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Physical activity levels and pattern of use for youth participants at a traditional aquatic venue

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ABSTRACT

In an effort to encourage youth to acquire recommended levels of moderate to vigorous physical activity (MVPA), we need to examine affordances available to enhance opportunities. Included for consideration should be built environments such as swimming pools which can have significant impacts through leisure service delivery to promote active lifestyles. For this study, The System for Observing Play and Recreation in Communities (SOPARC), was employed at a traditional aquatic venue during July and August in the Midwestern region of the U.S. Data was collected on three physical activity postures for youths age 4 to 18 along with variables including: (a) age, (b) gender, (c) physical activity posture, and (d) areas of participation termed *target areas*. A total of 3780 observations were taken into account during analysis. To detect differences among key variables, One-Way ANOVA and *t*-tests were performed. Descriptive results indicated that MVPA accounted for 70% of activity in the aquatic venue. Overall, female youths generated more MVPA within target areas compared to males, and youth as a single group consistently scored higher in all target areas as well as overall in MVPA. Significant differences were discovered in relation to several target areas. Findings from the study indicate that the use of a traditional aquatic venue can have positive impacts on youth physical activity and assist in meeting national standards for daily requirements of MVPA. It is also indicated that design features of an aquatic venue can play a role in determining levels of engagement and physical activity.

1. Introduction

Physical inactivity can be seen as a main determinant of ill-health (Giles-Corti and Donovan, 2002), thus efforts to promote opportunities for youth to become more active are paramount for prevention and intervention. In the United States, health issues associated with being overweight and obese as a result of physical inactivity remain top of mind for public health professionals. The result of physical inactivity is important due to its association with negative health outcomes, such as diabetes, high blood pressure, asthma, arthritis, high cholesterol, and general poor health status. This poor health status can take place regardless of age, gender, and education level (Mokdad et al., 2003). Today, physical inactivity still poses a substantial public health challenge that can be attributed to over 280,000 deaths each year in the United States (Allison et al., 1999), and while we know that engaging in physical activity plays a role in reducing depression and anxiety (Paluska and Schwenk, 2000; Dimeo et al., 2001), as well as in preventing cardiovascular disease, obesity, cancer, hypertension, osteoporosis and diabetes (Warburton et al., 2006; Lee and Skerrett, 2001; Fang et al., 2003; Kai et al., 2003; Williams, 2003); these conditions still exist on a large scale. From an intervention standpoint, research conducted by Van Dyck et al. (Van Dyck et al., 2015) concluded that moderate-to-vigorous physical activity (MVPA) was positively associated with preventing weight gain with MVPA which is denoted as the function of aggregating the estimated Metabolic Equivalents (METS) from energy expended in the moderate and vigorous categories (3.0 and 6.0 METS, respectively). Although youth obesity is prevalent worldwide, developed countries in regions such as North America and Western Europe have experienced particularly high rates (Nocon et al., 2008). Within research regarding the prevalence of obesity in school-aged youth from 34 countries, Janssen et al. (Janssen et al., 2005) concluded that increasing physical activity and decreasing the amount of television watched played an important role in preventing overweight and obesity in adolescents.

As part of the effort to educate the public on physical inactivity, entities such as the U.S. Department of Health and Human Services

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(DHHS) and American College of Sports Medicine (ACSM) have created guidelines for child and adolescent physical activity, but despite the fact that these guidelines are viewed as important, the reality remains that people must still be able to locate, access, and interact with built and natural environments to "play out" the movement necessary (U.S. Department of Health and Human Services (DHHS), 2008) These physical spaces provide opportunities for varying levels of physical activity through design characteristics, systems of management, and service delivery methods that are often found in the realm of recreation (Kaczynski and Henderson, 2007). Using recreation and leisure delivery systems can help to empower individuals to meet the recommended requirements for physical activity. The impact of these spaces are valuable and worth addressing as part of the larger picture in combating the problem with youth physical inactivity (Israel et al., 1998; Merom et al., 2003; Potwarka et al., 2008).

From a leisure context, youth today find themselves over extended, mostly as the result of engagement in organized sport (Matz, 2014). Although beneficial on many fronts, including providing opportunities for physical activity, we should not discount time set aside for informal recreation. Within the profession of recreation and leisure delivery, the area of informal recreation is represented by creating time for participants that is managed and supervised, but designed to allow for individual choice in order to maximize engagement through less structured activity and play (Mull et al., 2013).

1.1. Water-based aspects of physical activity

Water-based activities help provide youth with above average amounts of MVPA (Ramos and Ross, 2013). Beets, Weaver, Beighle, Webster, and Pate (Beets et al., 2013) discovered that water-based activities in a summer day camp setting were linked to a high proportion of vigorous type activity in youth. Despite research demonstrating that water-based physical activity is related to both moderate and vigorous physical activity, there are few studies addressing physical activity by aquatic venue type. In addition, the literature tends to address the negative impacts covering aquatic venues, such as chemical exposure, drowning, and the effects of sunlight in relation to skin cancer, while studies highlighting the positive outcomes are less popular (Middlestadt et al., 2015). One study highlighting the benefits of using an aquatic venue for physical activity was conducted by Ashbullby et al. (Ashbullby et al., 2013) where it was discovered that those with access to coastal beach water-spaces were encouraged to be more active by the nature of the environment. Thomson and Veneman (Thompson and Veneman, 2005) also discovered through a study of traditional swimming pools in two communities, that there were positive health impacts related to the physical, social, and mental dimensions of well-being. The information becomes more relevant regarding swimming pools when we consider that the average person in the U.S. swims in a pool six times per year, and that 41% of those are children and teens between the ages of seven and seventeen (*Interesting Fact and Statistics About Swimming Pools [Internet]. Visually US*, 2017).

Our study focused on how a traditional aquatic venue (swimming pool) may provide opportunities to produce levels of physical activity for youth participants in an informal recreational setting along with an examination of possible differences based on gender, two developmental age groupings, and specific areas of use. The research was a follow up to work performed by Ramos and Ross (Ramos and Ross, 2013) in which the setting of a waterpark type aquatic venue was examined.

For the purposes of this article, the term "aquatic venue" is coined to address the current description of aquatic spaces in the Centers for Disease Control's – Model Aquatic Health Code (MAHC) which includes swimming pools.(U.S. Centers for Disease Control and Prevention (CDC), 2016)

2. Methods

Data collection was performed using The System for Observing Play and Recreation in Communities (SOPARC). SOPARC is a tool that employs systematic observational data collection grounded in the framework of Momentary Time Sampling (MTS) to record selected variables on specific groups of individuals in order to gauge levels of physical activity within specified recreational spaces. SOPARC was chosen as the data collection tool due to its existing measures of reliability and validity, as well as being a non-intrusive measure, which is amenable to the Internal Review Board process when working with youth. For the purpose of this study the following variables were chosen for data collection: (a) age, (b) gender, (c) physical activity postures, and (d) target areas.

As prescribed by the creators of SOPARC, data collectors were trained using a multi-step process. Steps included: (a) tutorial through DVD produced by the Robert Wood Johnson Foundation and San Diego State University with built in practice scenarios, (b) on-site practice sessions, and (c) dual observer on-site reliability practice sessions. Rigorous and repeated training was crucial to ensure reliability. During practice sessions, conversations were encouraged to discuss training discrepancies that culminated with agreed upon criteria for coding variables.

In order to achieve a satisfactory level of reliability, two data collectors worked simultaneously to record observations. The same two personnel were able to collect all of the data needed with daily spot checks conducted for accuracy. After data collection was completed, a Pearson Product-moment Correlation was used to determine the reliability between the pair of data collectors. Acceptable *r*-squared outcomes from previous work with SOPARC are typically within the range of 0.70 and above (McKenzie et al., 2006).

A seasonal outdoor aquatic venue was chosen in the Midwest region of the United States. This venue was determined to meet the classification of a "traditional" type of swimming pool. Characteristics leading to this classification included: (a) built mainly for lap swim/competitive swimming and diving purposes, (b) does not vary widely in pool shape from a rectangle or square frame, and (c) does not contain any special play or spray type features. This would be in contrast to a waterpark, splash ground, wading pool, open water, or other types of known aquatic venues. The aquatic facility used in the study included a 10 lane/50 m lap pool (4 to 6 ft in depth), a diving well (13 to 14 ft in depth) with a series of diving boards and towers, as well as a shallow pool (3 to 4 ft in depth) used for instruction. Deck space surrounded all pools and also existed between pools as well. The north, south, and east sides of the facility were surrounded by fencing up to the deck, with the main building closing in the west end. It is important to note that although there is a traditional lap pool at the venue, during informal time, half of this space remains for lap swimming while the other half is opened as a space for recreational play.

The facility was situated on the edge of a university campus but services were available and delivered in the same manner as in a public recreation model. Membership at the facility was open to anyone on a daily pass, weekly pass, or season membership basis and open to youths of any age. Youths under the age of 16 were required to be accompanied by a parent or guardian at least 18 years of age.

In preparation for data collection, the aquatic venue was divided into major areas designated as *main target areas*. These were defined as areas deemed significant in nature either through design, function, or from the standpoint of feasibility for observation. Main target areas were then segmented into smaller more manageable areas for observation termed *sub-target areas*. Data collected from the observation of sub-target areas was aggregated to provide overall data for each main target area, with data from all main target areas aggregated to provide a view of the venue being studied as a whole. The following is a summary of main target areas and the number of sub-target areas within each:

- Main target area number one – Pool deck
  - o Sub-target areas = 11
- Main target area number two – Diving well
  - o Sub-target areas = 1
- Main target area number three – Instructional pool
  - o Sub-target areas = 2
- Main target area number four – Lap pool
  - o Sub-target areas = 4

Convenience sampling was employed and consisted of those who attended the facility during times of observation. Data collection was performed during the months of July and August. Observations occurred for 4 days with each day consisting of three to four rounds. A single round of observation included collecting data on all of the four main target areas (via associated sub-target areas) thus representing the entire aquatic venue. Observational rounds averaged 45 to 60 min each. Due to the varying nature of venue operating hours, during weekdays (Monday through Friday) four rounds of observation were completed with three rounds occurring on weekends when operating hours were reduced (Saturday and Sunday). Rounds of observations within each day included collecting data for all designated sub-target areas simultaneously, using the same order as prescribed through a numbered site map (see Fig. 1).

For data collection in this study the variables of: (a) age grouping, (b) gender, (c) physical activity posture, and (d) target area were recorded. With regards to the coding of age groups, observers were trained to recognize youth in the age categories of 4 to 12 and 13 to 18. Age groupings were chosen to mirror recommendations derived from Erikson's stages of development differentiating the younger group as "middle childhood" and the older group as "older childhood" (Erikson, 1993). For the purposes of this study, those in "middle childhood" are referred to as "children" and "older childhood" as "teens" which is consistent with other SOPRAC publications (Reed et al., 2012; Shores and West, 2010). Training to determine differences between age groups through observation followed the process outlined in a study using SOPARC by Bacarro et al. which identifies visible biological and social group markers as well as general indicators of height and weight (Bocarro et al., 2009). Regular practice and debriefing was used to establish norms regarding notable characteristics to discern age groups and enhance reliability. Gender was relatively easy to gauge with youth often in gender specific swimming attire. Physical activity postures were categorized into sedentary, moderate (also termed "walking" in SOPARC protocol), and vigorous through definitions and examples provided by the SOPARC training manual. Additional training was necessary in regards to aquatic specific physical activity postures unique to the environment. The training regime was based on previous work performed by Ramos and Ross (Ramos and Ross, 2013) when applying SOPARC to a water park setting to address items such as the following examples: (a) standing in the water or lying/sitting on deck or pool gutters = sedentary, (b) stepping or jumping into the water from the deck = moderate, (c) walking up stairs to diving board/diving platforms = moderate, and (d) using arm actions and/or leg actions while moving independently or while holding on to an object in the water = vigorous. Data was then analyzed using a Pearson product-moment correlation for establishing robust reliability between observers. Once inter-rater reliability was established and determined to be acceptable, a descriptive analysis, series of One-Way Analysis of Variances, and Independent Sample *t*-tests were performed to detect possible differences among demographic variables, patterns of use, MVPA, and METS generated within the study site.

Approval to conduct this research was granted through the principal investigator's internal review board (protocol number 1304011180) and given the designation of "expedited". A system of implied consent was used to on-board participants during data collection through unobtrusive observation.

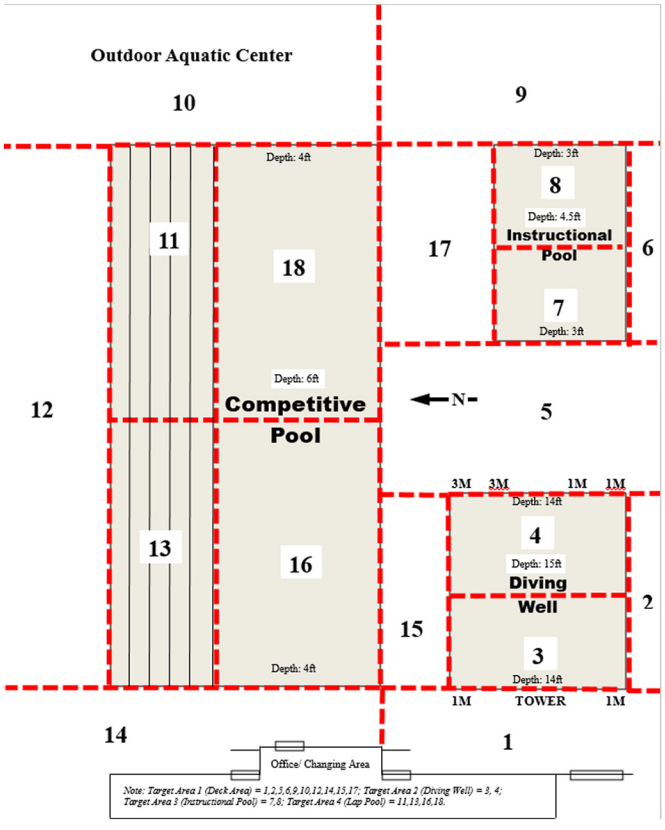

Fig. 1. Outdoor aquatic center.

3. Results

3.1. Inter-rater reliability

Inter-Rater reliability was examined through the use of a Pearson product-moment correlation (PPMC). Overall, $r^2 = 0.73$ indicating moderate and acceptable agreement between observers with the observations for physical activity postures achieving a level of $r^2 = 0.84$ representing a level of substantial agreement. Previous literature on SOPARC suggests that 0.70 is an acceptable value to demonstrate reliability between observers.

3.2. Descriptive analysis

A total of 3780 separate observations were conducted between the two data collectors which included on average monitoring 407 individuals that represented 205 females (50.37%) and 202 males (49.63%). With regards to age groupings, 321 of the subjects were assigned into the range of 4 to 12 years old (78.87%) with the remaining 86 in the 13 to 18 year old grouping (21.13%). Patterns of use within target areas by subjects were reported as follows in descending order: (a) deck, (b) instructional pool, (c) main pool, (d) diving well. See Table 1 for a summary of the descriptive findings.

3.3. Average Metabolic Equivalents (METS)

Observed physical activity postures were multiplied by their corresponding METS (sedentary = 1.5, moderate = 3.0, and vigorous = 6.0). Results indicated that for gender, males showed a slightly higher

Table 1
Frequencies for age groupings, gender, and target areas.

Variable	n	%
Age groupings		
4 to 12	321	78.87
13 to 18	86	21.13
Gender		
Female	205	50.37
Male	202	49.63
Target area		
Deck	160	39.31
Diving well	58	14.25
Instructional pool	106	26.04
Main pool	83	20.39

average for sedentary and moderate METS compared to females, with females slightly above males for accumulated average vigorous METS. Overall, gender was relatively close for the total average of METS produced between females (3.44) and males (3.16; see Table 2).

When examined by age groupings, results showed that children consistently produce higher METS in all categories when compared to their teen peers. For teens, METS were derived mostly from sedentary levels of physical activity followed by moderate and vigorous, respectively (see Table 3).

3.4. One-Way Analysis of Variance (ANOVA)

A One-Way ANOVA calculation was performed to examine differences among target areas by METS. Results indicated a statistically significant difference among the four target areas, $F(3, 403) = 99.07$, $p < 0.001$ (see Table 4). A Tukey's Post Hoc analysis revealed that youth have significantly lower METS in the deck area of the aquatic venue ($M = 2.11$, $SD = 0.94$) compared to those engaging in the instructional pool ($M = 4.13$, $SD = 1.91$) and main pool ($M = 4.46$, $SD = 1.78$). Furthermore, no statistical significance was noted between the diving well, instructional, and main pools.

A series of *t*-tests were also performed to examine differences between gender and age groups, respectively. There was no statistically significant difference between males and females, $t(405) = 1.59$, $p = 0.11$. Between the two age groups (Paluska and Schwenk, 2000; Nocon et al., 2008; Janssen et al., 2005; Potwarka et al., 2008), no significant difference was indicated from the analysis, $t(405) = 1.42$, $p = 0.16$.

3.5. Moderate to Vigorous Physical Activity (MVPA)

As an outcome of determining METS, MVPA was calculated by obtaining the average aggregate of moderate and vigorous data. Table 5 illustrates the average levels of MVPA generated in relation to age groupings, gender, and target areas within the study site. More specifically, female youth contributed 63.4% of their movement to MVPA with male youth reporting a similar percentage (59.9%) of MVPA overall. For age groups, children and teens generated 63.12% and 55.81%, respectively. Among all the target areas, the main pool revealed the highest percentage of MVPA, followed by the instructional pool. Deck and diving well areas indicated relatively lower MVPA in this study.

Table 2
Total frequency observed and average total METS[a] by gender.

METS	Female (n)	Male (n)
Sedentary	75	81
Moderate	62	70
Vigorous	68	51
Average total	3.44	3.16

[a] Metabolic equivalents.

Table 3
Total frequency observed and average total METS[a] by age groupings.

METS	Age 4 to 12 (n)	Age 13 to 18 (n)
Sedentary	119	37
Moderate	103	29
Vigorous	99	20
Average total	3.37	3.05

[a] Metabolic equivalents.

4. Discussion

4.1. Energy expenditure

With no significant differences appearing in regards to METS generated by age groupings or gender, the result can be seen as different from what is typically found in the literature regarding these populations and physical activity. For example, Brodersen, Steptoe, Boniface, and Wardle (Brodersen et al., 2007) discovered significant decreases in physical activity and increased sedentary behaviors within children and teens ages 11 to 12 and 15 to 16 years. Finding no significance within this area of the study may indicate that an aquatic environment can act as an equalizer where normally differences are noted in age and gender for youth and a potentially vital affordance to promote physical activity. However, it is worth considering that these findings are the result of possible similarities that could exist among youth as a whole. Further study to quantify a comparison with age demographics such as emerging adults, adults, and senior populations would be a valuable next step in the research. It is important to note that despite no significant differences being found here, the descriptive statistics presented in the results still reveal that some groups overall show more or less generation of MVPA and varying patterns of use within the facility.

When thinking of the traditional aquatic venue many might jump to the conclusion, that due to its inherent design for lap swimming, it will yield high levels of physical activity. We find though that when it's used during informal programming, the activity can be quite different. Without the organized structure of a swim practice or intentional programming, the informal participant will have a different motive when engaging in the aquatic venue. Perhaps without the addition of specific instruction, direct programming, or attractions such as waterpark play features, the informal participant may find themselves with few options for organic informal play.

4.2. Impact of facility design on physical activity

From a design standpoint it can be derived that deck space was not a valuable contributor to activity levels but yet drew the greatest number of participants at any given time during observational data collection. Viewing deck space as a potential avenue to encourage physical activity could be re-imagined to incorporate items which would engage swimmers when not in the water. In the past, deck areas have been primarily used for sunbathing and adorned with lounge chairs which encourages sedentary behavior. Providing safe games to deck areas, such as bag toss, or bocce ball could encourage youth to stay active even when not in the water, while still remaining informal in nature. In the case of the diving well space, which one might consider to be the only novelty in a

Table 4
ANOVA: METS[a] by target areas.

Source	SS	*df*	MS	F	*p*
Between groups	409.52	3	136.50	99.07[a]	0.000[**]
Within groups	975.30	403	2.42		
Total	1384.82	406			

[a] Metabolic equivalents.
[**] $p < 0.01$.

Table 5
MVPA[a] by gender, age groupings, and target area.

Variable	(METS >1.5)	% Overall MVPA
Gender		
Female	130	63.40
Male	121	59.90
Age grouping		
4 to 12	202	63.12
13 to 18	49	55.81
Target area		
Deck	58	35.25
Diving well	12	20.69
Instructional pool	82	77.35
Main pool	72	86.74

[a] Moderate and vigorous physical activity.

traditional aquatic venue, results revealed the lowest levels of use and ability to produce MVPA by both genders and age groupings. Diving wells could potentially offer more opportunities for creative programming activities such as water jogging, or informal water pool play which lend themselves to MVPA type movements.

5. Conclusion

Physical activity is medicine, and with traditional aquatic venues still prevalent in the U.S. they continue to provide an opportunity for youth to engage in ways that can result in the accumulation of MVPA. The outcome can be a positive benefit to their overall health and an effective factor in reducing the chances of becoming overweight and/or obese (Warburton et al., 2006). Results from this study show that the majority of physical activity produced at the venue is within the zone of MVPA. In the aquatics community a controversy exists between those who want a more traditional style pool for primarily competitive purpose versus those who desire more of a water park design which are seen as more engaging, life-span friendly, and perhaps more profitable. Results previously mentioned from the study by Ramos and Ross (Ramos and Ross, 2013) discovered that the overall MVPA from all activity recorded in a water park aquatic venue, with similar square footage as this study site, found an almost identical amount of MVPA being produced by youths with only a slighter higher percentage at the water park. If interested parties are concerned about a venue's ability to contribute to physical activity then information from this study will be of help in those discussions and decision making. The traditional aquatic venue may currently be lower in MVPA production on average, but it does present the greatest prospect through program development and design improvement of what is often referred to as the "big rectangle in the ground." On the other hand, a water park aquatic venue can be seen as already fixed by having the novelties in place and in essence "pre-programmed" with little room for change. This study will allow interested parties the ability to discuss making additional contributions and rework existing programs to help promote physical activity within their own venue.

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Conflict of interest

Conflict of interest: none.

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