</sup>, Masayo Matsuzaki<sup>1</sup>, Le Huu Tho<sup>5</sup>, Koya Ariyoshi,<sup>3</sup> SeonAe Yeo<sup>6</sup> and Sachiyo Murashima<sup>1,7</sup>

<sup>1</sup>Department of Midwifery and Women's Health, Division of Health Science and Nursing, Graduate School of Medicine, The University of Tokyo; <sup>2</sup>Center for International Collaborative Research, Nagasaki University; <sup>3</sup>Institute of Tropical Medicine, Nagasaki University, Japan; <sup>4</sup>National Institute of Hygiene and Epidemiology (NIHE), Ministry of Health, Hanoi; <sup>5</sup>Khanh Hoa Health Service, Nha Trang, Vietnam; <sup>6</sup>School of Nursing, The University of North Carolina at Chapel Hill, USA; <sup>7</sup>Department of Public Health, Division of Health Sciences and Nursing, Graduate School of Medicine, The University of Tokyo, Japan

**Abstract.** This study aimed to translate the Pregnancy Physical Activity Questionnaire (PPAQ) into Vietnamese, and test its reliability and validity among Vietnamese pregnant women. Intra-class correlation (ICC) and the Bland and Altman method were used to assess the test-retest reliability of the PPAQ. The Pearson correlations coefficient between the PPAQ measurements and those obtained from a pedometer that measured step counts (10-day averages) were used to determine the validity of the questionnaire. The PPAQ was successfully translated from English into Vietnamese with face validity through a rigorous process of the cross-cultural validation. For the analysis of reliability, the ICC value was 0.88 (95% CI 0.83-0.94) for total activity, 0.94 for sedentary, 0.88 for light, 0.90 for moderate, and 0.87 for vigorous activities. The Bland and Altman analysis showed that the first and second PPAQ total scores did not significantly differ from zero, and mostly fell within the range of  $0 \pm 1.96$  SD. The analysis of validity showed that there were moderate correlations with statistical significance ( $p = 0.02$ ) between the step counts and PPAQ total. Our study indicates that the Vietnamese PPAQ is within acceptable reliability and validity.

## INTRODUCTION

The maternal mortality ratio (MMR) in Vietnam was 130 per 100,000 live births in 2000 (WHO, 2005). The government aims to reduce the MMR to 70 per 100,000 live births by 2010. According to previous data (WHO,

2005), the MMR is mainly affected by intra-partum hemorrhage (41%) and pregnancy-induced hypertension (21.3%). To help antenatal care management of Vietnamese children and mothers, it is important to obtain scientific information, such as pregnancy-induced hypertension, gestational diabetes, pre-term delivery, and low birth weight data to reduce perinatal risks.

Among pregnant women, physical activity tends to be of lower duration, frequency, and intensity compared to pre-pregnancy (Ning *et al*, 2003; Butte *et al*, 2004; Lof and Forsum, 2006). Recent epidemiologic studies

---

Correspondence: Dr Hideki Yanai, Professor of the Collaborative Study on Emerging and Re-emerging Infectious Diseases in Vietnam Program, National Institute of Hygiene and Epidemiology (NIHE), 1 Yersin Street, Hanoi, Vietnam.  
Tel/Fax: 84-4-972-4493  
E-mail: hyanai@nagasaki-u.ac.jp

(Sorensen *et al* 2003; Dempsey *et al*, 2004; Hegaard *et al*, 2008) have shown that women who are more active during pregnancy may have reduced risks of gestational diabetes, hypertensive disorders, and pre-term birth in developed countries. However, the amount of activity required for favorable pregnancy outcomes, remains to be determined in Asian populations, especially those in developing countries.

A questionnaire is a feasible tool for assessing physical activity in large populations for applications including epidemiologic research or public health surveillance. It is easy to administer, relatively inexpensive, non-invasive, and allows the estimation of activity intensity.

Most currently available physical activity questionnaires have been developed and validated in men, and have emphasized participation in moderately and vigorously intensive sports (Chasan-Taber *et al*, 2004). However, most questionnaires fail to include household or childcare activity, which comprises a substantial portion of physical activity during pregnancy (Schmidt *et al*, 2002). The resultant misclassification may provide misleading relationships between physical activity during pregnancy and maternal and fetal health, limiting the ability to detect important associations with diseases (Dunlop *et al*, 2001; Moons *et al*, 2003; van Baak *et al*, 2003). Arguably, the pregnancy physical activity questionnaire (PPAQ) (Chasan-Taber *et al*, 2004) is the only widely used tool for assessing pregnant women's physical activity. The PPAQ is an instrument able to measure the duration, frequency, and intensity of the total activity patterns in pregnant women. The PPAQ is short in length, self-administered, and easily understood by the respondents in a variety of settings, making it useful for epidemiologic research (Chasan-Taber *et al*, 2004). Because there is no equivalent questionnaire in Vietnamese, the aim of this study was to trans-

late the English version of the PPAQ into Vietnamese, and to examine its reliability and validity in Vietnamese pregnant women.

## MATERIALS AND METHODS

### Tools

We used the pregnancy physical activity questionnaire (PPAQ) to measure the duration, frequency, and intensity of total activity (household/caregiving, occupational, and sports/exercise) during pregnancy. It is a semi-quantitative questionnaire that asks the respondents to report on the time spent participating in 32 activities, including household/caregiving (13 activities), occupational (5 activities), sports/exercise (8 activities), transportation (3 activities), and inactivity (3 activities) (Chasan-Taber *et al*, 2004). The respondents were asked to select a category for each activity to the nearest amount of time spent per day or week. The duration ranged from 0-to-6 or more hours-per-day, and from 0-to-3 or more hours-per-week during the current one month. At the end of the PPAQ, an open-ended section allowed each respondent to add activities not already listed but sleeping activity was not included (Chasan-Taber *et al*, 2004). Self-administration of the PPAQ in Vietnamese takes approximately 10 minutes.

### Translation process

The PPAQ was translated into Vietnamese as follows. First, the English version of the PPAQ was translated into Vietnamese by a person whose native language is Vietnamese and who speaks fluent English as a professional English translator in Vietnam. Second, a preliminary validation of this translation was conducted by another Vietnamese English teacher who is originally from Vietnam, who speaks fluent English, who has a Master degree in public health from Singapore, and who had not seen the original English version. The PPAQ and the back-translation were compared by a public health medical doctor, a

midwife, a translator in Vietnam, and two midwife researchers (MM, EO) who have Master degrees in health science in Japan, and one midwife researcher (MH) who has a Doctoral degree in health science in Japan. In order to increase the face validity of the Vietnamese version of the PPAQ, an experienced supervisor (SY) who is a professor of midwifery and women's health department in the United States was consulted. This expert was asked to assess the content of the questionnaire, and especially to pay attention to the items and expressions to see whether they would be acceptable to and easily understood by a pregnant woman. A pretest was performed with five pregnant women. The final version was modified based on a cross-cultural considerations.

#### Study subjects

A longitudinal study was conducted at three commune health centers in Nha Trang City, which is about 450 km from Ho Chi Minh City, in central Vietnam, from July to October 2007. Sixty pregnant women were recruited from their pregnancy check-ups at the commune health centers. Women were considered ineligible for the validation study if they had any of the following characteristics: diabetes requiring insulin administration, hypertension or heart disease requiring medications, chronic renal disease, non-singleton pregnancy, under 16 or over 40 years of age. The study protocol was approved by the Institutional Review Board (IRB) of the National Institute of Hygiene and Epidemiology (NIHE), Ministry of Health, Vietnam; and by the Graduate School of Medicine, the University of Tokyo, Japan. Each participant read and gave written informed consent.

In order to assess the test-retest reliability, the second PPAQ was administered during face-to-face consultations two weeks after the initial one at three commune health centers. The participants were asked to wear a digital pedometer (Digiwalker Pedometer

SW-200, Yamax Corp, Japan) on a belt at the waist during active hours in their ordinary daily activities, except during bathing or swimming and sleeping. The participants wore the pedometers for two weeks, starting on the day after their first visit, and they returned them after 2 weeks when they came back to the commune centers. Physical activity was evaluated by the average number of steps taken per day over 10 days (the first two days and last two days were excluded). Data of physical activity were double entered into the FoxPro database (Version 9.0, Microsoft, USA, 2007) for further analysis.

Of the 60 participants, 48 were considered to have worn the pedometer continuously from morning until night for 14 days, 9 forgot to wear it on the first day, 2 forgot to wear it the last 2 days, and 1 wore it but forgot to reset it everyday and could not provide accurate data for the measurement period. A validity study was performed by the 59 participants who wore the pedometer for 10 days, from the third to the twelfth day.

A pedometer estimates the number of steps while walking or jogging. The reliability and validity of the pedometer in counting walking steps have been established in healthy people (Schneider *et al*, 2004). We checked the accuracy of the pedometer for walking step counts for pregnant women. Pregnant women wore the pedometers on a belt at the waist, and walked at their normal pace for 100 steps. The accuracy of the pedometer was calculated from the walking-step counts obtained from the pedometer, and divided by the exact number of steps counted for 100 steps. The mean accuracy of the pedometer was 97.3% (SD = 9.7).

#### Statistical analysis

The intra-class correlation (ICC) (McGraw and Wong, 1996) and Bland and Altman method (Bland and Altman, 1986) were used to analyze the test-retest reliability of the PPAQ. Generally, ICC values above 0.75 indi-

cate good reliability (Portney *et al*, 1993). Reliability was assessed separately for total PPAQ scores according to intensity, such as sedentary, light moderate, and vigorous activities; and by types, such as household/caregiving, occupational, and sports/exercise. Between and within subject variance components were estimated using log-transformed activity data assuming a compound symmetric covariance structure. Pearson correlation coefficients were calculated from the data between the PPAQ and the pedometer values to assess the validity of the PPAQ. All statistical analyses were performed using the computer software STATA 10 (Texas, USA, 2007). P-values < 0.05 were considered statistically significant.

## RESULTS

### Face validity of the Vietnamese version of the PPAQ

The semantic equivalences of the newly translated and original PPAQ were achieved using the back-translation technique. The content equivalence of the questionnaire was tested after the translation process by four experts under clinical supervision (face validity). Overall, during the processes of translation, back-translation, pretest, and face validity assessment of the PPAQ, challenging considerations were found for the semantic and content equivalence tasks. The concerns raised by the semantic differences were all straightforward because after consideration and collaboration between the researchers and the translator, it was found that the questionable concepts were actually identical in meaning. For example, two items were changed in the questionnaire. The question 'Mowing lawn using a walking mower, raking, and gardening' was not commonly used in Vietnamese culture so we deleted this question. Because many people ride a bicycle or a motorbike to go to work or other places in

Vietnam and most of them do not use a car, we added the following to the questionnaire: 'Riding a bicycle to go places (such as the bus, work, or school) *not* for fun or exercise.' In addition, we replaced the term 'a car' with 'a motorbike,' for example, 'driving or riding in a motorbike or bus'.

### Subject characteristics

Table 1 shows the demographics and characteristics of the participants. The 60 participants had a mean age of 26.8 years (SD = 5.0), and a mean Body Mass Index of 21.3 (SD = 2.5) kg/m<sup>2</sup>. Twenty-three women were in their first trimester, 21 were in their second trimester, and 16 were in their third trimester. The mean and median step counts-per-day

Table 1  
Demographic characteristics (N = 60).

	Mean ± SD	Range
Age (years)	26.8 ± 5.0	17-39
Weight (kg)	50.2 ± 7.0	37-72
Height (cm)	153.6 ± 5.2	143-175
BMI <sup>a</sup> (kg/m <sup>2</sup> )	21.3 ± 2.5	16.0-27.1
Step counts <sup>b</sup> (per day)	7,358 ± 3,964	303-22,764
Monthly income (US\$)	163.2 ± 76.5	66.7-466.7
Education, n (%)		
Primary school	8	13.3
Secondary school	30	50.0
High school	15	25.0
Intermediate school	3	5.0
College/university	4	6.7
Trimester, n (%)		
First trimester	23	38.3
Second trimester	21	35.0
Third trimester	16	26.7
Occupation, n (%)		
Have	35	58.3
Not have	25	41.7

<sup>a</sup>BMI: Body mass index

<sup>b</sup>Number of participants for step counts were 59, since 1 pregnant women forgot to reset the pedometer everyday.

were 7,357 (SD = 3,964), and 6,369, respectively.

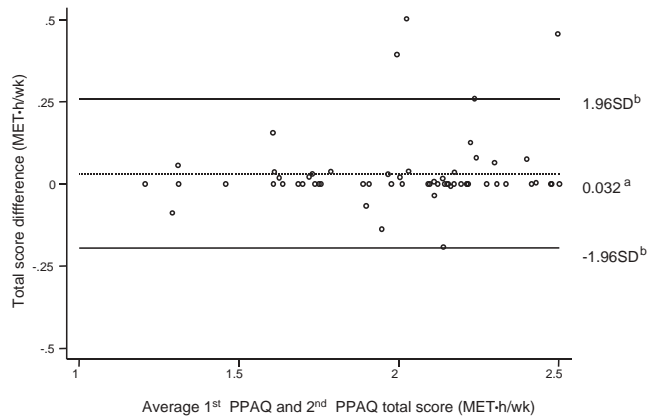
**Reliability of the Vietnamese version of the PPAQ**

Data were obtained from the 60 (100%) participants who completed the first and second PPAQs. Table 2 shows the median (25<sup>th</sup> and 75<sup>th</sup> percentiles) values (MET·h/wk) for the first and second PPAQs. The first PPAQ median values were comparable to the second PPAQ median values for total activity (68.1 MET·h/wk vs 54.6 MET·h/wk), and for activity intensities and types (Table 2).

The reliability between the two administrations of the questionnaire was strong (ICC = 0.88 for total physical activity) (Table 3). The ICC values for total activity, and subscales such as intensity and type scores, were all > 0.75, reaching a substantial level. For the PPAQ total score, the Bland and Altman analysis showed no significant difference between the first and second PPAQ total scores, with most of the values falling between 0 ± 1.96 SD (Fig 1).

**Validity of the Vietnamese version of the PPAQ**

To assess the validity of the questionnaire, total physical activity (light intensity and above) from the PPAQ was compared to the pedometer values. Overall, the Pearson correlation



<sup>a</sup> The broken line shows the mean differences in PPAQ log-transformed total scores.

<sup>b</sup> The solid lines show ± 1.96 SD of the PPAQ total score.

Fig 1—Bland-Altman plots of the first and second PPAQ log transformed total scores.

Table 2  
Median (25<sup>th</sup> and 75<sup>th</sup> percentile) values (MET·h/wk) for 1<sup>st</sup> and 2<sup>nd</sup> Pregnancy Physical Activity Questionnaires (PPAQs).

	1 <sup>st</sup> PPAQ (MET·h/wk)			2 <sup>nd</sup> PPAQ (MET·h/wk)		
	25 <sup>th</sup>	Median	75 <sup>th</sup>	25 <sup>th</sup>	Median	75 <sup>th</sup>
Summary activity scores						
Total activity (light and above)	39.9	71.4	140.7	39.7	55.5	130.2
By intensity						
Sedentary (<1.5 METs)	11.6	26.4	46.8	11.4	24.6	46.8
Light (1.5-<3.0 METs)	35.7	49.7	100.6	35.4	42.7	81.3
Moderate activity (3.0-6.0 METs)	2.4	5.3	36.6	2.1	5.3	35.5
Vigorous activity (>6.0 METs)	0.0	0.0	0.0	0.0	0.0	0.0
By type						
Household/caregiving	26.4	38.0	67.3	21.2	38.0	74.6
Occupational activity	0.0	5.3	67.2	0.0	0.0	66.7
Sports/exercise	0.8	2.4	4.2	0.8	2.4	4.2

N=60

Table 3  
Interclass correlation coefficients (ICC<sup>a</sup>)  
between two self-administered PPAQs.

	ICC (95%CI)
Total activity (light and above)	0.88 (0.83-0.94)
By intensity	
Sedentary (<1.5 METs)	0.94 (0.90-0.97)
Light (1.5-<3.0 METs)	0.88 (0.82-0.94)
Moderate activity (3.0-6.0 METs)	0.90 (0.85-0.95)
Vigorous activity (>6.0 METs)	0.87 (0.81-0.93)
By type	
Household/caregiving	0.92 (0.88-0.96)
Occupational activity	0.90 (0.85-0.95)
Sports/exercise	0.93 (0.90-0.97)

<sup>a</sup>ICC were calculated on log-transformed data of 60 participants.

coefficient for measurements between the PPAQ and pedometer was 0.29 ( $p = 0.02$ ), and the correlation between the measurements was moderately significant for total activity (light intensity and above).

## DISCUSSION

This study first described the translation process of the PPAQ from English to Vietnamese. The translation process involved the methods of translation and back-translation. The translations were compared by both collaborative parties from Vietnam, US, Japan, and five experienced researchers. The PPAQ was successfully translated from English into Vietnamese, with face validity achieved through a rigorous process of cross-cultural validation.

This study also evaluated the reliability and validity of the physical activity questionnaire in Vietnamese pregnant women. The PPAQ demonstrated an acceptable reliability and validity, and provided a useful tool for assessing physical activity in women during pregnancy.

When comparing the median result val-

ues between the Vietnamese version and original English version of the PPAQ (Chasan-Taber *et al*, 2004), the total activity (light and above) of Vietnamese was more than three times higher than that of the US value (25.2 MET·h/wk). The activity scores by intensity showed that the Vietnamese values were higher than those of the US were. For the sedentary and light activities, but not the moderate and vigorous activities, the activity scores were higher than those of the US were. The activity scores by type showed that the value for household/caregiving was four times higher in Vietnam than in the US (38.0 MET·h/wk), that of occupational activity was higher in the US (10.6 MET·h/wk), and that for sport activities was slightly higher in Vietnam. The results show that Vietnamese pregnant women do not perform as much moderate and vigorous activity as US women do. Vietnamese women do sedentary, light activities, and household/caregiving activities more than their counterparts in the US do.

An earlier study of the PPAQ among 54 pregnant women assessing the one-week reliability showed that the intra-class correlation coefficient (ICC) ranged from 0.78 to 0.93 for all activity indices (Chasan-Taber *et al*, 2004). The Vietnamese PPAQ has an excellent absolute agreement with the exact ICC of 0.87 to 0.94. We observed that the measurements of reliability for the PPAQ in Vietnamese were higher than previous findings (Chasan-Taber *et al*, 2004). This may be because the first and second PPAQ were conducted differently in the earlier PPAQ study (the first was done face-to-face, and the second was mailed), and face-to-face assessments were conducted for both PPAQs in our study. The results of the present study indicate the good test-retest reliability of the PPAQ, for assessing physical activity in pregnant women.

In order to measure the usual activity amount during the current one month, we used estimates of physical activity from a pe-



dometer worn for a two-week period. A number of studies (Pols *et al*, 1998) have been conducted to determine how many measurement days are needed to estimate reliably habitual physical activity. In these studies, the number of days varied between 4 and 12, depending on the required precision of the data, the accuracy of the reference method, and the intra-individual validation in activity. Two weeks of pedometer use was appropriate and of sufficient duration for our purposes.

We used a pedometer to assess the step counts as reference equipment for the PPAQ. The pedometer that we used was one of the most suitable brands for research use (Schneider *et al*, 2004). The mean accuracy of the pedometer was high and reliable (97.3%). The original PPAQ used an actigraph that could show activity by intensity. The pedometer data did not allow the analysis of activity by intensity as with an actigraph; it only reflected total activity. However, the use of pedometers, combined with a physical activity questionnaire, has been a useful tool to assess the validity of physical activity (Voorrips *et al*, 1991; Sequeira *et al*, 1995; Ono *et al*, 2007). The pedometer proved to be useful in assessing physical activity in a large, free-living population (Sequeira *et al*, 1995).

Few studies have assessed the validity of self-administered questionnaires for women of reproductive age using objective measures as standards (Ainsworth *et al*, 1999, 2000; Chasan-Taber *et al*, 2004). In the original PPAQ validation study, the observed overall correlation between the PPAQ and actigraph (average counts/min) was 0.27. Our observations were comparable to this previous data, with higher observed correlations for total activity. The pedometer steps-per-day are only relevant to total physical activity per day. We could not assess the validation for physical activity by intensity and types from the pedometer, but the original English PPAQ showed validated physical activities by intensity and types from

an actigraph, which were evident correlations for sedentary (-0.10), light (0.03), moderate (0.38), vigorous (0.37), household/caregiving (-0.04), occupational (0.16), and sports/exercise activities (0.48) (Chasan-Taber *et al*, 2004).

The validity results are affected by errors from the pedometer data and PPAQ measurements. For example, because the pedometer is worn on the hip, errors may result from upper body movements, pushing or carrying a load, stationary exercise (*eg*, cycling), weight lifting, and sedentary activity (Bassett, 2000). Self-reported physical activity may be affected by reporting bias, and physical activity questionnaires do not accurately quantify activity-related energy expenditure (Maddison, 2007). The inherent difficulties associated with recalling physical activities may limit data for the estimation of energy expenditure associated with free living physical activity (Maddison, 2007). Furthermore, errors associated with the pedometer and the PPAQ are largely independent, that is, our correlation coefficients were likely to have been underestimated.

In conclusion, the PPAQ in Vietnamese was within acceptable reliability and validity, suggesting that the Vietnamese version reflects concepts similar to those of the original English version. We recommend the use of the Vietnamese PPAQ for the measurement of physical activity in Vietnamese pregnant women.

#### ACKNOWLEDGEMENTS

This study was part of a research project funded by grants from the Cooperative Research Grant 2007–19–A–1, the Institute of Tropical Medicine, Nagasaki University; the Program of Founding Research Centers for Emerging and Reemerging Infectious Diseases, MEXT Japan; and The Ministry of Education, Culture, Sports, Science and Technology (Grant-in-Aid for Scientific Research (B),

2005-2008, No 17390577). Authors are grateful to the Khanh Hoa Provincial Health Service, especially Dr Truong Tan Minh, Dr Phu Quoc Viet, Mr Luu Trung Hieu, Ms Trinh Thi Van Giang, and participating commune health centers for their assistance during the fieldwork of this study.

## REFERENCES

- Ainsworth BE, Richardson MT, Jacobs DR, *et al.* Accuracy of recall of occupational physical activity by questionnaire. *J Clin Epidemiol* 1999; 52: 219-27.
- Ainsworth BE, Sternfeld B, Richardson MT, *et al.* Evaluation of the kaiser physical activity survey in women. *Med Sci Sports Exerc* 2000; 32: 1327-38.
- Bassett DR. Validity and reliability issues in objective monitoring of physical activity. *Res Q Exerc Sport* 2000; 71 (suppl 2): 30-6.
- Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986; 1: 307-10.
- Butte N, Wong W, Treuth M, Ellis K, Smith E. Energy requirements during pregnancy based on total energy expenditure and energy deposition. *Am J Clin Nutr* 2004; 79:1078-87.
- Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. Development and validation of a Pregnancy Physical Activity Questionnaire. *Med Sci Sports Exerc* 2004; 36: 1750-60.
- Dempsey JC, Butler CL, Sorensen TK, *et al.* A case-control study of maternal recreational physical activity and risk of gestational diabetes mellitus. *Diabetes Res Clin Pract* 2004; 66: 203-15.
- Dunlop DD, Manheim LM, Song J, Chang RW. Arthritis prevalence and activity limitations in older adults. *Arthritis Rheum* 2001; 44: 212-21.
- Hegaard HK, Hedegaard M, Damm P, Ottesen B, Petersson K, Henriksen TB. Leisure time physical activity is associated with a reduced risk of preterm delivery. *Am J Obstet Gynecol* 2008; 198: 180e1-5. [Cited 2008 March 7]. Available from: URL: [http://www.ajog.org/article/S0002-9378\(07\)01023-X/fulltext](http://www.ajog.org/article/S0002-9378(07)01023-X/fulltext)
- Lof M, Forsum E. Activity pattern and energy expenditure due to physical activity before and during pregnancy in healthy Swedish women. *Br J Nutr* 2006; 95: 296-302.
- Maddison R, Ni Mhurchu C, Jiang Y, *et al.* International Physical Activity Questionnaire (IPAQ) and New Zealand Physical Activity Questionnaire (NZPAQ): A doubly labelled water validation. *Int J Behav Nutr Phys Act* 2007; 4: 62. [Cited 2008 March 7]. Available from: URL: <http://ijbnpa.org/content/4/1/62>
- McGraw KO, Wong SP. Forming inferences about some intra-class correlation coefficients. *Psychol Methods* 1996; 1: 30-46.
- Moons P, Vanrenterghem Y, Van Hooff JP, *et al.* Health-related quality of life and symptom experience in tacrolimus-based regimens after renal transplantation: a multicentre study. *Transpl Int* 2003; 16: 653-64.
- Ning Y, Williams MA, Dempsey JC, Sorensen TK, Frederick IO, Luthy DA. Correlates of recreational physical activity in early pregnancy. *J Matern Fetal Neonatal Med* 2003; 13: 385-93.
- Ono R, Hirata S, Yamada M, Nishiyama T, Kurosaka M, Tamura Y. Reliability and validity of the Baecke physical activity questionnaire in adult women with hip disorders. *BMC Musculoskelet Disord* 2007; 8: 61.
- Polis MA, Peeters PH, Kemper HC, Grobbee DE. Methodological aspects of physical activity assessment in epidemiological studies. *Eur J Epidemiol* 1998; 14: 63-70.
- Portney LG, Watkins MP. Foundations of clinical research: applications to practice. East Norwalk CT: Appleton Lange, 1993.
- Schmidt MD, Erickson JB, Freedson PS, Markenson G. Physical activity patterns during pregnancy in a low income racially diverse population. *Am J Epidemiol* 2002; 155: S103.
- Schneider PL, Crouter SE, Bassett DR. Pedometer measures of free-living physical activity: comparison of 13 models. *Med Sci Sports Exerc* 2004; 36: 331-5.



- Sequeira MM, Rickenbach M, Wietlisbach V, Tullen B, Schutz Y. Physical activity assessment using a pedometer and its comparison with a questionnaire in a large population survey. *Am J Epidemiol* 1995; 142: 989-99.
- Sorensen TK, Williams MA, Lee IM, Dashow EE, Thompson ML, Luthy DA. Recreational physical activity during pregnancy and risk of preeclampsia. *Hypertension* 2003; 41: 1273-80.
- van Baak MA, van Mil E, Astrup AV, *et al*. Leisure-time activity is an important determinant of long-term weight maintenance after weight loss in the Sibutramine Trial on Obesity Reduction and Maintenance (STORM trial). *Am J Clin Nutr* 2003; 78: 209-14.
- Voorrips LE, Ravelli AC, Dongelmans PC, Deurenberg P, van Staveren WA. A physical activity questionnaire for the elderly. *Med Sci Sports Exerc* 1991; 23: 974-9.
- WHO. Maternal mortality in Viet Nam 2000-2001: an in-depth analysis of causes and determinants. Geneva: World Health Organization, 2005.