Assessing Physical Activity During Youth Sport: The Observational System for Recording Activity in Children: Youth Sports (OSRAC:YS)

Citation	Cohen, A., McDonald, S., McIver, K., Pate, R., & Trost, S. (2014). Assessing Physical Activity During Youth Sport: The Observational System for Recording Activity in Children: Youth Sports. Pediatric Exercise Science, 26(2), 203-209. doi:10.1123/pes.2013-0095
DOI	10.1123/pes.2013-0095
Publisher	Human Kinetics, Inc.
Version	Accepted Manuscript
Terms of Use	http://cdss.library.oregonstate.edu/sa-termsofuse

Assessing Physical Activity During Youth Sport: The Observational System for Recording Activity in Children:Youth Sports (OSRAC:YS)

Abstract

The purpose of this study was to evaluate the validity and inter-rater reliability of the Observation System for Recording Activity in Children: Youth Sports (OSRAC:YS). Children (N=29) participating in a parks and recreation soccer program were observed during regularly scheduled practices. Physical activity intensity and contextual factors were recorded by momentary time-sampling procedures (10-sec observe, 20-sec record). Two observers simultaneously observed and recorded children's PA intensity, practice context, social context, coach behavior, and coach proximity. Inter-rater reliability was based on agreement (Kappa) between the observer's coding for each category, and the Intraclass Correlation Coefficient (ICC) for percent of time spent in MVPA. Validity was assessed by calculating the correlation between OSRAC:YS estimated and objectively measured MVPA. Kappa statistics for each category demonstrated substantial to almost perfect inter-observer agreement (Kappa = 0.67 to 0.93). The ICC for percent time in MVPA was 0.76 (95% C.I. = 0.49 - 0.90). A significant correlation (r = 0.73) was observed for MVPA recorded by observation and MVPA measured via accelerometry. The results indicate the OSRAC:YS is a reliable and valid tool for measuring children's physical activity and contextual factors during a youth soccer practice.

Introduction

The health benefits of regular physical activity in children and adolescents are well-established (7,15,24). Yet, despite the benefits, population level surveillance studies suggest that less than half of U.S. children and adolescents meet public health recommendations for physical activity (3,21). In the 2003-2004 cycle of NHANES, only 42% of children aged 6 to 11 years and 7.6% of adolescents aged 16 to 19 years accumulated 60 minutes or more of moderate-to-vigorous physical activity daily (21). Of concern, the prevalence of meeting the 60-minute guideline is lower among girls than in boys, and higher in white compared to African American and Hispanic youth (3,21).

Participation in organized youth sports is considered an excellent source of physical activity (8,9,16,25). National data from the CDC Youth Risk Behavior Survey indicate that adolescents participating in youth sports report significantly more vigorous physical activity than adolescents not involved in youth sports programs (16). Moreover, in a study employing accelerometers to objectively measure physical activity, children participating in youth sports demonstrated significantly greater time in moderate-to-vigorous physical activity (MVPA) on sport practice days compared to non-practice days (25).

Although participation in organized youth sports continues to be promoted as an important source of health-enhancing physical activity, studies measuring physical activity levels during regularly scheduled sports practices, suggest that activity levels are relatively low and insufficient for meeting guidelines for daily participation in MVPA. Leek et al. (11) measured physical activity levels in children aged 7 to 14 years participating in youth sports programs for soccer and softball/baseball. On average, children spent less than half of practice time (46.1%) in MVPA during soccer practice and 35.5% of practice time during baseball/softball practice. Less

than one-fourth of children met the 60-minute physical activity guideline as a direct result of participating in youth sports practices

In order to devise effective policies and practices to promote higher MVPA levels during youth sports practices, it is important to understand what factors influence physical activity in this setting (1). To do so, a reliable and valid instrument is needed to measure children's physical activity and the contextual factors that influence physical activity during youth sports practice. While direct observation systems have been developed for observing physical activity during school physical education (13), community parks (14), and family homes (12), we are unaware of any physical activity observation tools developed specifically for the youth sports setting. Therefore, the primary purpose of this study was to evaluate the validity and reliability of a newly developed direct observation system for measuring children's physical activity and the contextual factors that are associated with physical activity during participation in youth sports. A secondary purpose was to use the accelerometer data to estimate the proportion of practice time spent in MVPA.

Methods

Participants and Setting

A purposive sample of five soccer teams from a single community-based parks and recreation program located in the north-western United States took part in the study. After receiving the approval from the Program Director, coaches were approached and invited to participate in the study. Coaches from all five teams agreed to participate. After receiving consent from the coaches, members of each team were invited to participate in the study. Of the 40 players eligible (8 players per team), 29 players (72.5%) completed the mandatory parental written consent and child assent procedures (15 males, 14 females). The teams were grouped

according to grade level: two teams were K-1st grade, two 2nd-3rd grade, and one 4th-5th grade. The study was approved by the university's institutional review board.

Development of the OSRAC:YS

The Observation System for Recording Activity in Children: Youth Sports (OSRAC:YS) is based on the OSRAC observational tools for documenting physical activity levels and contextual factors in preschools (OSRAC-P) and family homes (OSRAC-H) (2,12). Observational systems developed for measuring physical activity level, lesson context, and teacher behavior during physical education classes also informed the development of the OSRAC:YS (13,14). Five observational categories are included in the OSRAC:YS - physical activity level, practice context, social context, coach behavior, and coach proximity.

Consistent with the approach used in other OSRAC observation tools, physical activity intensity level was measured using the Children's Activity Rating Scale (CARS) in which the child's physical activity level is coded as one of five levels - stationary/motionless, stationary with movement of trunk or limbs, slow/easy movement, moderate movement, and fast movement (18). Practice context described the type of practice activity and included seven codes: warm-up, drills, tactic/instruction, fitness, game, cool down, and transition. Social context described the social structure and included four codes: individual, one-to-one, small group, and full team. Coach behavior described the actions of the coach. Coach behavior codes included: watching the child with verbal feedback, watching the child without verbal feedback, demonstration of a skill or drill, management or general instruction, and disengaged or off-task. Coach proximity described the location of the coach relative to the focal-child. Proximity codes included, proximal to the child and distal to the child. Proximal was operationalized as being within the

boundary of the practice area or playing area (e.g., sideline). Distal was operationalized as being outside the boundary of the practice or playing area.

Like the other members of the OSRAC suite of observational systems, the OSRAC:YS utilized a momentary time-sampling procedure recording the activity of a single focal-child and the coach. Each 30-second cycle included a 10-second observation and 20-second recording interval during which the observer recorded a single code for each category. The focal-child's physical activity level, coded first, was coded as the highest level observed during the 10-second observation period. If the team under observation had more than one coach, codes were recorded for only one coach.

Observation Protocol

Prior to each observed practice session, participants were randomly assigned to 10-minute observation blocks. At the beginning of the practice session, the observer positioned themselves on the sideline of the playing field with a clear view of the practice. A single focal-child was observed during each 10-minute observation block. Pre-recorded audio prompts to "observe" and "record" guided the observers through the observation and record cycles. Codes were recorded on blank recording forms. Observers also noted the start and stop time of each observation window, which allow temporal matching to the accelerometer data. At the completion of the 10-minute observation block an automated alarm signaled the end of the session. The process was repeated with a new focal-child until the end of practice. The primary observer (AC) completed the observational protocol on all 29 participants from the five teams, yielding a total of 580 coded intervals for descriptive analyses (29 players x 20 coding intervals per 10 min block = 580).

For the assessment of inter-observer reliability, the focal child and coach were concurrently observed by two trained observers (AC and SM). Concurrent observations were completed on 19 children and their coaches, yielding a total of 380 coded intervals for the reliability analyses (19 players x 20 coding intervals per 10 min block = 380).

Accelerometry

The ActiGraph GT1M or GT3X accelerometer-based motion sensor (ActiGraph Corporation, Pensacola, FL) was used to objectively measure children's physical activity during the observed youth sports practices. Accelerometers are small light-weight motion sensors that have been shown to be a valid and reliable method for measuring physical activity in children (23). In addition, recent work has shown the output from the GT1M and GT3X models to be identical (19). To ensure synchronization with the observational system, the accelerometers were initialized to record counts in 1-second epochs.

For the current study each child wore a single accelerometer for the duration of practice. At the start of practice, an accelerometer was secured around the child's waist by an elastic waist belt resting on the right hip and then removed at the end of practice. For each child, the time was recorded for placement on and removal of the accelerometer. A single time clock synchronized to the ActiGraph proprietary software was used for recording observation and accelerometer time periods. At the end of practice, accelerometer data were downloaded and later reduced to estimates of physical activity intensity and duration using a customized Excel macro.

Data Reduction

The percentage of observation intervals with MVPA during each 10-min block was determined by calculating the percentage of 30-sec observation intervals with CARS activity codes of codes 4 or 5 (moderate-movement, fast-movement). To evaluate the relative validity of

this estimate, accelerometer data for the corresponding 10-min time period were parsed and reduced to the percentage of 15-sec epochs classified as MVPA. Epochs were classified using the intensity-based cut-points established by Evenson et al. (4). The percentage of time in MVPA for the entire practice session was based on the full-length accelerometer data and was calculated as time spent in MVPA ([Number of 15-sec epochs with MVPA / 4]) divided by practice time.

Statistical Analyses

Percent agreement and Kappa coefficients were used to assess inter-rater reliability for each of the OSRAC:YS's five coding categories. In addition, an Intraclass Correlation Coefficient (ICC) (absolute agreement) for the percentage of observation intervals coded as MVPA was calculated. The validity of the OSRAC:YS to measure physical activity intensity was evaluated by determining the Pearson correlation between observer-rated and accelerometer-determined percentage of intervals/epochs with MVPA during the 10-minute observational period.

Results

Descriptive results for the OSRAC:YS observational categories are reported in Table 1. Approximately one-third of observation intervals (33.3%) were coded as slow or easy movement, with 33.1% of intervals codes as either moderate (12.4%) or vigorous movement (20.7%). The majority of practice time was allocated to drills (45.7%) and game play (29.8%). Practice activities were most frequently completed individually (50.9%) or as a full team (36.2%). Coaches watched and provided feedback to players approximately 50% of the time, while management/general instruction accounted for approximately 27% of all observational intervals. Coaches were nearly always observed as being in close proximity to the focal child (90.7%).

Although the study was not designed to evaluate the influence of the contextual factors, the MVPA levels associated with each of the OSRAC:YS contextual codes are reported for illustrative purposes. MVPA tended to be higher during drills and fitness instruction and higher during small group and individual practice activities. MVPA levels tended to be lower when coaches were demonstrating skills, providing general instructions, or disengaged. Coach proximity had little impact on MVPA.

--Insert Table 1 near here--

Physical activity levels across the entire practice session, as measured by accelerometry, are reported in Table 2. On average, children spent 23 ± 6.8 minutes or 36.8% of practice time engaged in MVPA. Children engaged in sedentary behavior for 15.2 ± 6.2 minutes or 24.2% of practice time.

Inter-observer percent agreement scores and Kappa coefficients for each of the five OSRAC:YS categories are presented in Table 3. For interpretation of the Kappa coefficients, we followed the ratings suggested by Landis and Koch (10): 0–0.2 poor, 0.2–0.4 fair, 0.4–0.6 moderate, 0.6–0.8 substantial, and 0.8–1.0 almost perfect. The resultant Kappa coefficients indicated almost perfect agreement for practice context and social context and substantial agreement for physical activity intensity level, coach behavior, and coach proximity. The inter-rater reliability ICC for percentage of intervals coded as MVPA was substantial at 0.76 (95% CI: 0.48 – 0.90).

--Insert Tables 2 and 3 near here--

Figure 1 shows a scatterplot depicting the relationship between OSRAC:YS observed and accelerometer-measured MVPA for temporally matched 10-minute observation periods (N=29).

The percentage of intervals with MVPA was significantly correlated with the percentage of 15-sec epochs with MVPA, as measured by the accelerometer. ($r = 0.73$, $P < 0.001$)

--Insert Figure 1 near here--

Discussion

The results indicate that the OSRAC:YS observational system is a valid and reliable tool for measuring children's physical activity and contextual factors during a youth sports practice. High levels of inter-observer agreement were reported for practice context and social context, while agreement statistics for child physical activity level, coach behavior, and coach proximity were moderate to strong. At the individual level, MVPA estimates derived from the OSRAC:YS were strongly correlated with accelerometer-based estimates of MVPA. At the practice level, the OSRAC:YS estimate of one-third of practice time engaged in MVPA aligned well with the 36.8% of practice time measured via accelerometry.

Our findings for inter-rater reliability are comparable to those obtained for other OSRAC observation systems. The OSRAC:P included eight observational categories specific to the preschool setting - children's physical activity level, type, and location, indoor and outdoor activity context, activity initiator, group composition, and prompts (2). Kappa statistics for four of the eight OSRAC:P categories exhibited moderate agreement (0.4-0.6), with the remaining categories exhibiting Kappa statistics indicating almost perfect agreement (0.8-1.0). The OSRAC:H included 10 observational categories, 8 previously developed for the preschool setting, plus two additional categories for the home - engagement and screen time. Kappa statistics for the physical activity prompts and initiator categories exhibited moderate agreement (0.4-0.6); physical activity level and screen time categories exhibited substantial agreement (0.6-

0.8); with the remaining six categories - activity type, activity location, indoor context, outdoor context, group composition, and engagement exhibiting almost perfect agreement (0.8-1.0) (12).

Participants in this study spent approximately one-third of practice time engaged in MVPA. This result is lower than the MVPA levels reported by Leek et al. (11) among children aged 7-14 years participating in a youth soccer program. In that study, children spent 46% of practice time in MVPA. The MVPA levels observed in this study were also lower than those reported by Wickel and Eisenmann (25) among boy's aged 6-12-years who spent 43% of practice time in MVPA. The lower levels of MVPA observed in the current study may be attributable to sample differences with respect to age, gender, and types of sport studied. The current study included boys and girls from grades K through 5 (generally between the ages of 5 to 10 years), whereas Leek et al. recruited participants aged 7 to 14 years, and Wickel and Eisenman recruited only boys aged 6 to 12-years. Wickel and Eisenman measured physical activity levels during flag football and basketball practices, in addition to soccer, and differences in the type of practice activities performed in each sport may have influenced the level MVPA. The discrepancy in findings may also be attributable, in part, to differences in the accelerometer data reduction protocol. In both the Leek and Wickel studies, time spent in MVPA was measured by applying the Freedson age-specific cut-point for 3 METs (5) which has been shown to significantly overestimate MVPA levels, particularly among children under the age of 10 years (22). In the current study, accelerometer counts were classified as MVPA using the Evenson et al. (4) cut-point, which has shown to be the most accurate of all currently available cut-points for children and youth aged 6 to 15 years (22).

The OSRAC:YS is a direct observation system for measuring children's physical activity and contextual factors of physical activity behavior during youth sports practice. The instrument

could be used to provide information on physical activity levels of children participating in youth sports programs, including the overall contribution of youth sports practices to the recommended 60-minutes of MVPA per day. In addition, by measuring contextual factors, the OSRAC:YS provides information regarding environmental and social influences on children's activity behavior. This information could be used by programmers to develop training programs for volunteer coaches to maximize opportunities for physical activity. For example, children's MVPA levels observed during small group activities were higher than that observed during activities involving the full team. Thus, a training module designed to improve a volunteer coach's knowledge of small group activities could be an effective strategy to promote physical activity. Also, the low levels of MVPA observed when coaches focused on tactical instruction or provided demonstrations suggests that volunteer coaches be educated on how to minimize the time allocated to these activities or explore strategies to integrate them into other more active practice contexts. Of note, in both scenarios, the OSRAC:YS could be employed as a tool to monitor progress and provide feedback to coaches.

To our knowledge, this is the first study to develop and test a direct observation system for contextualizing physical activity levels in the youth sports practice setting. A further strength was the use of an objective measure of physical activity as a validation realm. Limitations included a modest sample size, observation of only one sport, potential for reactivity, and recruitment of participants from a single geographic location. However, it is important to note that for the reliability assessments, simultaneous observations were completed on 19 participants, yielding a total of 380 concurrent observation intervals for the agreement analyses. Additionally, for the validity analysis, the sample size of 29 participants provided 80% power to detect a correlation of 0.50 or larger. Therefore, the sample size was adequate to evaluate validity and

reliability. Furthermore, although validity and reliability was evaluated using observations from a single sport, the observational categories and codes included in the OSRAC:YS were, by design, generic in nature and relevant to a wide range of team sports. Nonetheless, future studies exploring the utility of the OSRAC:YS should examine different sports and employ larger samples with greater age and gender diversity.

In summary, the OSRAC:YS was a reliable and valid instrument for measuring children's physical activity levels and the contextual factors potentially associated with physical activity during youth soccer practice. The OSRAC:YS could thus be a useful instrument for studying children's physical activity in the youth sports setting, and potentially contribute to the development of training programs to increase activity levels and coaching quality.

References

1. Baranowski T, Anderson C, Carmack C. Mediating variable framework in physical activity interventions: How are we doing? How might we do better? Am J Prev Med 1998;15(4):266-297.

2. Brown WH, Pfeiffer KA, McIver KL, Dowda M, Almeida M, Joao CA, Pate RR. Assessing preschool children's physical activity: The observation system for recording activity in children – preschool version. Res Q Exerc Sport. 2006;77(2):167-176.

3. Centers for Disease Control and Prevention. Youth risk behavior surveillance—United States, 2011. MMWR 2012;61(No. SS-04):1-162.

4. Evenson KR, Catellier DJ, Karminder G, Ondrak KS, McMurray RG. Calibration of two objective measures of physical activity for children. J Sports Sci 2008; 26(14):1557-1565.

5. Freedson P, Pober D, Janz, KF. Calibration of accelerometer output for children. Med Sci Sports Exerc 2005;37(11):S523-S530.

6. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. Int J Behav Nutr Phys Act 2010;7:40-56.

7. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Circulation. 2007;116(9):1081-93.

8. Katzmarzyk PT, Malina RM. Contribution of organized sports participation to estimated daily energy expenditure in youth. Ped Exerc Sci 1998;10:378-386.

9. Katzmarzyk PT, Walker P, Malina RM. A time-motion study of organized youth sports. J Human Movement Studies. 2001;40:325-334.

10. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33:159-174.

11. Leek D, Carlson JA, Cain KL, Henrichon S, Rosenberg D, Patrick K, Sallis, JF. Physical activity during youth sports practices. Arch Pediatr Adolesc Med 2011;165(4):294-299.

12. McIver KL, Brown WH, Pfeiffer KA, Dowda M, Pate RR. Assessing children's physical activity in their homes: The observation system for recording physical activity in children – home. J Appl Behav Analysis. 2009;42(1):1-16.

13. Mckenzie TL, Sallis JF, Nader PR. SOFIT: System for observing fitness instruction time. J Teach in Physical Educ. 1991;11:195-205.

14. Mckenzie TL, Cohen DA, Sehgal A, Williamson S, Golinelli D. System for observing play and recreation in communities (SOPARC): Reliability and feasibility measures. J Phys Act Health. 2006;3:S208-S222.

15. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA. 1995 Feb 1;273(5):402-7.

16. Pate RR, Trost SG, Levin S, Dowda M. Sports participation and health-related behaviors among US youth. Arch Pediatr Adolesc Med 2000;154:904-911.

17. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report, 2008. Washington, DC: U.S. Department of Health and Human Services, 2008. Available from: http://www.health.gov/paguidelines/committeereport.aspx

18. Puhl J, Greaves K, Hoyt M, Baranowski T. Children's activity rating scale (CARS): description and calibration. Res Q Exerc Sport 1990;61:26-36.

19. Robusto KM, Trost SG. Comparison of three generations of Actigraph activity monitors in children and adolescents. J Sports Sci. 2012;30(13):1429-1435.

20. Strong WB, Malina RM, Blimkie CJR, et al. Evidence based physical activity for school-age youth. J Pediatr 2005;146:732-737.

21. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical Activity in the United States Measured by Accelerometer. Med Sci Sports Exerc. 2008;40(1):181-188.

22. Trost SG, Loprinzi PD, Moore R, Pfeiffer KA. Comparison of accelerometer cut points for predicting activity intensity in youth. Med Sci Sports Exerc. 2011;43(7):1360-1368.

23. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc. 2005;37(11):S531-S543.

24. World Health Organization. Global Recommendations on Physical Activity for Health. World Health Organization, Geneva, 2010.

25. Wickel EE, Eisenmann JC. Contribution of youth sport to total daily physical activity among 6- to 12-yr-old boys. Med Sci Sports Exerc 39(9), 1493-1500.

Table 1. Descriptive results for the OSRAC:YS observations (N=29).

Observational Category	Observational Codes	Percentage of Intervals (%)[1]	% Intervals with MVPA[2]
Physical Activity Level	Stationary/motionless	19.8	-
	Stationary with movement of limbs or trunk	13.8	-
	Slow/easy movement	33.3	-
	Moderate movement	12.4	-
	Fast movement	20.7	-
Practice Context	Warm-up	7.1	17.0
	Drills	45.7	44.5
	Tactic / Instruction	4.5	0.0
	Fitness	2.1	41.7
	Game	29.8	28.3
	Cool-Down	1.7	0.3
	Transition	9.1	18.9
Social Context	Individual	50.9	37.3
	1 vs. 1	11.5	28.4
	Small Group	1.4	62.5
	Full Team	36.2	27.6
Coach Behaviour	Watching with Verbal Feedback	49.7	43.4
	Watching without Verbal Feedback	10.9	44.4
	Demonstration	5.9	20.6
	Management / General Instruction	26.7	15.5
	Disengaged / Off Task	6.9	20.1
Coach Proximity	Proximal to the Child	90.7	33.3
	Distal to the Child	9.3	31.5

1. Based on 580 observation intervals (29 participants x 20 observation intervals per participant)
2. Percentage of observation intervals with MVPA (Moderate or Fast Movement)

Table 2. Children's physical activity levels during youth soccer practice. Results from accelerometer data recorded over the duration of practice (N=29).

	Mean (SD)	Range	95% Confidence Interval
Practice Time (minutes)	62.5 (8.7)	52.0 - 80.0	59.5 - 65.4
MVPA Time			
Minutes	23.0 (6.8)	7.3 - 33.1	20.8 - 25.2
% Practice Time	36.8 (9.9)	12.6 - 55.1	33.6 - 40.0
Sedentary Time			
Minutes	15.2 (6.2)	4.6 - 29.9	13.2 - 17.2
% Practice Time	24.2 (9.2)	8.2 - 38.5	21.2 - 27.2

Table 3. OSRAC:YS Category Reliability Coefficients (N=19)

OSRAC-YS Variables	Percent Agreement	Kappa	95% Confidence Interval
Physical Activity Level	63.3%	0.71	0.66 to 0.75
Practice Context	90.2%	0.91	0.87 to 0.94
Social Context	96.2%	0.93	0.89 to 0.97
Coach Behavior	80.0%	0.75	0.69 to 0.81
Coach Proximity	94.3%	0.67	0.54 to 0.80

Note: Analysis based on 380 concurrently coded observation intervals (19 subjects x 10 min/subject x 2 codes/min = 380)

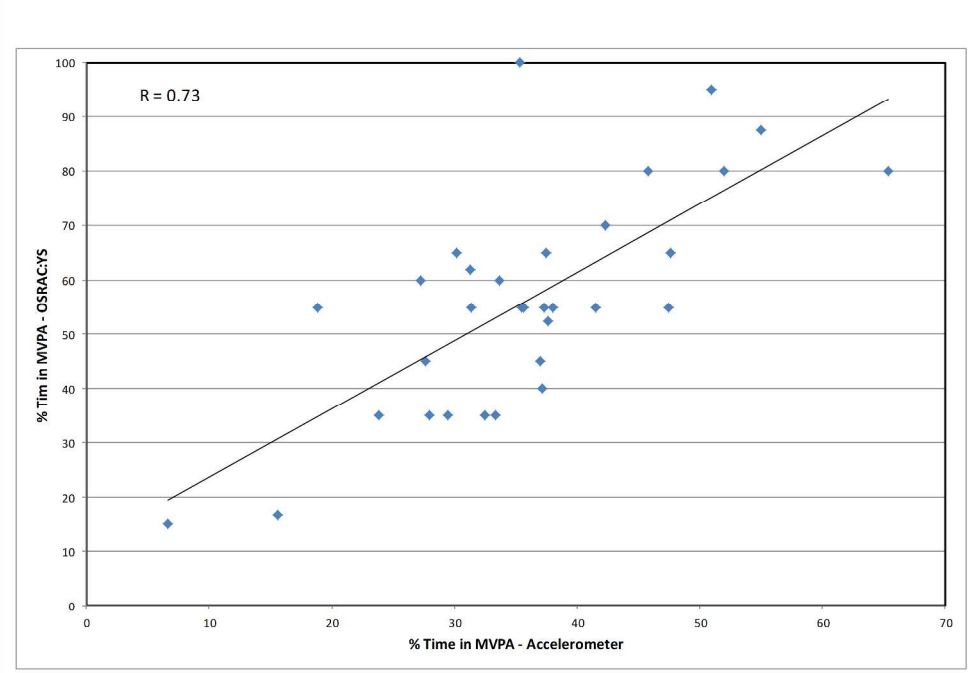

Figure 1. Correlation between observed and objectively measured MVPA during each 10-min observational period
297x209mm (300 x 300 DPI)