Initial Validation of an Exercise "Vital Sign" in Electronic Medical Records

KAREN JACQUELINE COLEMAN[1], EUNIS NGOR[1], KRISTI REYNOLDS[1], VIRGINIA P. QUINN[1], CORINNA KOEBNICK[1], DEBORAH ROHM YOUNG[1], BARBARA STERNFELD[2], and ROBERT E. SALLIS[3]

[1]Department of Research and Evaluation, Kaiser Permanente Southern California, Pasadena, CA; [2]Division of Research, Kaiser Permanente Northern California, Oakland, CA; and [3]Department of Family Medicine Fontana Medical Center, Kaiser Permanente Southern California, Fontana, CA

ABSTRACT

COLEMAN, K. J., E. NGOR, K. REYNOLDS, V. P. QUINN, C. KOEBNICK, D. R. YOUNG, B. STERNFELD, and R. E. SALLIS. Initial Validation of an Exercise "Vital Sign" in Electronic Medical Records. *Med. Sci. Sports Exerc.*, Vol. 44, No. 11, pp. 2071–2076, 2012. **Purpose**: The objective of this study is to describe the face and discriminant validity of an exercise vital sign (EVS) for use in an outpatient electronic medical record. **Methods**: Eligible patients were 1,793,385 adults 18 yr and older who were members of a large health care system in Southern California. To determine face validity, median total self-reported minutes per week of exercise as measured by the EVS were compared with findings from national population-based surveys. To determine discriminant validity, multivariate Poisson regression models with robust variance estimation were used to examine the ability of the EVS to discriminate between groups of patients with differing physical activity (PA) levels on the basis of demographics and health status. **Results**: After 1.5 yr of implementation, 86% (1,537,798) of all eligible patients had an EVS in their electronic medical record. Overall, 36.3% of patients were completely inactive (0 min of exercise per week), 33.3% were insufficiently active (more than 0 but less than 150 min·wk^{-1}), and 30.4% were sufficiently active (150 min or more per week). As compared with national population-based surveys, patient reports of PA were lower but followed similar patterns. As hypothesized, patients who were older, obese, of a racial/ethnic minority, and had higher disease burdens were more likely to be inactive, suggesting that the EVS has discriminant validity. **Conclusions**: We found that the EVS has good face and discriminant validity and may provide more conservative estimates of PA behavior when compared with national surveys. The EVS has the potential to provide information about the relationship between exercise and health care use, cost, and chronic disease that has not been previously available at the population level. **Key Words:** PHYSICAL ACTIVITY COUNSELING, PRIMARY CARE, PHYSICIAN, POPULATION

Although the benefits of regular physical activity (PA) have been well documented, including those for prevention and treatment of cardiovascular disease, cancer, and depression (7), the high prevalence of physical inactivity remains a major public health concern. The national *2008 Physical Activity Guidelines for Americans* (7), recommend that Americans engage in at least 150 min·wk^{-1} of moderate-to-vigorous intensity PA to receive maximal health benefits. Recent estimates using objective PA assessment found that only 8% of the US adult population achieved the recommended levels of PA (11), although self-report measures found the prevalence to be considerably higher than this (60%) (11).

Address for correspondence: Karen Jacqueline Coleman, Ph.D., Department of Research and Evaluation, Southern California Permanente Medical Group, 100 S. Los Robles, 2nd Floor, Pasadena, CA; E-mail: Karen.J.Coleman@kp.org.
Submitted for publication March 2012.
Accepted for publication June 2012.

0195-9131/12/4411-2071/0
MEDICINE & SCIENCE IN SPORTS & EXERCISE®

DOI: 10.1249/MSS.0b013e3182630ec1

One of the focus areas in the National Physical Activity Plan is the health care sector. Health care providers have contact with the majority of Americans and have a unique opportunity to encourage PA among their patients through PA assessment and brief counseling. Recommendations for assessment include a PA "vital sign" that is incorporated into patients' routine health screening and is kept as a health indicator in their medical record (8). This indicator can be monitored over time as are blood pressure and weight to provide continued opportunities for counseling and support for adopting a healthy lifestyle. In response to these recommendations, the American Medical Association in partnership with the American College of Sports Medicine developed the Exercise is Medicine™ initiative (9). Specific details about the initiative can be found at the program Web site (4). Briefly, the vision for the initiative is as follows:

"For physical activity to be considered by all health care providers as a vital sign in every patient visit, the patients are effectively counseled and referred as to their physical activity and health needs, thus leading to overall improvement in the public's health and long-term reduction in health care cost."

In response to the Exercise is Medicine™ initiative, Kaiser Permanente Southern California (KPSC), a large health care system, has incorporated questions about PA into the measurement of traditional vital signs (blood pressure, pulse, temperature, and respirations), which are currently assessed for every patient during an outpatient visit. This exercise vital sign (EVS) was designed to identify patients who are not meeting PA recommendations and to assist health care providers in promoting PA among patients.

This article describes the initial results from efforts to validate the KPSC EVS. Face validity for the KPSC EVS was established by comparing exercise levels found with this measure to those found in US population surveys. We also examined the ability of the KPSC EVS to discriminate between groups of patients with differing activity levels on the basis of demographics and health status. We hypothesized that women would be less active than men, older patients would be less active than younger patients, ethnic minority patients would be less active than non-Hispanic white patients, obese patients would be less active than patients having a healthy weight, and those patients with a higher disease burden would be less active than those without chronic health conditions.

METHODS

Participants and Setting

KPSC provides comprehensive health care services for approximately 3.4 million residents of Southern California. Members enroll through the Kaiser Foundation Health Plan for prepaid health care insurance. KPSC provides care at 14 hospitals and nearly 200 medical offices through a partnership of more than 4000 physicians who comprise the entire range of medical specialists. Data were examined for the period of April 2010 to March 2011. This time frame was chosen to reflect 1 yr of full implementation of the EVS after a 6-month implementation phase (18 months total). During this time, there were 2,149,800 adult patients who were KPSC members. Of these patients, 1,793,385 (83%) had at least one outpatient medical visit and were eligible for the study. Study procedures were approved by the KPSC Institutional Review Board for Human Subjects. The KPSC Institutional Review Board approved a waiver of informed consent for this study.

EVS. Use of the EVS began in October of 2009, with every patient being asked two questions during their intake procedures as part of an outpatient visit: 1) "On average, how many days per week do you engage in moderate to strenuous exercise (like a brisk walk)?" and 2) "On average, how many minutes do you engage in exercise at this level?" These questions are typically asked by medical assistants and licensed vocational nurses who enter patients' responses into the electronic medical record. Response choices for days are categorical (0–7). Minutes are recorded in blocks of 10: 0, 10, 20, 30, 40, 50, 60, 90, 120, and 150 or greater. The electronic medical record system software then multiplies the two self-reported responses to display minutes per week of moderate or strenuous exercise for the health care provider to review. There is a comment section to note any issues with the assessment. The EVS is embedded in the "vital sign" section of the electronic medical record, which also contains height, weight, body mass index (BMI), blood pressure, pulse, respirations, and body temperature.

The EVS was developed with assistance from leading experts in the PA promotion and assessment community as part of the national Exercise is Medicine™ initiative and is a modified version of the Behavioral Risk Factor Surveillance System (BRFSS) PA questions (1,12). When modifying these questions for clinical use, key considerations were made for implementation so that the EVS would be easy to use and acceptable to medical staff. This meant combining intensity categories into one question (moderate to strenuous) and categorizing minute responses to minimize errors in data entry. On average, the EVS takes less than 1 min to administer. A set of training materials also accompany the EVS to assist health care professionals in asking these questions consistently, as well as probing patients about their answers if the patient seems uncertain or provides an answer that is unreasonable (e.g., "I exercise five hours every day"). These training materials are available upon request.

A median total minutes per week of moderate to strenuous exercise was used for each patient across the study period of April 2010 to March 2011. The median was used instead of the mean to control for extreme differences in self-reported exercise across multiple visits.

Demographic and Health Variables

Demographics. Date of birth (for calculation of age), race/ethnicity, and gender were obtained from electronic membership files. These data are collected when patients enroll in the KPSC health plan. Self-reported race/ethnicity is also collected when patients have a health care visit. All demographic variables were obtained at the beginning of the study period (April 2010).

BMI. BMI was assessed using measured height and weight and calculated as weight in kilograms divided by height in meters squared. Height and weight are measured and entered into the electronic medical record by health care professionals each time a patient has a health care visit. We directly accessed electronic records to obtain all BMI values during the study period (April 2010 to March 2011) and then calculated a median value for analyses.

Disease burden. Disease burden was assessed by calculating a modified Charlson Comorbidity Index for each patient in the study population. The modified Charlson Comorbidity Index was created using diagnosis codes assessed in the 3 yr before enrollment in the study to provide a summary score assessing a patient's risk for 10 yr of mortality based upon 22 different health conditions (3).

Analyses. Data on patient demographics and health are presented as descriptive frequencies. To establish the face validity of the KPSC EVS, we further consolidated data into categories to compare with the estimates reported by the 2005–2006 Nutrition Health and Examination

Survey (NHANES) for the United States (11) and the 2007 California BRFSS (1). These categories were completely inactive (median, 0 min·wk^{-1}), insufficiently active (median value, >0 but <149 min·wk^{-1}), and sufficiently active (median, ≥150 min·wk^{-1}).

To determine the discriminant validity of the KPSC EVS, we used multivariate Poisson regression models with robust variance estimation. Prevalence ratios (PR) and their corresponding 95% confidence intervals (CIs) were calculated to determine how levels of inactivity and insufficient activity were associated with patient age, gender, race/ethnicity, Charlson Comorbidity Index (disease burden), and BMI. All analyses were done with SAS Enterprise Guide 4.3 (SAS Institute Inc., Cary, NC).

RESULTS

Patient characteristics. From the 1,793,385 KPSC adult patients with an outpatient medical visit during April 2010 to March 2011, we identified 1,537,798 (86%) with an EVS measure. Table 1 presents patient characteristics for those patients who did and did not have an EVS measure. In general, patients with an EVS were older, were female, had less missing information for race/ethnicity and BMI, and had more comorbid conditions and more outpatient visits when compared with those patients who did not have an EVS.

TABLE 1. Characteristics of KPSC adult patients 18 yr and older with a medical outpatient visit during the study period of April 2010 to March 2011 are shown with and without an EVS.

	Patients with an EVS (n = 1,537,798)	Patients without an EVS (n = 255,587)
Age (yr)		
18–29	228,802 (14.9%)	51,705 (20.2%)
30–39	243,531 (15.8%)	46,340 (18.1%)
40–49	293,639 (19.1%)	52,423 (20.5%)
50–64	456,833 (29.7%)	71,536 (28.0%)
65+	314,993 (20.5%)	33,583 (13.1%)
Gender		
Female	891,420 (58.0%)	125,623 (49.2%)
Male	646,364 (42.0%)	129,960 (50.8%)
Race/ethnicity		
Non-Hispanic white	504,365 (32.8%)	75,527 (29.6%)
Hispanic	437,813 (28.5%)	57,930 (22.7%)
Non-Hispanic black	136,869 (8.9%)	16,099 (6.3%)
Asian/Pacific Islander	120,505 (7.8%)	18,382 (7.2%)
Native American/Alaskan	2269 (0.1%)	284 (0.1%)
Others	27,171 (1.8%)	4401 (1.7%)
Multiple	3392 (0.2%)	510 (0.2%)
Unknown	305,414 (19.9%)	82,454 (32.3%)
BMI (kg·m^{-2})		
18–24.99	418,413 (27.4%)	56,125 (22.1%)
25–29.99	536,458 (35.1%)	64,693 (25.5%)
30–34.99	322,868 (21.1%)	36,819 (14.5%)
35–39.99	140,344 (9.2%)	14,481(5.7%)
40+	90,504 (5.9%)	9019 (3.6%)
Unknown	19,023 (1.2%)	72,833 (28.7%)
Charlson index		
0	1,392,988 (90.6%)	245,423 (96.0%)
1	57,303 (3.7%)	4635 (1.8%)
2	33,205 (2.2%)	2411 (0.9%)
≥3	54,302 (3.5%)	3118 (1.2%)
Outpatient visits		
0	—	—
1	158,831 (10.3%)	103,667 (40.6%)
2–4	494,331 (32.1%)	103,720 (40.6%)
≥5	884,636 (57.5%)	48,200 (18.9%)

All characteristics are significantly different between patients with and without an EVS (P < 0.001).

Face validity. Exercise participation is shown for different participant characteristics in Table 2. Comparison data for face validity are provided from the 2005–2006 US NHANES and 2007 California BRFSS. In general, KPSC patient self-reported levels of sufficient exercise (median, 150 min or more of exercise per week) were lower than those self-reported in either NHANES or BRFSS surveys (31% vs. 60% and 50%, respectively). The patterns of PA among different KPSC patient populations were similar to the population measures.

Discriminant validity. Table 3 describes Poisson regression results of patient-reported PA from the KPSC EVS measure. Models are fully adjusted for all variables. Patients who were 65 yr and older were 1.25 (95% CI, 1.24–1.26) times more likely to be inactive when compared with patients 18–29 yr old. The likelihood of physical inactivity was significantly greater with each age category because they were compared with 18–29 yr old patients. Women were 1.12 (95% CI, 1.11–1.12) times more likely than men to be inactive, and both Hispanics (PR = 1.16; 95% CI, 1.15–1.16) and non-Hispanic blacks (PR = 1.05; 95% CI, 1.05–1.06) were more likely to be inactive than non-Hispanic whites. In addition, a greater disease burden increased the likelihood of inactivity. Those patients with a modified Charlson Comorbidity Index of 3 or more (highest disease burden) were 1.54 (95% CI, 1.53–1.55) times more likely to be inactive as compared with patients with an index of 0. Finally, higher BMI levels also increased the likelihood of inactivity. Extremely obese patients (BMI, ≥40 kg·m^{-2}) were 1.61 (95% CI, 1.60–1.62) times more likely to be inactive as compared with patients having a healthy weight (BMI, 18–24.99 kg·m^{-2}). Similar associations were found with inadequate activity (more than 0 but less than 149 min or less per week), although the effects were somewhat attenuated.

DISCUSSION

We found that self-reported exercise assessment can be successfully incorporated as a vital sign into the electronic medical record of a large health care system serving a diverse population. Within 18 months of implementation, 86% of all adult members who had at least one outpatient medical visit had an EVS measure. As hypothesized, the KPSC EVS discriminated between different patient populations such that increasing age, female gender, being of a racial/ethnic minority group, and increasing BMI were all associated with lower PA. Higher disease burden was also significantly related to inactivity.

Although the general patterns of PA were similar between the KPSC EVS and other population-based self-report measures, the KPSC EVS exercise levels were less than those found for both self-reported BRFSS and NHANES data. For example, only 30.4% of KPSC patients self-reported that they

TABLE 2. Self-reported exercise levels as measured with the EVS for KPSC adult patients 18 yr and older.

	KPSC EVS			NHANES			BRFSS		
	Inactive (%)	Insufficient (%)	Sufficient (%)	Inactive (%)	Insufficient (%)	Sufficient (%)	Inactive (%)	Insufficient (%)	Sufficient (%)
Overall (*n* = 1,537,798)	36.3	33.3	30.4	12.5	27.9	59.6	12.5	37.6	50.0
NHANES age (yr)									
20–29	31.9	31.8	36.3	10.5	25.6	63.9		Not available	
30–39	35.9	34.4	29.7	10.0	30.9	59.0			
40–49	36.4	34.3	29.3	10.5	25.1	64.4			
50–59	35.5	34.7	29.8	9.3	31.9	58.8			
60–69	35.0	33.4	31.6	13.8	26.6	59.7			
70+	44.9	31.1	24.0	25.9	27.2	46.9			
BRFSS age (yr)									
18–24	30.4	28.9	40.7		Not available		—	29.8	64.4
25–34	34.2	33.9	31.9				10.4	37.5	52.1
35–44	36.6	34.5	28.9				10.7	40.6	48.7
45–64	35.5	34.4	30.1				13.4	39.5	47.1
65+	41.6	31.6	26.8				20.5	36.0	43.5
Gender									
Female	37.9	35.0	27.1	14.1	30.2	55.8	12.5	38.6	48.9
Male	34.2	30.9	34.9	10.7	25.5	63.9	12.5	36.4	51.1
Race/ethnicity									
Non-Hispanic white	35.5	31.7	32.8	9.6	27.5	63.0	6.3	36.6	57.1
Hispanic	40.2	34.3	25.5	27.0	32.3	40.7	18.1	36.4	45.5
Non-Hispanic black	39.3	34.6	26.1	18.3	34.0	47.7	—	36.2	49.6
BMI ($kg \cdot m^{-2}$)									
18–24.99	30.5	32.4	37.1	11.6	25.3	63.1		Not available	
25–29.99	33.6	33.7	32.7	11.6	29.8	58.6			
30–34.99	40.2	33.9	25.9	11.7	29.2	59.1			
35+	47.5	33.5	19.0	17.7	27.8	54.5			

Levels are compared with the 2005–2006 NHANES (11) and the 2007 California BRFSS (1). Levels are presented as inactive (0 median minutes of moderate to strenuous exercise per week), insufficient (more than 0 but less than 149 median minutes of exercise per week), and sufficient (150 median minutes or more of exercise per week). BRFSS and NHANES use different age categorizations, so both age categorizations are shown here in comparison with the KPSC EVS.

were sufficiently active ($\geq$150 $min \cdot wk^{-1}$), whereas 50% of BRFSS and 59.6% NHANES participants self-reported these levels. This may be due to some factors. One of the most important differences between the population measures and the KPSC EVS, and a limitation of its use in measuring different exercise intensities, is that the EVS combined moderate and vigorous PA. By selecting 150 $min \cdot wk^{-1}$ as the threshold for being sufficiently active, we may not have captured those patients obtaining 75 $min \cdot wk^{-1}$ of vigorous activity, which also meets PA guidelines. However, it is unlikely that this made a large effect on the findings given that so few Americans engage in regular vigorous PA (11), especially those populations represented in the KPSC EVS analyses: ethnic minorities, women, and older patients with higher disease burdens.

It may be more likely that the difference in activity levels between the KPSC patient population and respondents on the NHANES and BRFSS surveys was due to differences in demographics. On the basis of published data, NHANES and California BRFSS participants were 50% female and 47% non-Hispanic white, and 32% were at 20–39 yr old and 23%–34% were obese (2,5). KPSC had more female (58%) and fewer non-Hispanic white (33%) members, but age distribution was similar to NHANES and BRFSS. KPSC obesity rates (36%) were similar to NHANES but higher than BRFSS findings. It is possible that more women and ethnic/racial minority participants, two populations known to have lower levels of PA, could have contributed to the lower PA levels reported by KPSC patients.

It is also possible that overall PA reports would be higher had they included patients who did not have an EVS measure (14% of patients having an outpatient medical visit during April 2010 to March 2011). Those patients without an EVS were younger, healthier, and more likely to be male when compared with patients with an EVS. These are all characteristics associated with higher levels of PA. Despite this fact, it is unlikely that 14% of the population would make a substantial effect on estimates for 86% of the KPSC population.

There were also several other differences between the KPSC EVS measure and the population-based measures of PA that could have accounted for the difference seen in PA estimates. Although the KPSC EVS most closely resembled the BRFSS questions, the word "strenuous" was used instead of "vigorous." A second difference is that the KPSC EVS did not provide patients with a specific referent time frame for assessing PA (i.e., past month or week). This may lead patients to consider their "usual" pattern of activity when answering the question. In the only other study of an EVS, Greenwood et al. (6) found that asking about a typical week, rather than using the time frame of the last week, was a better predictor of obesity in an adult sample of 137 patients. However, Greenwood et al. did not report total minutes of PA, and thus, it is difficult to directly compare their results with the KPSC EVS.

A final difference between the KPSC EVS and population-based questions of PA like the BRFSS is the use of the word "exercise" instead of PA. This may frame the question such

TABLE 3. PRs and CIs are shown for median total minutes of moderate to strenuous exercise per week by patient demographics and health status for KPSC adult patients 18 yr and older.

Determinant	0 vs. >0 min·wk^{-1} PR	95% CI	0–149 vs. ≥150 min·wk^{-1} PR	95% CI
Age (yr)				
18–29	1.00	—	1.00	—
30–39	1.09	1.08–1.10	1.09	1.09–1.10
40–49	1.10	1.09–1.11	1.10	1.09–1.10
50–64	1.07	1.06–1.07	1.09	1.085–1.09
65+	1.25	1.24–1.26	1.15	1.145–1.15
Gender				
Male	1.00	—	1.00	—
Female	1.12	1.11–1.12	1.13	1.12–1.13
Ethnicity				
Non-Hispanic white	1.00	—	1.00	—
Hispanic	1.16	1.15–1.16	1.11	1.11–1.11
Non-Hispanic black	1.05	1.05–1.06	1.06	1.06–1.07
Asian/Pacific Islander	0.99	0.98–1.00	1.10	1.09–1.10
Native American/Alaskan native	1.05	1.00–1.11	1.01	0.98–1.04
Multiple	0.99	0.94–1.03	1.04	1.02–1.06
Other	1.00	0.98–1.01	1.03	1.02–1.04
Unknown	1.02	1.02–1.03	1.02	1.01–1.02
Charlson index				
0	1.00	—	1.00	—
1	1.19	1.17–1.20	1.09	1.09–1.10
2	1.26	1.25–1.28	1.12	1.12–1.13
≥3	1.54	1.53–1.55	1.23	1.22–1.23
BMI (kg·m^{-2})				
18–24.99	1.00	—	1.00	—
25–29.99	1.10	1.09–1.11	1.08	1.07–1.08
30–34.99	1.31	1.30–1.32	1.18	1.18–1.19
35–39.99	1.47	1.46–1.48	1.25	1.25–1.26
≥40	1.61	1.60–1.62	1.31	1.31–1.32
Unknown	1.25	1.23–1.28	1.06	1.05–1.07

Data were analyzed using two comparisons: 1) inactive (median, 0 min exercise per week during the study period of April 2010 to March 2011) versus active (anything greater than 0 median exercise per week reported during the study period), and 2) insufficiently active (median, 149 min or less exercise per week during the study period) versus sufficiently active (median, 150 min or more per week reported during the study period). Models are fully adjusted for all determinants listed in the table.

that patients considered only traditional aerobic exercises when answering rather than including lifestyle activities such as gardening and housework. Evidence suggests that aerobic fitness, increased primarily by traditional exercises such as walking, running, and swimming, may be the key to disease treatment and prevention rather than any kind of lifestyle activity (10). Consequently, the KPSC EVS may be a good indicator of moderate aerobic exercise levels and provide an ideal opportunity to study the effect of moderate aerobic exercise on disease prevention and treatment at the population level.

Regardless of the differences between the KPSC EVS and the population-based surveys of PA, embedding these questions in the electronic medical record provides an opportunity to counsel millions of patients during routine medical care regarding the importance of PA for health. There are very few tools for health promotion available to health care and public health professionals that provide the same level of reach as the KPSC EVS. Although we did not assess whether the EVS increased PA counseling rates, future studies will examine if adding a PA assessment to vital signs in primary care actually leads to higher rates of physician counseling for PA and eventually increases in the PA levels of the KPSC adult population.

Despite its use, the KPSC EVS is still a self-report measure and thus subject to the biases inherent to this mode of data collection. This is evident in comparison with recent NHANES accelerometer results (11), which found that only 8.2% of adults were sufficiently active. The KPSC EVS likely overestimates the levels of exercise in this population, albeit less so than other population-based self-report measures of PA. However, despite this limitation, because the EVS is asked in a medical setting by a health care professional (rather than a research assistant as with NHANES and BRFSS), it may be that patients are less likely to exaggerate their level of PA.

Assessment of PA levels in the clinical setting is a key component of the Exercise is Medicine™ initiative (8). Including PA as a vital sign reinforces its importance for prevention and management of disease. Once assessed, self-reported exercise levels can be used to initiate brief counseling sessions with patients about lifestyle change as recommended by the Exercise is Medicine™ initiative (9). Future research should establish the reliability and validity of the KPSC EVS over time by directly comparing its exercise estimates to objective activity monitoring and concurrently administered self-report PA measures.

Importantly, the face and discriminant validity of the KPSC EVS supports the use of this assessment tool in diverse patient populations in clinical practice. Results show that with minimal effort on the part of clinic staff, the assessment of exercise can be integrated into the vital signs taken as part of routine patient care and serve to initiate patient counseling. Furthermore, the KPSC EVS may facilitate population-based research on the effect of PA on disease prevention and treatment outcomes.

Funding for this research was provided by the Southern California Permanente Medical Group.
None of the authors have any conflicts of interest to declare.
The results of the present study do not constitute endorsement by the American College of Sports Medicine.

REFERENCES

1. California Behavioral Risk Factor Surveillance System Web site [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [cited 2012 Feb 21]. Available from: http://apps.nccd.cdc.gov/PASurveillance/DemoCompareResultV.asp#result.
2. California Behavioral Risk Factor Surveillance System Web site [Internet]. Atlanta (GA): Centers for Disease Control and Prevention; [cited 2012 Feb 21]. Available from: http://apps.nccd.cdc.gov/BRFSS/page.asp?cat=DE&yr=2007&state=CA.

3. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chron Dis*. 1987;40(5):373–83.
4. Exercise Is Medicine Web site [Internet]. Indianapolis (IN): American Medical Association and American College of Sports Medicine; [cited 2012 Feb 21]. Available from: http://www.exerciseismedicine.org/about.htm.
5. Flegal KM, Carroll MD, Ogden CL, et al. Prevalence and trends in obesity among US adults, 1999–2008. *JAMA*. 2010;303(3): 235–41.
6. Greenwood J, Joy E, Stanford J. The physical activity vital sign: a primary care tool to guide counseling for obesity. *J Phys Act Health*. 2010;7(5):571–6.
7. Physical Activity Guidelines for Americans Web site [Internet]. Washington (DC): Department of Health and Human Services; [cited 2012 Feb 21]. Available from: http://www.health.gov/paguidelines/guidelines/default.aspx.
8. Sallis RE. Developing health care systems to support exercise: exercise as the fifth vital sign. *Br J Sports Med*. 2011;45:473–4.
9. Sallis RE. Exercise is medicine and physicians need to prescribe it! *Br J Sports Med*. 2009;43:3–4.
10. Swain DP, Franklin BA. Comparison of cardioprotective benefits of vigorous versus moderate intensity aerobic exercise. *Am J Cardiol*. 2006;97:141–7.
11. Tucker JM, Welk GJ, Beyler NK. Physical activity in US adults: compliance with physical activity guidelines for Americans. *Am J Prev Med*. 2011;40(4):454–61.
12. Yore MM, Ham SA, Ainsworth BE, Kruger J, Reis JP, Kohl HW, Macera CA. Reliability and validity of the instrument used in BRFSS to assess physical activity. *Med Sci Sports Exerc*. 2007;39(8):1267–74.