The reliability and validity of the Adolescent Physical Activity Recall Questionnaire

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ABSTRACT

BOOTH, M. L., A. D. OKELY, T. CHEY, and A. BAUMAN. The reliability and validity of the Adolescent Physical Activity Recall Questionnaire. *Med. Sci. Sports Exerc.*, Vol. 34, No. 12, pp. 1986–1995, 2002. **Purpose:** This study assessed the test-retest reliability and validity of the Adolescent Physical Activity Recall Questionnaire (APARQ) among 13- and 15-yr-old Australians. **Methods:** Two studies were conducted using the same instrument. Self-reported participation in organized and nonorganized physical activity was summarized into four measures: a three-category measure of activity, a two-category measure, and estimated energy expenditure expressed as a continuous variable and as quintiles. The reliability study ($N = 226$) assessed strength of agreement for all measures between responses to two administrations of the questionnaire. The validity study ($N = 2026$) assessed the relationship between the APARQ and performance on the Multistage Fitness Test (MFT). **Results:** Reliability study: for the three-category measure, percent agreement ranged 67–83% and weighted kappa ranged 0.33–0.71. For the two-category measure, percent agreement ranged 76–90% and kappa ranged 0.25–0.74. For energy expenditure expressed as a continuous variable, the intraclass correlations coefficients were generally greater than 0.6 for grade 10 students, but most were below 0.5 for grade 8 students. Validity study: for the three-category measure, mean laps were higher in the adequately and vigorously active categories than the inactive category for girls, but only the mean laps in the vigorously active and inactive categories were significantly different for boys. For the two-category measure, mean laps were higher in the active category than the inactive category for all groups. Correlations between energy expenditure and MFT laps were 0.15, 0.21, 0.14, and 0.39 for grade 8 boys, grade 8 girls, grade 10 boys, and grade 10 girls, respectively. **Conclusion:** The APARQ has acceptable to good reliability and acceptable validity, but further validation using other methods and in other population groups is required. **Key Words:** EXERCISE, ADOLESCENTS, MEASUREMENT, RECALL, SELF-REPORT

Although the relationship between physical activity during childhood and adolescence and health during adulthood is poorly understood, evidence is accumulating in support of improved blood lipid profiles, blood pressure, body composition, glucose metabolism, bone strength, and psychological health being causally associated with regular physical activity participation among young people (15).

Effective programs to promote physical activity participation must have their roots in a clear understanding of the nature and extent of the problem, and good quality epidemiological data are fundamental to this understanding. The development of a reliable and valid measure of physical activity participation is the first step in this process. The preferred instrument will provide the maximum amount of useful information to the investigator while remaining acceptable to respondents in terms of its complexity and time for completion.

There are several types of information we normally want from a physical activity questionnaire. First, data on the specific activities in which young people participate are far more useful than data on participation in broad classes of activity (e.g., vigorous intensity). They are useful for sport and recreation policy-makers and managers, for planning facilities and other services, and provide maximum flexibility in data manipulation. Information on specific activities also allows some activities to be excluded from analyses, if appropriate, and allows weighting or classification of activities based on intensity, function (e.g., organized sports and games, nonorganized activities, activities for transport, household, work-related, and incidental activities) or according to the aspects of health-related fitness that are predominantly influenced by the activity (e.g., muscular

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endurance, muscular strength, aerobic or anaerobic performance). Second, information on both the frequency and average duration of participation in each activity, rather than just total duration, contributes to our understanding of the physical activity patterns among young people. Finally, data on participation during summer and winter are useful because the types of activity may show seasonal variation and because the prevalence of participation may vary by season.

Kohl et al. (9) recently reviewed methods of assessing physical activity participation among children and adolescents and reported on the reliability and validity of self-report measures. Some authors (3,6) have developed physical activity diaries that require a record to be made every 15 min, but these place considerable burden on the respondents and are not suitable for epidemiological studies. A past-year recall measure (e.g., 1) asks students to identify all activities in which they participated on at least 10 occasions over the last year, the months in which they participated in each activity, the days per week during those months, and the minutes per day. Although this type of questionnaire asks for all activities, it does not draw a distinction between organized and nonorganized activities like walking or cycling for transport.

The Physical Activity Questionnaire for Adolescents (PAQ-A) (10) seeks information on participation in vigorous-intensity activities over the last 7 d drawn from a limited checklist, and other items ask about participation in vigorous-intensity activities during specific times of the day (lunch) or week (weekends). No information is sought on duration of participation, moderate-intensity activities, nonorganized activities, or seasonal differences. An interviewer-administered 7-d recall questionnaire (16) asked students to recall time spent sleeping, in moderate-intensity, hard and very hard activities on each day of the previous week, using several procedures to aid recall. It is not clear whether reports of participation in both organized and nonorganized activities is sought, but no information on participation in specific activities is recorded, and it is not possible to identify seasonal differences in participation. Sallis and colleagues (16) have also developed checklists for self-completion by grade 5 students, requiring the student to report the time spent participating in 21 common activities on the previous day. Because these instruments are limited to one day and a small subset of activities, they are very unlikely to yield information on habitual activities. Both the Previous Day Physical Activity Recall (PDPAR) (19) and the Computer Assisted Recall (CAR) (13) instruments seek information only about participation in activities on the previous day, which does not provide an estimate of habitual activity. In summary, there are presently no physical activity recall instruments designed for population studies of adolescents that provide the desired breadth and detail of information. The Adolescent Physical Activity Recall Questionnaire (APARQ) was designed to provide all of the information described above and, therefore, to meet the need for a comprehensive instrument.

The two studies reported herein include the APARQ items. In the reliability study, the questionnaire was administered to the same students on two occasions, 2 wk apart, and test-retest reliability was assessed. The data were stratified by gender and grade (grades 8 and 10) before analysis. In the validity study, a field measure of aerobic fitness (the multistage fitness test or PACER) was also administered to the students who completed the questionnaire, allowing partial validation of the self-report instrument (12).

METHODS

The reliability and validity studies were conducted independently and involved different schools and students, but both studies employed the same survey instrument, which was administered under the same conditions. The questionnaires were administered to students in class groups (15–35 students) by at least two survey administrators. Instructions were delivered from a pre-prepared script and students were encouraged to seek clarification if uncertain about any questions. Upon completion, a survey administrator scanned the questionnaire for any obvious omissions or unusual responses and rectified these before the student left the room. The physical activity questions, with instructions, are included in Appendix 1.

The survey collected self-report information, including demographic information; participation in physical activity, the amount of time spent in sedentary activities, attendance at physical education (PE) classes and time spent in vigorous activity during PE, liking of PE, and individual factors associated with sport and other physical activity participation based on Social Cognitive Theory.

Reliability Study

Five high schools were selected at random from all high schools in the southern half of the Sydney metropolitan region, and two high schools from a regional city were approached to participate in the study. The questionnaire was administered on two occasions, 2 wk apart, in each of the schools during November and December 1998. One grade 8 and one grade 10 class in each school was selected by school staff to participate in the study.

Validity Study

Sample selection. Data relevant to the validation analyses were collected as part of the NSW Schools Fitness and Physical Activity Survey, 1997, the details of which have been published elsewhere (4,5). Briefly, 44 high schools were selected at random from the three education sectors (New South Wales Department of Education and Training, Catholic Education Commission, and Association of Independent Schools) in proportion to the number of students enrolled in each sector. The likelihood of a school being selected in each stratum was proportional to the size of the student enrollment and within each school, one class was chosen at random from grades 8 and 10. This sampling method ensures that each student had an approximately equal chance of selection. The study was approved by the University of Sydney Human Ethics Committee, parental

written permission was required for participation, and students were free to decline to participate or withdraw at any time.

Data collection and management. The data were collected during school weeks 3–8 (17 February to 27 March 1997) of the first NSW school term of 1997 (mid-late summer). Data collection took place concurrently in schools from each education sector and in metropolitan and rural schools to prevent potential bias due to progression through the school term on participation rates or performance. Responses to the self-report questionnaire were checked and cleaned by hand before being scanned directly into a computer file. The records of the MFT results were double entered by a commercial data entry organization.

Aerobic fitness. Aerobic fitness was assessed using the Multistage Fitness Test (MFT; also known as the 20-m Shuttle Run Test; Beep Test; PACER) first described by Leger and Lambert (12). Students are required to run between two lines 20 m apart (one "lap"), starting at 8.5 $km \cdot h^{-1}$ and increasing by 0.5 $km \cdot h^{-1}$ every 2 min, in synchrony with a cadence tape. Students were tested in groups of approximately 15, and the test was supervised by at least two of the field team. The number of laps completed was determined by the student failing to keep pace with the cadence tape for two consecutive laps (at which point they were withdrawn from the test) or by the student withdrawing of their own volition. Verbal encouragement was provided throughout to enhance motivation and performance. Stage and level was converted to number of laps completed for the analysis.

Questionnaire Items

The APARQ has two main components: participation in organized sports, games, and other activities; and participation in nonorganized physical activities. Organized sports and games were described as activities that were usually supervised by adults, usually involved organized training or practice and usually involved organized competition. Nonorganized activities were described as activities that were not usually supervised by adults and did not usually involve training or competition (e.g., cycling or walking for transport or recreation, skate boarding, casual ball games with friends, surfing, and dancing). The students were told, however, that the same activity could be played both as an organized and a nonorganized activity (e.g., soccer for competition and recreation) and therefore could be reported twice.

For each of these two components, students were asked to think about a normal week during summer school terms and a normal week during winter school terms (excluding vacations) and to report separately for each season: each activity they did (up to seven activities could be reported); the frequency with which they participated in that activity in a normal week (including training for organized activities); and the usual time they spent doing that activity, each time they did it. (If students asked what a "normal week" was, they were told that we wanted them to report the activities they did regularly, from week to week.) That is, separate estimates of physical activity participation were made for summer school terms and for winter school terms and these were not combined. These data were used to create continuous and categorical measures of physical activity participation.

A rate of energy expenditure was ascribed to each activity based on reports of Ainsworth and her colleagues (2), and each activity was classified as aerobic or not (see Appendix 2). Where the rate of energy expenditure had not been published, a MET value was estimated on the basis of similar activities for which a rate of energy expenditure was available. The following exclusion and adjustment criteria were applied: activities with a MET value less than 3.5 as well as cricket, softball, baseball, T-ball, sailing, handball (handball played by Australian students involves two or more students standing in adjacent marked spaces of about 1–1.5 m^2 each and batting a tennis ball between them using an open hand as a "bat"), "school sports," or fishing were not included because they mostly involve sitting or standing and because students may participate with very little vigor. Some of the excluded activities have intermittent, brief bursts of anaerobic activity, but no sustained rhythmic activity. Activities for which the duration of participation was less than 10 min were also excluded. Where a student did not indicate the duration or frequency of a particular activity, the median of the duration (or frequency) reported by other students of the same sex and grade reported participating in that activity was substituted for the missing value. The time spent surfing was divided by four (based on consultation with regular surfers) because much of the time is spent sitting or lying on the board and we wanted to assess the amount of time that the students who reported surfing were actually active (paddling out from the shore).

Current recommendations for child and adolescent physical activity make reference to regular participation in vigorous-intensity activity, and, for young people who do not want or are not able to exercise vigorously, daily participation in moderate-intensity activity is also recommended (17). We wished to create a measure of activity which was consistent with these recommendations so developed a three-category measure: vigorously active—students who participated in vigorous-intensity activities (METs $\geq$6.0) that require rhythmic use of the large muscle groups at least three times per week for at least 20 min per session; adequately active—students not classified as vigorously active and who participated in at least 3.5 h of moderate-intensity activity (3.5–5.9 METs) over at least five sessions in a normal week; inactive—students not in the vigorously active or adequately active categories. Although this measure allows estimation of the proportion of the population who meet current physical activity guidelines, it is often simpler to express the findings of epidemiological studies using a dichotomous measure. Consequently, we also created a dichotomous measure by combining the vigorously active and adequately active categories into a single active category and the inactive category remained the same. The three- and two-category measures were calculated on the basis of or-

TABLE 1. Proportion of grade 8 and grade 10 boys and girls in each category of self-reported activity at test 1 (T1) and test 2 (T2), percent agreement (%A), and kappa (95% CI) presented separately for summer and winter school terms. The top panel shows the data for three categories of physical activity and weighted kappa and the bottom panel shows the data for two categories of physical activity and unweighted kappa.

	Grade 8 boys (N = 63)				Grade 8 girls (N = 58)				Grade 10 boys (N = 75)				Grade 10 girls (N = 30)			
	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)
Three categories																
Summer																
Vigorous	69.8	69.8	67	0.33 (0.10–0.56)	74.1	70.7	78	0.55 (0.33–0.77)	56.0	48.0	72	0.62 (0.47–0.77)	33.3	26.7	80	0.71 (0.50–0.93)
Adequate	14.3	11.1			13.8	17.2			14.7	25.3			23.3	16.7		
Inactive	15.9	19.1			12.1	12.1			29.3	26.7			43.3	56.7		
Winter																
Vigorous	77.8	66.7	73	0.39 (0.17–0.61)	69.0	60.3	83	0.71 (0.54–0.88)	54.7	54.7	75	0.59 (0.42–0.76)	23.3	26.7	73	0.58 (0.32–0.85)
Adequate	4.8	11.1			10.3	10.3			14.7	17.3			26.7	16.7		
Inactive	17.5	22.2			20.7	29.3			30.7	28.0			50.0	56.7		
	T1	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**
Two categories																
Summer																
Active	84.1	81.0	81	0.34 (0.05–0.63)	87.9	87.9	90	0.51 (0.17–0.85)	70.7	73.3	84	0.60 (0.40–0.81)	56.7	43.3	87	0.74 (0.51–0.97)
Inactive	15.9	19.0			12.1	12.1			29.3	26.7			43.3	56.7		
Winter																
Active	82.5	77.8	76	0.25 (0.00–0.54)	79.3	70.7	88	0.68 (0.47–0.90)	69.3	72.0	81	0.55 (0.34–0.76)	50.0	43.3	80	0.60 (0.32–0.88)
Inactive	17.5	22.2			20.7	29.3			30.7	28.0			50.0	56.7		

ganized activities, nonorganized activities, and organized and nonorganized activities combined.

Energy expenditure for each specific activity was calculated as the rate of energy expenditure (in METs; where 1 MET equals 1 $kcal \cdot kg^{-1} \cdot h^{-1}$) listed for that activity multiplied by the frequency of participation in a normal week and the average duration of participation in each episode of activity. Energy expenditure (EE) for each respondent was then calculated on the basis of organized activities (EE_O), nonorganized activities (EE_{NO}), and organized and nonorganized activities combined (EE_T). Energy expenditure was expressed as a continuous variable and as quintiles, calculated for grade 8 and grade 10 boys and girls separately. All measures were prepared separately for summer and winter school terms.

Statistical Analysis

Test-retest reliability was assessed for agreement beyond chance using the kappa statistic for the dichotomous measure and weighted kappa (95% confidence intervals) for measures with more than two categories. Skewed binomial data can give rise to erroneously low values of kappa (7,8), so percent agreement was also calculated as the number of students classified in the same category at both test 1 and test 2 as a proportion of the total number of students. Energy expenditure for each student was calculated separately for organized, nonorganized, and combined activities for summer and winter school terms. As the distributions for total energy expenditure were highly skewed with the majority of cases having very low values, both intraclass correlation coefficients (ICCs) and Spearman's rank correlation coefficients were computed as a measure of test-retest reliability. The values of kappa and ICC were characterized as follows: <0.40 represented poor agreement, 0.40–0.75 represented fair to good agreement, and values >0.75 represented excellent agreement beyond chance (11).

For the validity study, only self-reported physical activity in summer school terms was used as aerobic fitness was measured concurrently in summer. The validity analysis consisted of two parts. First, the mean and standard error of the number of laps on the MFT were calculated for grade 8 and grade 10 boys and girls in each category of self-reported physical activity. Standard errors were adjusted for the design effects. Comparisons of the mean number of laps between the categories of activity and the reference group (inactive) were carried out using multiple regression with indicator variables for the categories (18). Second, the energy expenditure for summer school terms for each student was calculated and grouped into quintiles such that the number of students in each quintile was approximately equal within grade for boys and girls. Comparisons across quintiles of the number of laps completed on the MFT were carried out using one-way analysis of variance and pairwise comparisons were carried out using Tukey adjustments for multiple comparisons (14). As the distributions for total energy expenditure were highly skewed, log and square root transformations were applied to the data. Both failed to adequately normalize the distributions so the correlation between MFT laps and total energy expenditure was assessed by Spearman's rank correlation coefficient (r_s).

RESULTS

Reliability study. Of the 121 grade 8 students, 48% were girls and the mean age was 13.7 (SD 0.40) yr. Twenty-nine percent of the 105 grade 10 students were girls and the mean age was 15.7 (SD 0.40) yr. Table 1 shows the proportion of grade 8 and grade 10 boys and girls in each category of self-reported activity at test 1 and test 2 and provides values for percent agreement and the appropriate kappa statistic. The data are presented separately for summer and winter school terms.

For the three-category measure of physical activity, percent agreement ranged 67–80% and 73–83% for summer and winter schools terms, respectively. The values of weighted kappa ranged 0.33–0.71 and 0.39–0.71 for sum-

mer and winter school terms, respectively. For both measures of agreement and for both seasons, the values tended to be higher for girls than for boys, and the values also tended to be higher for older students, within sex. For the two-category measure, percent agreement ranged 81–90% and 76–88% for summer and winter schools terms, respectively. The values of kappa ranged 0.34–0.74 and 0.25–0.68 for summer and winter school terms, respectively. That is, the values for percent agreement, but not kappa, were higher for the two-category measure compared with the three-category measure. Like the three-category measure, the values tended to be higher for girls than for boys.

Table 2 shows, for grade 8 and grade 10 boys and girls separately, the proportion who were in each category of self-reported activity at test 1 and test 2, based on participation in organized and nonorganized activity. That is, the data in Table 2 are related to the data provided in Table 1, the only difference being that, in Table 2, the categories of physical activity were calculated separately for organized and nonorganized activities. Like Table 1, values for percent agreement and the appropriate kappa statistic are provided and the data are presented separately for summer and winter school terms.

For the three-category measure of organized physical activity, percent agreement ranged 76–97% and 83–97% for summer and winter schools terms, respectively, and the values of weighted kappa ranged 0.47–0.89 and 0.67–0.87 for summer and winter school terms, respectively. For both measures of agreement, the values were higher for girls than for boys (with the exception of grade 8, winter school terms) and were higher for older students compared with younger students. For the three-category measure of nonorganized physical activity, percent agreement ranged 59–80% and 60–73% for summer and winter school terms, respectively, and the values of weighted kappa ranged 0.37–0.66 and 0.40–0.46 for summer and winter school terms, respectively. Like organized activities, for both measures of agreement the values were generally higher for girls than for boys and were higher for older students compared with younger students in all cases.

For the two-category measure of organized physical activity, percent agreement ranged 76–97% and 83–97% for summer and winter schools terms, respectively, and the values of simple kappa ranged 0.44–0.89 and 0.65–0.87 for summer and winter school terms, respectively. For both measures of agreement and for both seasons, the values were higher for girls than for boys and were higher for older students compared with younger students. For the two-category measure of nonorganized physical activity, percent agreement ranged 71–87% and

TABLE 2. Proportion of grade 8 and grade 10 boys and girls in each category of self-reported activity at test 1 (T1) and test 2 (T2), percent agreement, and kappa (95% CI) presented separately for summer and winter school terms. The top panel shows the data for three categories of physical activity based on organized activities and nonorganized activities separately (and weighted kappa) and the bottom panel shows the data for two categories of physical activity based on organized activities and nonorganized activities separately (and unweighted kappa).

	Grade 8 boys (N = 63)				Grade 8 girls (N = 58)				Grade 10 boys (N = 75)				Grade 10 girls (N = 30)			
	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)	T1	T2	%A	Weighted Kappa (95% CI)
Three categories																
Summer																
Organized																
Vigorous	28.6	30.2	76	0.47 (0.24–0.71)	43.1	44.8	90	0.83 (0.69–0.96)	25.3	25.3	88	0.71 (0.53–0.89)	16.7	20.0	97	0.89 (0.68–1.00)
Adequate	0.0	3.2			3.5	0.0			1.3	2.7			0.0	0.0		
Inactive	71.4	66.7			53.4	55.2			73.3	72.0			83.3	80.0		
Nonorganized																
Vigorous	52.4	50.8	59	0.37 (0.17–0.56)	60.3	58.6	67	0.52 (0.33–0.72)	37.3	37.3	67	0.52 (0.35–0.69)	20.0	13.3	80	0.66 (0.42–0.90)
Adequate	22.2	14.3			15.5	20.7			16.0	20.0			30.0	23.3		
Inactive	25.4	34.9			24.1	20.7			46.7	42.7			50.0	63.3		
Winter																
Organized																
Vigorous	50.8	39.7	83	0.68 (0.51–0.86)	43.1	46.6	83	0.67 (0.48–0.86)	30.7	40.0	85	0.71 (0.56–0.87)	13.3	16.7	97	0.87 (0.62–1.00)
Adequate	0.0	3.2			0.0	1.7			0.0	2.7			0.0	0.0		
Inactive	49.2	57.1			56.9	51.7			69.3	57.3			86.7	83.3		
Nonorganized																
Vigorous	41.3	41.3	62	0.46 (0.27–0.65)	39.7	44.8	60	0.40 (0.20–0.61)	34.7	36.0	67	0.46 (0.27–0.64)	13.3	10.0	73	0.44 (0.14–0.74)
Adequate	15.9	17.5			15.5	12.1			16.0	14.7			23.3	20.0		
Inactive	42.9	41.3			44.8	43.1			49.3	49.3			63.3	70.0		
	T1	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**	**T1**	**T2**	**%A**	**Kappa (95% CI)**
Two categories																
Summer																
Organized																
Active	28.6	33.3	76	0.44 (0.21–0.68)	46.6	44.8	91	0.83 (0.68–0.97)	26.7	28.0	88	0.70 (0.52–0.88)	16.7	20.0	97	0.89 (0.68–1.00)
Inactive	71.4	66.7			53.4	55.2			73.3	72.0			83.3	80.0		
Nonorganized																
Active	74.6	65.1	71	0.33 (0.09–0.57)	75.9	79.3	86	0.60 (0.36–0.85)	53.3	57.3	75	0.49 (0.29–0.69)	50.0	36.7	87	0.73 (0.50–0.97)
Inactive	25.4	34.9			24.1	20.7			46.7	42.7			50.0	63.3		
Winter																
Organized																
Active	50.8	42.9	83	0.65 (0.47–0.84)	43.1	48.3	84	0.69 (0.50–0.87)	30.7	42.7	85	0.69 (0.53–0.85)	13.3	16.7	97	0.87 (0.62–1.00)
Inactive	49.2	57.1			56.9	51.7			69.3	57.3			86.7	83.3		
Nonorganized																
Active	57.1	58.7	73	0.45 (0.22–0.67)	55.2	56.9	71	0.41 (0.17–0.64)	50.7	50.7	68	0.36 (0.15–0.57)	36.7	30.0	80	0.55 (0.24–0.87)
Inactive	42.9	41.3			44.8	43.1			49.3	49.3			63.3	70.0		

TABLE 3. Intraclass correlation coefficients (ICC: 95% confidence intervals) and Spearman rank correlation coefficients (r_s: 95% confidence intervals) for total energy expenditure, energy expenditure due to organized activities, and energy expenditure due to nonorganized activities assessed at test 1 and test 2, presented separately for summer and winter school terms.

	Grade 8 Boys ($N = 63$)	Grade 8 Girls ($N = 58$)	Grade 10 Boys ($N = 75$)	Grade 10 Girls ($N = 30$)
Summer (ICC)				
Total EE	0.30 (0.05–0.51)	0.52 (0.31–0.69)	0.79 (0.69–0.86)	0.86 (0.73–0.93)
Organized EE	0.39 (0.16–0.58)	0.50 (0.28–0.67)	0.52 (0.34–0.67)	0.87 (0.75–0.94)
Nonorganized EE	0.30 (0.06–0.51)	0.48 (0.25–0.65)	0.68 (0.53–0.78)	0.86 (0.72–0.93)
Summer (r_s)				
Total EE	0.64 (0.47–0.77)	0.76 (0.63–0.85)	0.75 (0.64–0.84)	0.81 (0.64–0.91)
Organized EE	0.49 (0.27–0.66)	0.84 (0.74–0.90)	0.84 (0.76–0.90)	0.88 (0.77–0.94)
Nonorganized EE	0.64 (0.46–0.76)	0.70 (0.53–0.81)	0.64 (0.48–0.76)	0.74 (0.52–0.87)
Winter (ICC)				
Total EE	0.49 (0.28–0.66)	0.36 (0.11–0.56)	0.52 (0.33–0.66)	0.91 (0.82–0.96)
Organized EE	0.64 (0.47–0.77)	0.41 (0.17–0.60)	0.40 (0.19–0.57)	0.63 (0.36–0.81)
Nonorganized EE	0.54 (0.33–0.69)	0.33 (0.08–0.54)	0.65 (0.50–0.77)	0.90 (0.80–0.95)
Winter (r_s)				
Total EE	0.52 (0.31–0.68)	0.62 (0.43–0.75)	0.71 (0.58–0.81)	0.74 (0.52–0.87)
Organized EE	0.54 (0.34–0.69)	0.84 (0.74–0.90)	0.79 (0.69–0.86)	0.88 (0.77–0.94)
Nonorganized EE	0.54 (0.33–0.69)	0.35 (0.10–0.55)	0.52 (0.34–0.67)	0.66 (0.39–0.82)

68–80% for summer and winter school terms, respectively, and the values of simple kappa ranged 0.33–0.73 and 0.36–0.55 for summer and winter school terms, respectively. The pattern of results was similar to that for organized activities, the values were higher for girls than for boys (with the exception of grade 8, winter school terms) and were higher for older students compared with younger students (with the exception of boys in winter school terms) for both measures of agreement and for both seasons.

Table 3 shows the values of the ICCs and r_s for total energy expenditure, energy expenditure due to organized activities, and energy expenditure due to nonorganized activities (expressed as continuous variables) assessed at test 1 and test 2, for grade 8 and grade 10 boys and girls. The data are presented separately for summer and winter school terms. For grade 10 students, ICC values were greater than 0.5 except in one case. For grade 8 students, ICC values were in the range 0.30–0.64, but most were below 0.5. Like the categorical variables, ICCs for EE_T, EE_O, and EE_{NO} were generally higher among girls than boys and among older students compared with younger students. The values for r_s were substantially higher than the values for the ICCs except for grade 10 students in summer school terms. The pattern of values for r_s was similar to that for ICCs: they were higher among girls than boys and among older compared with younger students.

Validity study. Forty-eight percent of the 1072 grade 8 students were girls and the mean age was 13.1 yr. Forty-five percent of the 954 grade 10 students were girls and the mean age was 15.1 yr. Approximately 70% of the students attended schools located in urban areas and 82%, 4.2%, 4.5%, and 7.0% identified themselves as being from English-speaking, European, Middle-Eastern, and Asian cultural backgrounds, respectively (2.6% did not respond or were otherwise classified). The response rates were 86.6% and 83.5% for grade 8 boys and girls, respectively, and were 80.5% and 70.8% for grade 10 boys and girls, respectively.

Table 4 shows the proportion of grade 8 and grade 10 boys and girls in each category of each of the categorical measures of physical activity for summer school terms and the mean (SE) laps completed by each group. For the three-category measure, close to two-thirds of grade 8 boys and girls and grade 10 boys were vigorously active, about 17% were adequately active and about 20% were in the inactive category. Among grade 10 girls, less than 58% were vigorously active, 20% were in the adequately active category, and 22% were in the inactive category.

For the three-category measure, the relationship between aerobic fitness (number of laps completed on the MFT) and physical activity category was consistent within each sex, but different between the sexes. Between both grade 8 and grade 10 boys, the mean number of laps completed was significantly greater for the vigorously active category than for the inactive category, but mean laps for the adequately active category was not greater than for the inactive category. In contrast, among girls mean laps for the vigorously active category and for the adequately active category were both significantly greater than the mean laps completed for the inactive category. For the dichotomous measure, mean laps were statistically significantly greater for the active category compared with the inactive category for grade 8 and grade 10 boys and girls.

The association between EE_T and laps completed on the MFT was assessed by calculating Spearman correlation coefficients. The values were 0.147 ($P < 0.001$) and 0.208 ($P < 0.001$) for grade 8 boys and girls, respectively, and 0.139 ($P < 0.01$) and 0.391 ($P < 0.001$) for grade 10 boys and girls, respectively.

Table 5 shows mean energy expenditure and laps completed on the MFT for each quintile of energy expenditure, separately for grade 8 and grade 10 boys and girls. For grade 8 and grade 10 girls, the increases in the number of laps completed are fairly consistent across quintiles of energy expenditure. Among grade 8 girls, mean laps for the bottom quintile were significantly lower than the means for the two top quintiles and mean laps for the second quintile was lower than the mean of the top quintile. Among grade 10 girls, the means of all quintiles were statistically significantly different from all other nonadjacent quintiles. A different pattern of results occurred among boys. Among grade 8 boys, mean laps completed were similar for

TABLE 4. Number (*N*) and proportion (%) of grade 8 and grade 10 boys and girls in each category of self-reported activity for summer school terms and mean (SE) laps completed on the Multistage Fitness Test (MFT) for each group.

	Grade 8 Boys		Grade 8 Girls		Grade 10 Boys		Grade 10 Girls	
	No. in Each Activity Category *N* (%)	Mean (SE) Laps on MFT (*N* = 542)	No. in Each Activity Category *N* (%)	Mean (SE) Laps on MFT (*N* = 499)	No. in Each Activity Category *N* (%)	Mean (SE) Laps on MFT (*N* = 502)	No. in Each Activity Category *N* (%)	Mean (SE) Laps on MFT (*N* = 399)
Summer								
Vigorous	360 (64.6)	48.4 (1.96)**	325 (63.1)	33.6 (2.19)**	382 (72.9)	66.8 (2.46)**	249 (57.9)	40.4 (2.55)**
Adequate	91 (16.3)	45.2 (1.98)	91 (17.7)	31.1 (1.61)**	68 (13.0)	58.0 (3.10)	85 (19.8)	34.0 (2.09)**
Inactive	106 (19.0)	42.1 (2.16)	99 (19.2)	25.4 (1.44)	74 (14.1)	57.8 (3.26)	96 (22.3)	25.0 (2.05)
Total	557 (99.9)		515 (100.0)		524 (100.0)		430 (100.0)	
Active	451 (81.0)	47.7 (1.75)**	416 (80.8)	33.1 (1.95)**	450 (85.9)	65.5 (2.33)**	334 (77.7)	38.8 (2.29)**
Inactive	106 (19.0)	42.1 (2.16)	99 (19.2)	25.4 (1.44)	74 (14.1)	57.8 (3.26)	96 (22.3)	25.0 (2.05)
Total	557 (100.0)		515 (100.0)		524 (100.0)		430 (100.0)	

** Significantly great number of laps compared with the Inactive group ($P < 0.01$).
N, number of students with non-missing values; SE, standard error of mean adjusted to design effects.

quintiles 2, 3, and 4, and the only statistically significant difference was between quintiles 1 and 5. Among grade 10 boys, mean laps completed increased across quintiles 1–4, but the mean for quintile 5 was equal to the mean for quintile 3. The means for quintiles 1 and 2 were both statistically significantly lower than the mean for quintile 4, but there were no other significantly different means.

DISCUSSION

Overall, the results of this study suggest that the APARQ has acceptable to good test-retest reliability and validity. Because of methodological differences, it is not possible to make direct comparisons with the findings of other studies, but the reliability and validity characteristics of APARQ appear to be at least comparable with other instruments. However, some limitations in the methods used require discussion, as do differences in the results between sample subgroups. For both the three-category and two-category measures, the values of percent agreement all exceeded 70% (with the exception of grade 8 boys), and all values of kappa were 0.50 or higher (again, with the exception of grade 8 boys), suggesting acceptable test-retest reliability. Where they occur, large differences between percent agreement and weighted or unweighted kappa are probably due to the distributions being highly skewed, creating paradoxically low values of kappa. In these cases, percent agreement is probably a better indicator of the strength of agreement between test 1 and test 2. The results for energy expenditure expressed as a continuous variable were quite consistent with the findings for the categorical variables. For grade 10 students, almost all values of the ICCs and r_s exceeded 0.6, and most of the values for grade 8 students exceeded 0.50 with the notable exception of the values for ICCs in summer school terms for grade 8 boys. The discrepancies between the values of ICCs and r_s are due to the highly skewed distributions and small sample sizes.

There were consistent associations between agreement and age, sex, and type of activity. Agreement between test 1 and test 2 was generally greater for girls compared with boys and for older students compared with younger students of the same sex for all of the measures, for summer and winter school terms and for organized and nonorganized activity, with few exceptions. These findings of higher reliability among girls and among older students are consistent with the findings of at least one other study (16). We offer the speculation, based on our experiences with data collection, that older students and girls probably take more care answering the questionnaire, increasing the accuracy and, hence, the reliability.

Perhaps the most striking feature of the results is the much higher values of percent agreement and kappa for organized compared with nonorganized activities, which occur consistently within season, within sex of the student, and within

TABLE 5. Mean (standard error) laps completed on the MFT, energy expenditure (Energy exp.: $kcal \cdot kg^{-1} \cdot wk^{-1}$) for quintiles of total energy expenditure and significant pairwise comparisons presented separately for grade 8 and grade 10 boys and girls.

	Grade 8 Boys		Grade 8 Girls		Grade 10 Boys		Grade 10 Girls	
	Energy Exp. Mean (SE[a])	Laps Mean (SE)	Energy Exp. Mean (SE)	Laps Mean (SE)	Energy Exp. Mean (SE)	Laps Mean (SE)	Energy Exp. Mean (SE)	Laps Mean (SE)
Quintiles								
1	9.2 (0.8)	41.0 (2.4)	10.4 (0.8)	26.3 (1.7)	16.4 (1.0)	57.5 (2.7)	8.5 (0.7)	25.3 (2.1)
2	35.3 (0.6)	46.0 (2.1)	30.2 (0.6)	28.8 (1.9)	45.7 (0.8)	62.1 (4.9)	26.2 (0.4)	31.1 (2.1)
3	62.0 (1.0)	47.7 (2.1)	52.6 (0.6)	32.3 (2.1)	75.4 (1.0)	65.4 (3.5)	50.5 (0.9)	36.2 (2.6)
4	105.1 (1.8)	46.5 (2.2)	88.2 (1.4)	34.2 (2.1)	117.3 (1.5)	72.6 (2.7)	86.3 (1.1)	39.5 (3.0)
5	230.4 (13.2)	52.0 (2.2)	211.5 (24.0)	36.2 (2.9)	226.8 (10.4)	64.7 (3.0)	159.4 (6.2)	46.6 (3.8)
Sig. pairwise comparisons[b]		1v5		1v4, 1v5, 2v5		1v4, 2v4		1v3, 1v4, 1v5, 2v4, 2v5, 3v5

[a] Standard error adjusted for design effects.
[b] Pairwise comparisons were subjected to Tukey adjustments using critical value of studentized range = 3.87 (instead of 1.96).

grade. It is entirely plausible that organized activities are recalled with greater reliability considering that competition games and training sessions are generally of fixed frequency and duration from week to week. However, higher values of the agreement statistics do not necessarily mean that organized activities are recalled more reliably. An underlying assumption of studies of test-retest reliability is that the object of measurement is very stable and is unlikely to change between measurements. This is unlikely to be entirely true in the case of nonorganized physical activities. Whereas some nonorganized activities may occur very consistently (e.g., walking to school every day or regular participation in recreational games), other nonorganized activities may occur spontaneously and without any fixed pattern. That is, nonorganized activities may be recalled with the same reliability as are organized activities, but because some of them occur irregularly, it may be difficult for students to judge what to report as the activities of their "normal" week. It should also be noted that inclusion of nonorganized activity recall in composite measures of activity (e.g., categorical measures describing respondents as active or inactive) will have the effect of lowering the values of the reliability statistics of those measures.

Although the data generally show that a higher number of laps were completed on the MFT by groups of students who reported greater physical activity participation, it must be kept in mind that aerobic fitness is an indirect measure of validity because factors other than participation in physical activity also influence aerobic fitness. That is, a measure of aerobic fitness is, at best, only partially related to the differences between self-report physical activity categories. Further studies that employ other approaches to validation are required before we can claim that the APARQ has been comprehensively validated.

Grade 8 and grade 10 girls in both the vigorously active and adequately active categories completed significantly more laps on the MFT than those in the inactive category, but only boys in the vigorously active category completed significantly more laps than boys in the inactive category. We offer two possible explanations for this pattern of results. First, because the MFT is a maximal test, performance is influenced by motivation. It may be that boys feel more strongly motivated than girls to perform as well as they can and this difference may be greatest for the least active boys and girls. That is, inactive girls may be largely indifferent to their performance on the MFT and may choose to drop out of the test earlier rather than give maximum effort, resulting in a very low mean laps completed for the inactive category. Second, it is possible that boys in the inactive category are substantially more active than girls in the inactive category, resulting in greater cardiorespiratory endurance and better performance on the MFT.

Many research questions are best addressed using an estimate of energy expenditure, particularly studies on obesity. This study found generally low correlations between total energy expenditure based on self-reported physical activity and aerobic fitness, but the values were entirely consistent with other reports in the literature (9). Very clear relationships between estimates of energy expenditure expressed as quintiles and performance on the MFT were revealed for girls, with almost monotonic increases in performance on the MFT across quintiles of energy expenditure. Although a different pattern of results emerged for boys, it does not necessarily mean that the self-report measure is less valid but may simply mean that boys engage in different patterns of behaviors. Although further elucidation of this issue requires different approaches to validation, overall, the results indicate that the APARQ is reasonably valid, at least to the extent that it can be assessed by the MFT. We suggest three other approaches to further validating this instrument. First, use of submaximal tests of cardiorespiratory endurance (so performance is less influenced by motivation). Second, the use of accelerometers, which will help to validate the reported time spent in moderate-intensity and vigorous-intensity activity. Third, the use of doubly labeled water will determine the validity of the instrument in terms of energy expenditure.

The findings of this study suggest that the APARQ has acceptable to good reliability, which tends to be better among older students and among girls compared with boys and that it has acceptable validity. This instrument identifies and quantifies most aspects of physical activity participation (type of activity, frequency, duration of participation, context of participation, and seasonal variation), meeting the data needs of sectors other than health and providing maximum flexibility in data manipulation and presentation. We are unaware of any other published measure that provides a similar breadth and detail of information. Although further validation using other methods and in other population groups is required, the APARQ shows promise as a useful research and evaluation tool.

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Appendix 1: Adolescent Physical Activity Recall Questionnaire

QUESTIONNAIRE INTRODUCTION

Thank you for being here today and for helping us by answering this questionnaire. We would like you to work through this questionnaire and answer all the questions set out here as best you can. Many other students throughout NSW in Years 2, 4, 6, 8 and 10 have been given these same questions to answer.

Please write your name on the questionnaire so we can match your questionnaire to your measurements that will be taken later. Your names will not be recorded and no-one will see your answers. Only myself and my field team will have access to the data. Your teachers, parents, or friends will not see your answers.

This is not a test, there are no right or wrong answers. We do want your honest answers as all your answers are important to us. It is important that you do not talk with your friends nearby. Everyone must be quiet so that everyone can think carefully about their answers.

Before you begin the questionnaire there are two ways of answering the questions: 1) by colouring in the box, or 2) by writing your answers on a line. (As shown on page ##). Please put up your hand if:

i) you do not understand a question,
ii) you do not understand what a word means or if you are not sure what you are supposed to do,
iii) you make a mistake and want to change your answer and need an eraser or liquid paper.

So take your time in completing the questionnaire. Read each question carefully and answer as best you can. Remember that it is not a test, there are no right or wrong answers, no-one apart from the research team will see your answers and if you need some help just put up your hand. When you complete the questionnaire please read back over your answers to ensure you have not missed any questions and your answers are those you intended. Then hand your questionnaire to one of the research team who will place it in an envelope.

NOW SOME QUESTIONS ABOUT ORGANISED SPORTS, GAMES AND OTHER PHYSICAL ACTIVITIES

1 The following questions are about your participation in organised sports and games at school, before and after school and on weekends during school terms.

The first questions are about the organised sports, games and other activities you do during the SUMMER SCHOOL TERMS (terms 1 and 4). Please think about a normal week and write in the table below the sports or games you usually do, how many times each week you usually do them and the usual amount of time you spend doing them. The time spent doing a sport or game includes the time you spend training.

There is a list of common activities at the bottom of the page to help remind you. If you do sports or games that are not on the list, please write them in the table anyway.

If you do not do any organised activities, please write 'zero' in the first row of the table.

Sport or game		Number of times per week you usually do this sport or game, including training	The usual amount of time you spend doing this activity **each time you do it** (you can write fractions like ½ hour or 2½ hours)
1			
2			
3			
4			
5			
6			
7			

Aerobics
Athletics
Austag
Australian Rules
Baseball
Basketball
Cricket
Cycling (competitive)
Dance (ballroom)
Dance (jazz)
Dance (modern)
Dance (performance)
Golf
Gymnastics
Hockey
Indoor soccer
Inline Hockey
Lifesaving (competition)
Martial arts
Netball
Rowing
Rugby League
Running
Soccer
Softball
Squash
Swimming
Tennis
Touch football
Volleyball
Water polo

2 These questions are about the organised sports, games and other activities you do during the WINTER SCHOOL TERMS (terms 2 and 3). Please think about a normal week and write in the table below the sports or games you usually do, how many times each week you usually do them and the usual amount of time you spend doing them.

There is a list of common activities at the bottom of the page to help remind you. If you do sports or games that are not on the list, please write them in the table anyway.

If you do not do any organised activities, please write 'zero' in the first row of the table.

Sport or game		Number of times per week you usually do this sport or game, including training	The usual amount of time you spend doing this activity **each time you do it** (you can write fractions like ½ hour or 2½ hours)
1			
2			
3			
4			
5			
6			
7			

Aerobics
Athletics
Austag
Australian Rules
Baseball
Basketball
Cricket
Cycling (competitive)
Dance (ballroom)
Dance (jazz)
Dance (modern)
Dance (performance)
Golf
Gymnastics
Hockey
Indoor soccer
Inline Hockey
Lifesaving (competition)
Martial arts
Netball
Rowing
Rugby League
Running
Soccer
Softball
Squash
Swimming
Tennis
Touch football
Volleyball
Water polo

NOW SOME QUESTIONS ABOUT NON-ORGANISED PHYSICAL ACTIVITY

3 **The following questions are about your participation in non-organised physical activities at school, before and after school and on weekends during school terms. This includes walking or cycling to and from school.**

These questions are about the activities you do during the SUMMER SCHOOL TERMS (terms 1 and 4). Please think about a normal week and write in the table below the activities you usually do, how many times each week you usually do them and the usual amount of time you spend doing them.

There is a list of common activities at the bottom of the page to help remind you. If you do activities that are not on the list, please write them in the table anyway.

Sport or game		Number of times per week you usually do this sport or game, including training	The usual amount of time you spend doing this activity **each time you do it** (you can write fractions like . hour or 2. hours)
1			
2			
3			
4			
5			
6			
7			

Aerobics
Basketball
Bushwalking
Circuit training
Cricket
Cycling for fun
Cycling for transport
Dance (ballroom)
Dance (jazz)
Dance (modern)
Dance (performance)
Fishing
Golf
Martial Arts
Mountain biking
Netball
Rollerblading
Sailing (sailboard)
Sailing (dinghies)
Skateboarding
Soccer
Surfing (board)
Surfing (body)
Squash
Swimming
Tennis
Touch football
Ultimate Frisbee
Volleyball
Walking for pleasure
Walking for transport

4 **The following questions are about your participation in non-organised physical activities at school, before and after school and on weekends during school terms. This includes walking or cycling to and from school.**

The next questions are about the activities you do during the WINTER SCHOOL TERMS (terms 2 and 3). Please think about a normal week and write in the table below the activities you usually do, how many times each week you usually do them and the usual amount of time you spend doing them.

There is a list of common activities at the bottom of the page to help remind you. If you do activities that are not on the list, please write them in the table anyway.

Sport or game		Number of times per week you usually do this sport or game, including training	The usual amount of time you spend doing this activity **each time you do it** (you can write fractions like . hour or 2. hours)
1			
2			
3			
4			
5			
6			
7			

Aerobics
Basketball
Bushwalking
Circuit training
Cricket
Cycling for fun
Cycling for transport
Dance (ballroom)
Dance (jazz)
Dance (modern)
Dance (performance)
Fishing
Golf
Martial Arts
Mountain biking
Netball
Rollerblading
Sailing (sailboard)
Sailing (dinghies)
Skateboarding
Soccer
Surfing (board)
Surfing (body)
Squash
Swimming
Tennis
Touch football
Ultimate Frisbee
Volleyball
Walking for pleasure
Walking for transport

APPENDIX 2. Estimated rates of energy expenditure.

The values shown here have been drawn primarily from Ainsworth et al. (2). The activities marked with an asterisk were not recorded in Ainsworth et al. and the MET value was estimated in consultation with physical education teachers on the basis of comparison with other activities for which measured values were available. The activities marked with an "a" beside the MET value are considered to be aerobic activities which, under usual conditions of play, are likely to elevate the heart rate to at least 60% of maximum.

Activity	METS	Activity	METS	Activity	METS
Abseiling*	4.0	Gliding	2.0	Skiing (downhill)	7.0a
Aerobics/callisthenics/physical culture	7.0a	Go-karting*	3.0	Skiing (cross-country)	8.0a
Aqua aerobics	4.0	Golf	4.5	Skipping	10.0a
Archery	3.0	Grassboarding*	3.5	Snooker	2.5
Athletics, track & field*	5.0	Gymnastics	4.0	Snorkeling	5.0
Badminton/korf ball	5.0	Gym workout	5.5	Softball, Bigaro, Modball	5.0
Bat and ball*	7.0a	Handball[2]	3.0	Snowboarding*	7.0a
Beach games*	8.0a	Hockey (indoor)	8.0a	Surfboat rowing*	8.0a
Baseball	5.0	Hockey (field)	8.0a	Surfing (board/body)[3]	6.0a
Basketball	7.0a	Horse-riding	4.0	Life Saving/Nippers*	10.0a
Boxing	9.0a	Ice hockey	8.0a	Squash	12.0a
Canoe polo*	7.0a	Ice skating	7.0a	Swimming (laps)	8.0a
Canoeing/kayaking	7.0a	Inline Hockey	9.0a	Table tennis	4.0
Caving*	5.0	Jogging	7.0a	Taichi	4.0
Cricket (indoor)*	6.0a	Korf ball*	6.0a	Tee-ball	5.0
Cricket (outdoor)[1]	5.0	Lacrosse (indoor)	8.0a	Tennis-outdoor	7.0a
Cross country running	9.0a	Lacrosse (outdoor)	8.0a	Tennis-indoor	7.0a
Cycling-BMX/mountain bike	8.5a	Lawn bowls	3.0	Tenpin bowling	3.0
Cycling-road/track race	12.0a	Marathon	16.0a	Training*	5.5
Cycling-transport	6.0a	Marching	6.5a	Trampolining	3.5
Cycling-recreation	4.0	Martial arts	10.0a	Triathlon*	10.0a
Dancing-boot scooting*	3.0	Moto X/motor cycling	4.0a	Ultimate Frisbee	3.5
Dancing-ballet	6.0a	Netball*	6.0a	Volleyball-beach	8.0a
Dancing-jazz	6.0a	Newcombe ball*	7.0a	Volleyball-indoor	6.0a
Dancing-modern	6.0a	Orienteering	9.0a	Volleyball-outdoor	4.0
Dancing-ballroom	4.0	Paintball/skirmish*	10.0	Walking-power	6.5a
Darts	2.5	Racquet ball	7.0a	Walking-bush	6.0a
Diving	3.0	Rafting	5.0	Walking-pleasure	3.5
Domestic work	3.0	Rock climbing	11.0	Walking-transport	4.0
Fencing	6.0a	Rodeo roping*	4.0	Water polo	10.0a
Figure skating	7.0a	Roller blading*	7.0a	Water-skiing	6.0a
Football-Aussie rules*	10.0a	Rowing	8.0a	Water volleyball	3.0
Football-Grid iron	9.0a	Sailboarding	3.0	Weight training	4.0
Football-Kickball	7.0a	Sailing (skiffs)	3.0	Sailboarding	4.0
Football-Rugby league	10.0a	Sandboarding*	5.0	Wrestling	6.0
Football-Rugby union	10.0a	Scuba diving	7.0a	Yoga/stretching	3.0
Football-Soccer	10.0a	Shooting	2.5		
Football-Soccer (indoor)	10.0a	Skateboarding	5.0		

[1] The value given here is the rate of energy expenditure while bowling or batting. The rate of energy expenditure for an entire game of cricket (waiting to bat and fielding would be much lower).

[2] Handball played in Australian schools involves standing a marked space approximately 1–2 m^2 and batting a ball with the hand. The value given in the tables of Ainsworth et al. (12.0 METS) is for a different, and much more energetic sport.

[3] The value given here for surfing differs from that given by Ainsworth et al. The value given here is intended to reflect the effort required for paddling a board.