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A Data-Driven Approach for Facility Use Definitions in Campus Recreation

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We have no known conflict of interest to disclose. The data that support the findings of the study are not publicly available because they contain potentially individually identifiable information that could compromise confidentiality. Authors can share variables and code used upon request, and data may be requested from the study institution with approval from the institutional review board. Data management and analysis adhere to IRB protocol # 1805106824.

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Abstract

Existing research in campus recreation establishes a relationship between facility use and academic outcomes, but published studies define users differently. In response to inconsistent definitions of participants in campus recreation, this study uses a data-driven approach to compare facility use definitions. Authors illustrate the implications of choosing different participant definitions for relationships between campus recreation and two undergraduate academic outcomes, first-year retention and first-year cumulative grade point average (GPA). This study uses data from a three-year timeframe, linking sources of data on students' recreation facility use, academic outcomes, and student records. Authors provide a summary of previous definitions, results from original regression analyses, results for specific student subgroups, and recommendations for defining users.

Keywords: institutional research, postsecondary retention, campus recreation, first-time undergraduate students, facility use definitions

14 **Using a data-driven approach to examine facility use definitions in campus recreation**

15 The campus recreation field has a growing body of literature examining academic success and
16 retention. Research has examined use of recreation facilities, as well as participation in club and
17 intramural sports. Studies have found campus recreation participants have higher grade point averages
18 (GPAs), retention rates, and graduation rates (Belch et al., 2001; Danbert et al., 2014; Huesman et al.,
19 2007, 2009; Leppel, 2005; Mayers et al., 2017; McElveen & Ibele, 2019; Roddy et al., 2017; Vasold,
20 Deere, & Pivarnik 2019; Vasold, Kosowski, & Pivarnik, 2019; Zegre et al., 2020). Beyond institutional
21 outcomes, benefits of campus recreation include physical and mental health outcomes (Brock et al.
22 2015; Forrester, 2014; Zizzi et al., 2004); Forrester (2014) reported nationwide evidence of positive
23 associations between campus recreation and a range of outcomes including student enrollment,
24 retention, academics, employment, health, and wellness.

25 Although research in campus recreation establishes a relationship between facility use and
26 academic outcomes, published studies define users differently, and as research in campus recreation
27 grows, so does the need for repeatability and comparability of findings. In response to inconsistent
28 definitions of participants in recreation facility use in existing research, this study illustrates the
29 importance of the choice of definition by illustrating the sensitivity of relationships between facility use
30 and first-year retention and first-year cumulative GPA outcomes to different definitions of facility users.
31 Subsample analyses were conducted in case relationships between use and outcomes may differ for
32 students with different demographic, family, and academic characteristics. Authors provide a summary
33 of previous definitions, results from regression analyses, and recommendations for defining users.

34 **Literature Review**

35 We review existing studies that investigated relationships between campus recreation
36 participation and our key outcomes of retention and GPA. Given much of the research in campus

37 recreation relies on recreation facility visits, we highlight the range of different facility user definitions
38 employed in the studies and illustrate different approaches to categorizing users.

39 **Campus recreation and academic outcomes**

40 Research reports positive relationships between participation in campus recreation and
41 academic outcomes including GPA, retention, and graduation (Belch et al., 2001; Danbert et al., 2014;
42 Leppel, 2005; McElveen & Ibele, 2019; Roddy et al., 2017; Huesman et al., 2007, 2009; Vasold, Deere, &
43 Pivarnik 2019; Vasold, Kosowski, & Pivarnik, 2019). These studies exhibit a range of research designs and
44 measurement approaches, including surveys, analyses of card-swipe data, descriptive statistics, and
45 regression-based approaches. Survey studies collected self-reported outcomes and facility visits (Brock
46 et al., 2015; Forrester, 2014, 2015; Henchy, 2011; Leppel, 2005; Mayers et al., 2017; Miller, 2011;
47 Vasold, Deere, & Pivarnik 2019; Zizzi et al., 2004), whereas card-swipe data collected when students
48 entered facilities allows for pairing with other institutional data and comparison of academic outcomes
49 for all enrolled students (Belch et al., 2001; Danbert et al., 2014; McElveen & Ibele, 2019) versus just
50 users (Roddy et al., 2017). Some studies have used multivariate approaches, finding significant
51 relationships between facility use and academic outcomes controlling for various student characteristics
52 (Belch, et al., 2001; Huesman et al., 2007, 2009; Roddy et al., 2017; Zegre et al., 2020).

53 Involvement in club and intramural sports has also been found to have a positive relationship
54 with academic outcomes (Astin, 1993; Light, 1992). Specifically, a study at a single institution found
55 relationships between participation and first year retention and cumulative GPA without controlling for
56 student characteristics (McElveen & Ibele, 2019). Other single institutional studies controlled for student
57 characteristics while examining the relationships among academic outcomes and intramural sports
58 (Vasold, Deere, & Pivarnik 2019) and club (Kampf & Teske, 2013) participation. Some multivariate
59 analytic studies have relied on self-reported measures (i.e., using a survey) of student participation
60 across multiple institutions (Vasold, Kosowski, & Pivarnik, 2019). All studies examining club and

61 intramural sports defined participation as binary; if the student participated in a game or reported
 62 participation, they were counted as a participant.

63 **Definition of a facility user**

64 Some research has examined facility use as a continuous variable (Huesman et al., 2009), but
 65 most has examined use as binary (i.e., user, non-user). The most common way of identifying facility
 66 users is if they came or not, for example, through a yes/no survey response (Mayers, et al., 2017). Using
 67 facility entry data, most studies classified users as those who used the facility once a semester or
 68 academic year (Belch, et al., 2001; Kampf & Teske, 2013; Roddy et al., 2017). Other studies used a more
 69 conservative definition, defining users as those who visited at least three (Misener, 2017) or four (Zizzi
 70 et al., 2004) times a semester. Others evaluated at least ten visits per semester (Huesman, et al., 2007,
 71 2009; Kampf and Teske, 2013). To determine use level that significantly increased probability of first-
 72 year retention by one percent, one study found 25 visits a semester (Huesman, et al., 2009). In the most
 73 conservative definition, industry reports used self-reported measures and classified student users as
 74 those who visited the facility at least weekly (Forrester, 2014; 2015). Another approach aimed to
 75 maximize the contrast between users and non-users excluded students in the nine to 34 visits range
 76 (i.e., between monthly and less than weekly), comparing non-users with ≤ 8 visits to users with ≤ 35
 77 (weekly) visits (Zegre et al., 2020). Table 1 outlines studies and their definitions of binary variable use.

78 **Table 1**

79 *Definitions of User as a Binary Variable in Recreation Facility Use Data*

Definition of user	Citation
One or more visits	Belch, et al. (2001); Kampf, & Teske (2013); Roddy et al. (2017)
Three or four or more visits	Meisner (2017); Zizzi et al. (2004)
> bimonthly (0.6x/wk., 10 visits)	Huesman, et al. (2007; 2009); Kampf, & Teske (2013)
> weekly (1.6x/wk., 25 visits)	Huesman, et al. (2007; 2009)
\geq weekly	Forrester (2014; 2015)
\geq weekly, excluding monthly to < weekly	Zegre et al. (2020)

Note. Per academic year (i.e., August through April).

81 **Use group categories**

82 In studies assessing campus recreation, facility use categories have been also been defined
 83 inconstantly (Table 2). Some studies used four categories (Belch et al., 2001; Roddy et al., 2017), one of
 84 which used quartile split (Roddy et al., 2017). Some defined users as those who visited weekly, including
 85 survey methods (Forrester, 2015) and methods pairing survey and facility use data (Brock et al., 2015).
 86 Non-users were less frequently analyzed, but often included those with low use. Non-users were
 87 classified as one visit (Das et al., 2021), less than four visits (Zizzi et al., 2004), or grouped in the low use
 88 group (Brock et al., 2015).

89 **Table 2**

90 *Definitions of Use Groups and Citation in Recreation Facility Use Data*

Citation	Use group & number of visits				
	<i>Low</i>	<i>Med-Low</i>	<i>Med-High</i>	<i>High</i>	<i>Very High</i>
Roddy et al. (2017) ^	1	2-6	7-20	20+	
Belch et al. (2001) ^	1-4		5-19	20-49 (1-2/wk.)	50+ (3+/wk.)
Zizzi et al. (2004)	<i>Non-user</i> < 4		<i>Infrequent</i> 1-2/wk.	<i>Frequent</i> 3+/wk.	
Forrester (2015)			<i>Light</i> 1-2/wk.	<i>Moderate</i> 2-4/wk.	<i>Heavy</i> 5/wk.
Brock et al. (2015)			<i>Low</i> 0-19 (<1/wk.)	<i>Moderate</i> 1-2/wk.	<i>High</i> 3+/wk.
Das et al. (2021)	<i>Non-users</i> 0-1	<i>Light</i> 2-16 (<1/wk.)	<i>Low</i> 17-32 (1-2/wk.)	<i>Med</i> 33-48 (2-3/wk.)	<i>Frequent</i> 49+ (3+/wk.)

^ Number of visits per semester verses per academic year; visits per week estimated by authors.

91 Given this lack of consistency in defining use, this research seeks to examine the relationship
 92 among different user definitions and estimates of academic outcomes. This research compares
 93 definitions of full-time, first time undergraduate student users and non-users of a campus recreation
 94 facility over a three-year timeframe, linking data on students' facility use, first-year retention, GPA, prior

95 academic achievement, financial aid, initial academic major declaration, first-generation status,
96 race/ethnicity, and gender.

97 **Methods**

98 This study analyzed data for three cohorts of full-time, first-time undergraduate students at the
99 main campus of a public land-grant research university in the Mid-Atlantic region between 2014 and
100 2017. We focus on retention and GPA outcomes for first-time, first-year undergraduate students
101 because many students at the study institution move off campus after the first year and may use other
102 recreational facilities, and future outcomes may depend on first-year usage as well as usage in future
103 years, complicating the analyses. Outcome variables included student retention from first-year fall to
104 second-year fall and first-year cumulative GPA (i.e., scale of 0.0 to 4.0). Full-time students were classified
105 as those with at least 12 credits in the fall or spring semester. The researchers' Institutional Review
106 Board allowed for collection of deidentified student data and reporting of aggregated statistical
107 relationships, linking institutional data as defined in IPEDS national reporting standards with facility use
108 card-swipe data enabled comparison of outcomes for participants and non-participants.

109 The modeling approach used in this study follows the approach used by Zegre et al. (2020). This
110 study uses both logit and ordinary least squares regression—depending on outcome variable—to assess
111 relationships between academic outcomes and participation definitions. Recreational facility (hereafter
112 “facility”) visits from facility use data (i.e., swipe card), August through April, represent the key
113 independent variable. It is important to note that the university in this study includes membership in
114 required student fees versus examining a facility with a fee-for-membership (Danbert et al., 2014). The
115 authors constructed approximations of the user definitions from previous studies using students' total
116 facility visits during their first year. Table 3 illustrates one potential grouping of facility users by
117 frequency of use, and Table 4 illustrates an additional approach to categorizing users with more
118 categories, allowing for comparison of several definitions from the literature. Statistical analyses in this

119 study incorporates indicators for each of the categories in Table 4 to demonstrate relationship between
 120 facility use in each part of the range and GPA and retention outcomes. Rates per week in Tables 3 and 4
 121 adjust accordingly if students attended the institution for only one semester during their first year.

122 **Table 3**

123 *Definitions of Use Groups and Sample Presence*

#	Use group	# of visits*	<i>n</i>	Percent (%)
0	Never used	0	2,157	14
1	Non-user	1 to < 1 per month	4,544	30
2	Infrequent	1 per month up to < 1 per week	4,839	32
3	Regular	1 per week up to < 2 per week	2,119	14
4	Frequent	2 per week up to < 3 per week	842	6
5	Heavy	3+ per week	578	4

124 *Note.* Per academic year (i.e., August through April), *n*=15,079

125 **Table 4**

126 *Binary User Definitions, Citations of Definition, and Sample Presence*

User definition	Citation(s)	<i>n</i>	Percent (%)
One visit	Belch et al., 2001; Kampf, & Teske, 2013; Roddy et al., 2017	1,078	7.15
Two or three	Misener, 2017	1,415	9.38
Four to eight	Zizzi et al., 2004	2,230	14.79
Monthly (9-17)	Huesman, et al, 2007; 2009; Kampf, & Teske, 2013	2,390	15.85
Bimonthly (18-34)	Huesman, et al, 2007; 2009	2,330	15.45
Weekly (35-69)	Forrester, 2014; 2015	2,085	13.83
Biweekly (70-104)	Huesman, et al, 2007; 2009	827	5.48
Triweekly (105+)	n/a	567	3.76

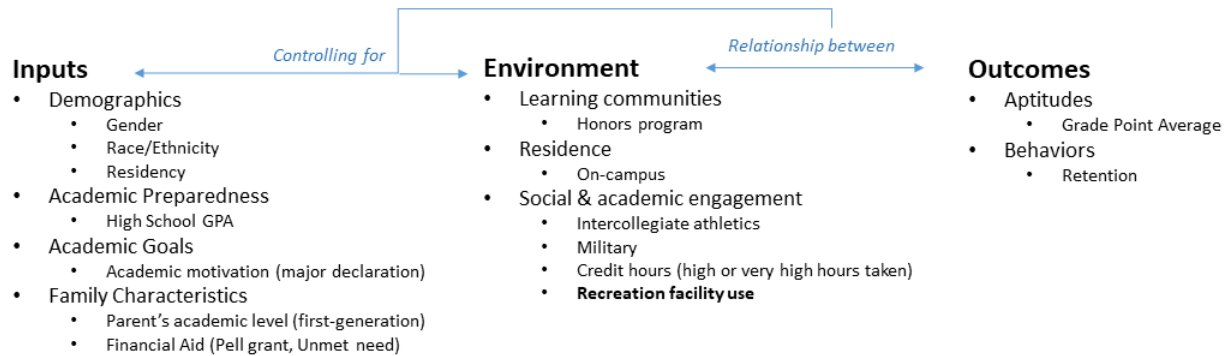
127 *Note.* Visits within academic year, August through April; *n*=15,079

128 Figure 1 highlights the conceptual model used, which is intended as a frame of reference for
 129 variable organization rather than an exhaustive list of influences on student outcomes. The model
 130 controlled for year, student demographics (gender, race/ethnicity, and state residency), academic
 131 measures (high school GPA, an indicator for having declared a major in the first term, and indicators for
 132 credit loads), first-generation status (based on parents' educational attainment), financial variables
 133 (students' unmet financial need and an indicator for having received a Pell Grant), and environmental
 134 factors (indicators were available for residential locations, honors program participation, military

135 affiliation, and intercollegiate athletics participation). Authors replicated results with concorded
 136 SAT/ACT scores versus high school GPA and yielded similar results with over 3,000 fewer observations so
 137 featured results using reported (non-normalized) high school GPA instead.

138 **Figure 1**

139 *Model of Student Outcomes Used in Analyses*



140 *Figure modified from Astin (1984) with concepts from Mayhew et al. (2016).*

141 *Note.* Adapted from Figure 2 in Zegre et al. (2020).

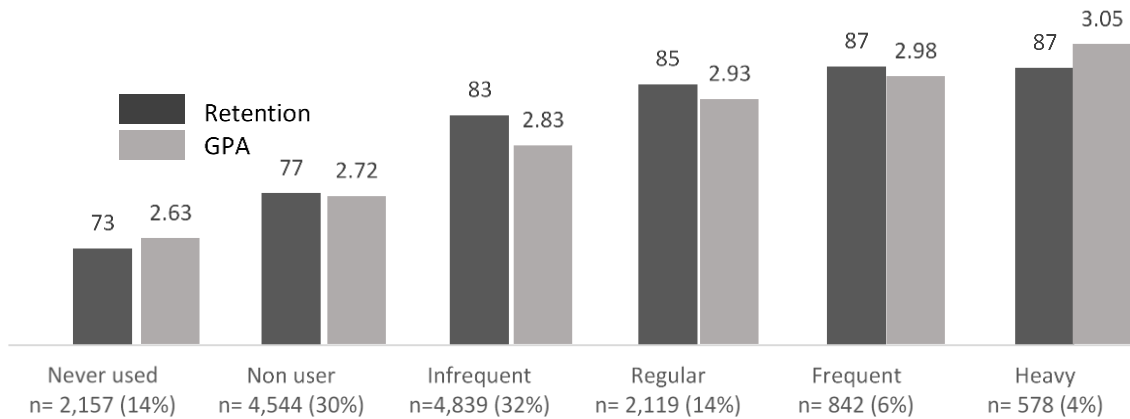
142 Any relationship between facility use and academic outcomes for the average student may
 143 differ from the relationships between use and outcomes for students with different characteristics.
 144 Thus, we also produced estimates between user definitions for student subsamples, maintaining the
 145 same regression model used for all students (Zegre et al., 2020). Subsample groups were broadly
 146 created to maintain a large enough sample for statistical analyses. For example, person of color (POC)
 147 includes the following: Black (not Hispanic), Asian, Hispanic, American Indian or Alaskan Native, Native
 148 Hawaiian or Pacific Islander, Two or More Races, and Unknown. We regressed the first-year retention
 149 outcome on each facility use increment for the following subsamples: female students, male students,
 150 people of color (POC), non-POC, students with high school GPA at or above 3.5, students with high
 151 school GPA less than 3.5, Pell Grant recipients, students who did not receive Pell Grant, first-generation
 152 students, and non-first-generation students.

153 **Summary statistics**

154 StataSE (2021) was used for statistical analyses. Summary statistics indicate increases in both
 155 outcomes with each ordinal use group increase. Figures 2 and 3 illustrate differences in outcomes across
 156 use categories (Figure 2) and finer-grained facility use increments (Figure 3) before introducing
 157 statistical controls.

158 **Figure 2**

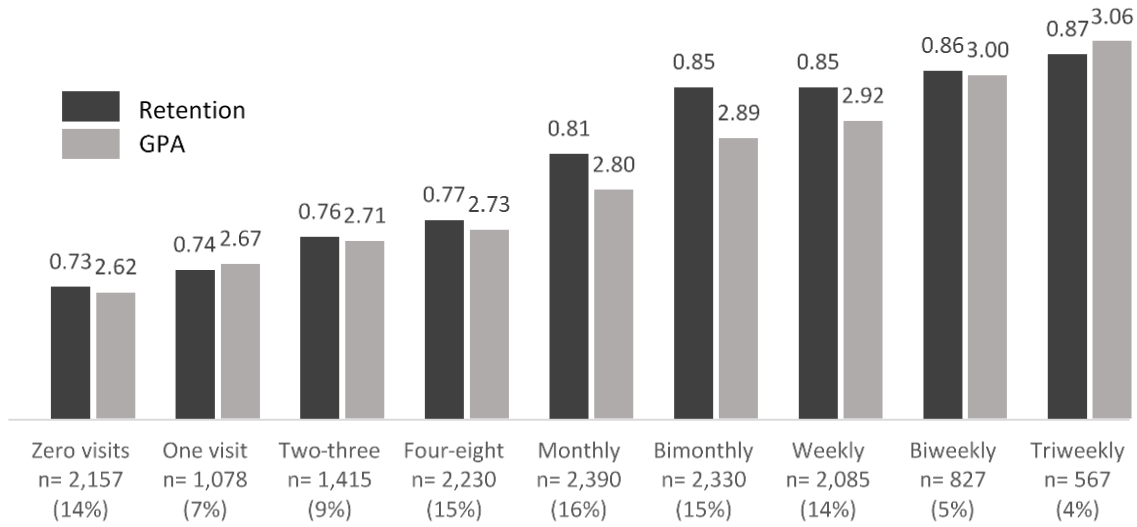
159 *Average First-Year Retention (in Percent, %) and Grade Point Average (GPA) by Facility Use Group for*
 160 *First-Time Undergraduate Students, 2014-2017*



161 *Note.* Mean GPA is 2.80, where scale is 0.0 to 4.0; Mean retention is 80%. Non-user = 1 to < monthly,
 162 Infrequent = monthly to < weekly, Regular = weekly to < biweekly, Frequent = biweekly to < triweekly,
 163 and Heavy = triweekly+.

165 **Figure 3**

166 *Summary Statistics of Facility Use by First Year Retention (in Percent, %) and Cumulative Grade Point*
 167 *Average (GPA) for First Time Undergraduate Students, 2014-17 (n=15,079)*



168
 169 *Notes.* Mean GPA is 2.80, where scale is 0.0 to 4.0; Mean retention is 80%. Monthly = 9-17, Bimonthly =
 170 18-34, Weekly = 35-69, Biweekly = 70-104, and Weekly = 105+ visits.

171 **RESULTS**

172 Results indicate that use at each increment in the possible definitions has a significant
 173 relationship with both academic outcomes. Holding all model variables constant, results show a positive
 174 and significant relationship among recreation facility use definitions and academic outcomes, including
 175 3.2 to 17.5 percentage points higher retention, and 0.07 to 0.53 higher GPA points, for users versus non-
 176 users for all user definition variables (Table 5).

177 **Table 5**

178 *Regression Results with Marginal Effects and Coefficients of Recreation Facility Use by User Definition*
 179 *and Academic Outcome for First Time Undergraduate Students 2014-2017*

User definition variable	Margins	Retention		Grade Point Average (GPA)		
		SE	p	Coeff.	SE	p
One visit	0.032	0.014	0.020	0.073	0.031	0.017
Two to three visits	0.038	0.013	0.004	0.087	0.029	0.002
Four to eight visits	0.060	0.012	<0.001	0.128	0.026	<0.001
Monthly visits (9-17)	0.097	0.012	<0.001	0.190	0.025	<0.001
Bimonthly visits (18-34)	0.134	0.123	<0.001	0.269	0.255	<0.001
Weekly visits (35-69)	0.146	0.128	<0.001	0.351	0.265	<0.001

Biweekly (70-104)	0.155	0.018	<0.001	0.437	0.342	<0.001
Triweekly (105+)	0.175	0.215	<0.001	0.530	0.394	<0.001

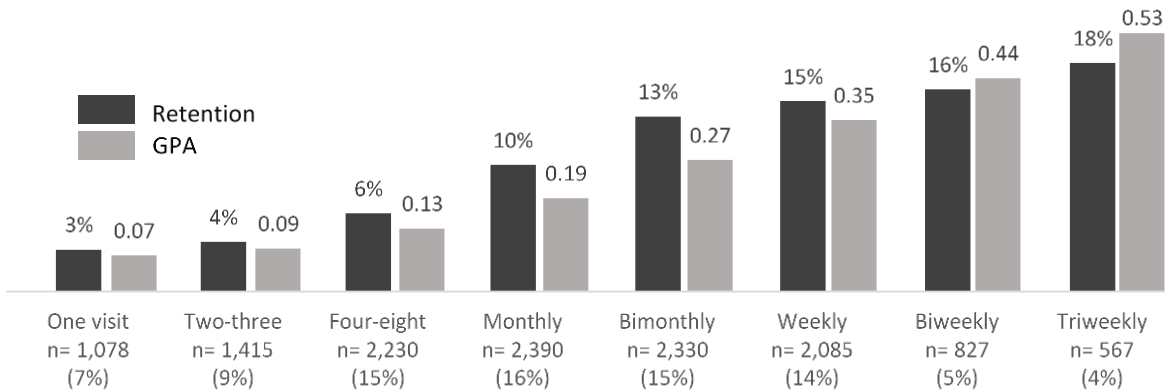
180 $n = 13,096$; Retention $R^2 = 0.124$; GPA $R^2 = 0.362$

181 *Notes.* GPA scale is 0.0 to 4.0. Values relative to students who did not use the facility. Model controlled
 182 for year, gender, race/ethnicity, residency, high school GPA, declaring a major in first term, credit loads,
 183 first-generation status, unmet financial need, Pell Grant receipt, residential location, military affiliation,
 184 and honors and intercollegiate athletics participation.

185 Marginal effects for retention and regression coefficients for GPA are both values relative to
 186 students who did not use the facility. All user definition variables report significant relationships with
 187 both outcomes; higher magnitudes for both outcomes are evident as use increases (Figure 4).

188 **Figure 4**

189 *Recreation Facility Visits and Academic Outcomes Relative to Students who Did Not Use the Facility for*
 190 *First Time Undergraduate Students, 2014-2017*



191 *Notes.* Grade Point Average (GPA) scale is 0.0 to 4.0. Marginal effects of first year retention; regression
 192 coefficients of cumulative GPA. Monthly= 9-17, Bimonthly = 18-34, Weekly = 35-69, Biweekly = 70-104,
 193 and Weekly = 105+ visits.

195 **Subsample analyses on first-year retention**

196 Findings from subsample analyses (Table 6) indicate that the smaller user definition variables
 197 (e.g., one visit, 2-3 visits) are not significant predictors of first year retention for the following
 198 subsamples: males, persons of color, first generation students (not pictured), Pell recipients (not
 199 pictured), and students with HS GPA above 3.5. Monthly to triweekly use levels were significant
 200 predictors of the retention outcome, but below monthly use did not predict significantly higher
 201 retention for persons of color or first-generation students. In addition, first year retention outcomes are
 202 higher compared to all students in the user definition variables of monthly through triweekly for
 203 students who are typically at risk for drop out (i.e., first generation students, lower HS GPA students,
 204 and Pell grant recipients). And, female students appeared to have larger marginal effects on retention
 205 for all user definitions except triweekly, relative to male students. In Table 6 we report the predicted
 206 marginal retention rates for all students and subsample by facility use definition. Reported marginal
 207 retention values are relative to students who did not use the facility.

208 **Table 6**

209 *Logit Regression Marginal Effects of Recreation Facility User Definition for First-Year Retention of First*
 210 *Time Undergraduate Students by Subsample, 2014-15 through 2016-17*

User definition	Female	Male	POC	Not POC	< 3.5 GPA	≥ 3.5 GPA	All Students
One visit	0.07*** (0.02)	-0.01 (0.02)	0.02 (0.05)	0.03* (0.01)	0.05 (0.02)	0.02 (0.02)	0.03* (0.01)
Two to three	0.05** (0.02)	0.02 (0.02)	-0.03 (0.04)	0.05** (0.01)	0.07** (0.02)	0.01 (0.01)	0.04** (0.01)
Four to eight	0.07*** (0.02)	0.05* (0.02)	0.05 (0.04)	0.06*** (0.01)	0.09*** (0.02)	0.04** (0.01)	0.06*** (0.01)
Monthly (9-17 visits)	0.11*** (0.02)	0.08*** (0.02)	0.11** (0.04)	0.09*** (0.01)	0.17*** (0.02)	0.04** (0.01)	0.10*** (0.01)
Bimonthly (18-34 visits)	0.17*** (0.02)	0.10*** (0.02)	0.08* (0.04)	0.14*** (0.01)	0.20*** (0.02)	0.08*** (0.01)	0.13*** (0.12)
Weekly (35-69 visits)	0.14*** (0.02)	0.14*** (0.02)	0.16*** (0.04)	0.14*** (0.01)	0.23*** (0.02)	0.08*** (0.01)	0.15*** (0.13)
Biweekly	0.18***	0.14***	0.16**	0.15***	0.25***	0.08***	0.16***

(70-104 visits)	(0.03)	(0.02)	(0.05)	(0.02)	(0.03)	(0.02)	(0.02)
Triweekly	0.15**	0.17**	0.17**	0.18**	0.32***	0.05*	0.18***
(105+ visits)	(0.05)	(0.03)	(0.06)	(0.02)	(0.04)	(0.02)	(0.22)
Observations	6,448	6,648	2,020	11,076	5,969	7,114	13,096

211 *Notes.* Grade Point Average (GPA) scale is 0.0 to 4.0. Observations for GPA subsamples less than
 212 observations for all students due to missing GPA data. Standard errors in parentheses. User definition
 213 based on visits in academic year. Values relative to students who did not use the facility. Person of color
 214 (POC) includes the following: Black (not Hispanic), Asian, Hispanic, American Indian or Alaskan Native,
 215 Native Hawaiian or Pacific Islander, Two or More Races, and Unknown. Results for Pell Grant recipients,
 216 students who did not receive Pell Grants, first-generation students, and students who were not first-
 217 generation are available upon request.
 218 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Significant coefficients bolded.

219 **Discussion**

220 Results in Table 5, Figure 4, and Table 6 illustrate positive relationships between frequency of
 221 use and both outcomes. Results suggest retention rates 3.2 percentage points higher for students with
 222 one visit up to 17.5 percentage points higher for students who visited three times per week, conditional
 223 on control variables (Table 5 and Figure 4) and relative to a baseline retention rate of 73 percent for
 224 students who never visited the recreation facility (Figure 3). Results illustrate GPAs 0.07 points higher for
 225 students with one visit up to 0.53 points higher for students who visited three times per week,
 226 conditional on control variables and relative to a baseline 2.63 GPA for students who never visited the
 227 recreation facility. Findings from subsample analyses (Table 6) suggest that relationships between
 228 frequency of use and retention are largest for students with high school GPAs below 3.5 and female
 229 students; students who were not persons of color had larger positive relationships between frequency
 230 of use and retention for use up to eight total visits in a year. Facility use at nine visits or above per year
 231 (i.e., at least monthly) was positively and significantly associated with retention for all student

232 subgroups, holding control variables constant. Previous research established a relationship between
233 facility use and academic outcomes (Belch, et al. 2001; Forrester, 2004; Huesman et al., 2007, 2009;
234 Kampf, & Teske, 2013; Roddy et al., 2017; Zizzi et al., 2004; Zegre et al., 2020), but does not examine
235 differences between user definitions. This data-driven approach seeks to contribute to practically useful
236 and statistically informed means of defining users in campus recreation facility use for research and
237 assessment purposes. We explore the implications of these results through the questions below.

238 *Going once...should we stop counting single users?* Although previous research on value of
239 campus recreation using facility entry data has mostly counted those who have participated only once as
240 users (Belch, et al., 2001; Kampf, & Teske, 2013; Mayers, 2017; Roddy et al., 2017), we question the
241 practical and statistical implications of counting individuals with single visits as users. For the full sample
242 in Table 5, students with exactly one visit had a retention rate 3.2 percentage points higher and GPA
243 0.073 percentage points higher relative to students with zero visits, conditional on control variables;
244 however, the mechanism through which only one visit might increase retention or course grades is not
245 clear. Although the model controlled for many potentially confounding factors like high school GPA and
246 financial aid, the authors emphasize that regression using secondary data cannot eliminate the possible
247 influence of unobserved variables that may differ across levels of facility use, including familiarity with
248 other campus resources, other health behavior, time spent working in jobs, time management, and
249 choice of academic major. For example, students with only one facility visit may also have more visits to
250 libraries or other academic resources relative to students with no facility visits, and relationships with
251 outcomes would reflect these additional differences if they are not captured in the statistical model.
252 Different estimated relationships between use and outcomes in the subgroup analyses may reflect
253 different effects of facility use on outcomes for students with different characteristics or may suggest
254 that unobserved differences between users and non-users are larger for some specific subgroups.
255 Considering this, we do not make causal claims about the relationship between facility use and

256 outcomes, in particular in the context of single visits. Instead, we point out average relationships holding
257 model control variables constant.

258 Professionals should consider alternatives to using unique visits (i.e., those who visit the facility
259 at least once) to classify a user when assessing use impacts. However, unique visits remain important for
260 counting and assessment purposes. Given the potential practical usefulness of the category for
261 evaluative use, we suggest reserving a dedicated category for only single-use users. If, for example,
262 managers would like to learn the number of students that visit once then never return—and reduce that
263 number—then that category should be used in grouping users.

264 *Are more use group categories better?* Estimated relationships between the two outcomes and
265 each of the eight use increments illustrates the relative importance of each level of use. These analyses
266 also go beyond past research to illustrate differences between increments and potential benefits gained
267 from adding more categories. Campus recreation professionals may want to know differences, for
268 example, between students who have never used the facility and students who have only used it once.
269 Alternatively, those who visit infrequently could be the target of new programming and follow-up
270 evaluation with a goal to “move them up” to higher levels of use and potentially improved outcomes.
271 The original categories in these analyses are practically useful and statistically significant; however,
272 authors suggest using categories as recommended in Table 7. Designed to correspond to the facility use
273 groups, fixed-scale survey choices decrease response burden and increase data entry ease, as well as
274 reliability and validity (Vaske, 2008). Given a higher use category may exist in other data, future surveys
275 may want to include a distinct category of “four or more times a week” to explore the limits of
276 maximum use. Outreach strategies such as advertising facilities’ serving offerings, bringing tour groups,
277 and offering fee waivers might be employed to attempt to increase facility use for students at particular
278 use levels or in certain subgroups, and use levels and later outcomes can be compared with those for

279 students who do not receive the same outreach (Oreopoulos, 2020). For example, although we did not
 280 have enough years of data to examine degree completion, this would be worthwhile in future research.

281 **Table 7**

282 *Proposed Recreation Facility Use Categories*

#	Use group	# of visits from facility data	Survey choices
0	Never used	0	Never
1	One visit	1	Once
2	Two to three visits	2-3	2-3 times
3	Four to eight visits	4-8	4-8 times
4	Monthly	9-17	Once a month
5	Bimonthly	18-34	Twice a month
6	Weekly	35-69	Once a week
7	Biweekly	70-104	Twice a week
8	Triweekly	105+	Three or more times a week

283 *Notes.* Per academic year (i.e., August through April). Corresponding survey questions may ask for
 284 semester or monthly use; questions that ask for weekly use may not capture less frequent users.

285 Researchers could also consider excluding a middle portion of the sample to clearly differentiate
 286 users and non-users when estimating differences in outcomes. Although Zegre et al. (2020) argued
 287 infrequent users (i.e., monthly to less than weekly) should not be classified as users in binary use
 288 analyses, the relationships and magnitudes of both outcomes are significant and large at monthly and
 289 bimonthly use in the present study (i.e., relationships with retention rates between 9.7 and 13.4
 290 percentage points and relationships with GPA between 0.19 and 0.27 grade points), suggesting
 291 bimonthly use could be important to consider in the user group. Future research should examine
 292 continue to examine the sensitivity of binary user/non-user distinctions to the frequency of visits
 293 needed to be counted as a user.

294 *What defines heavy use?* Forrester (2015) defined heavy users as students who used a
 295 recreation facility five times weekly. The present study’s categorization grouped together all students
 296 who visited the facility at least three times per week in the triweekly category (including students who
 297 used the facility four or five times per week). In the present study’s single-institution sample, under four

298 percent of students used the facility three or more times per week. At other institutions, more students
299 might use recreational facilities at this frequency, and pooling data together from multiple institutions
300 might yield more data for students using facilities four or five times per week. These would help to
301 differentiate relationships with outcomes for students at higher and less-common frequencies of usage.
302 In addition, Forrester's (2015) measurement drew on student survey responses and the present study's
303 measure relies on data from card swipes upon facility entry. Facility entry data are imperfect measures
304 of usage, and may not include activities like outdoor recreation, club or intramural sports participation.
305 Facility entry data also does not account for students accessing the facilities for work, spectating, classes
306 (although no academic classes were held in the facility studied), or just to take a shower. Additionally,
307 entry data did not capture duration or intensity of visits, which could prove interesting in future studies.

308 Despite these limitations, swipe card data from actual behavior offer some advantages related
309 to recall and removes some measurement error associated with response and non-response bias survey
310 non-response (e.g., students' estimates of use to be higher than actual use, and students who do not
311 use the facility and who do not respond to the survey). Emerging technologies like smartphone apps and
312 digital check-ins can be used to capture behavior and generate use data. Using actual student behaviors
313 can help universities better understand institutional retention; engagement measures, for example,
314 could be added to prediction models to improve identification of at-risk students, explore social
315 networks, and predict retention outcomes (Blue, 2018; Jutting, 2013).

316 Authors suggest practitioners and researchers use at least the triweekly use category –perhaps
317 including another category of four or more times a week– given results that triweekly use was a
318 significant predictor of both retention and GPA. Future research could use a sensitivity analysis to define
319 thresholds in different groups and could integrate graduation or health and wellness outcomes. Given
320 limitations in generalizability, authors suggest future analysis examine definitions of heavy use across
321 institutions, specifically how many visits defines maximum use. Beyond frequency, there is value to

322 knowing activity type and visit duration; attention should be given to limitations in capturing, reporting,
323 and analyzing these data using industry-standard data collection and reporting platforms.

324 *Then, what should we call a user?* Practitioners and researchers must define users for varying
325 objectives like goal setting, reporting, assessment, and research. Findings from the present study are
326 consistent with results from Huesman et al. (2007, 2009), who used a multivariate model and found
327 first-year retention greater than the mean at a range of facility visits from 10 to 12 days, slightly over
328 bimonthly use. Just because the academic outcomes were greater than the mean at bimonthly facility
329 use does not speak to health and wellness outcomes which should be examined simultaneously in the
330 future. Given bimonthly user variable was a significant predictor of retention in all students and
331 subsample analyses, as well as GPA, authors suggest using and examining this bimonthly user definition
332 and category.

333 In the present study, retention and GPA outcomes continued to suggest positive relationships
334 with higher usage increments through at least three times per week, so multi-institution studies with
335 larger samples might shed light on a level at which apparent benefits begin to level out. Targeted
336 outreach using treatment and control groups might also help to uncover the extent to which
337 unobserved differences between non-users, users, and heavier users influence estimated relationships
338 with outcomes. For goal setting and reporting, authors suggest practitioners use three different user
339 definitions: (a) unique users (one or more visits), (b) bimonthly use (~10 plus visits per academic year),
340 and (c) weekly use (35 plus visits per academic year). Using three definitions can help identify students
341 at differing use levels for strategic goal setting and assessment.

342 *Can we assume facility use has the same relationship with outcomes for all users?* Subsample
343 analyses indicates different magnitudes and significance of outcomes across user definition thresholds.
344 For example, non-significant relationships between use and outcomes below monthly use for students
345 who are persons of color or first-generation may indicate differences across student subgroups. In

346 addition, first-generation students, students receiving Pell Grants, and students with high school GPAs
347 below 3.5 had larger positive relationships between each increment of use, up through triweekly use,
348 relative to other students. These subsample findings suggest that students at higher risk of departure
349 may have higher marginal effects from facility use (Zegre et al., 2020). As above, this may be due to
350 differences in the relationships between use and outcomes across subgroups or differences in
351 unobserved variables across subgroups. Any efforts to promote facility use should assess effectiveness
352 in increasing visits and improving outcomes especially for underrepresented students.

353 **Conclusion**

354 How future researchers and practitioners define participants should depend on the goal, so
355 practitioners should consider their needs. There is value in comparing, for example, students visiting
356 once to those who visit weekly. Ideally, higher education professionals would set participation goals
357 without using an arbitrary target for participation. Rather, practitioners and researchers can use
358 definitions informed by data-driven approaches. Practitioners should consider standardizing user
359 definitions for generalizability and comparability across institutions and studies.

360 Given studies assessing the value of campus recreation define users and their groups differently,
361 this paper contributes to the field by offering a compilation of previous studies' definitions, as well as
362 data-driven analyses of a single institution's use data. This study reinforces previous user definitions and
363 provides a foundation for future research considerations at both single and multiple institutions. This
364 study serves as a case study for swipe card data to reconcile different user definitions for different users
365 in campus recreation but can inform different campus participations. A critical next step is a multi-
366 institutional analysis, using a data-driven approach to help standardize user definitions. Although some
367 survey research has investigated the relationship between campus recreation participation and
368 indicators of health and wellness (Brock et al., 2015; Ellis et al., 2002; Forrester, 2015), a multivariate,
369 data-driven approach using entry data could further illuminate the seemingly unidentified intersection

370 among use variables and higher education outcomes. Additionally, a working group could review
371 literature and objectives, compare use and outcome data across institutions, and consider common
372 definitions across methods. Higher education professionals should consider how participants are
373 counted and defined to make informed goals and quantify value.

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