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# The Effect of a Group Physical Activity Program on Behavior of Incarcerated Youth

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## Abstract

Behavioral health challenges are more prevalent in incarcerated youth than in the general youth population. Questions remain regarding whether physical activity programs can reduce behavioral health challenges in incarcerated youth. Data were available for 1,285 youths incarcerated between January 2017 and December 2018. The structured exercise program was implemented in January 2018. Primary outcomes were numbers of use of force (UoF) and of program modifications (PMs) indicative of delinquent behavior in pre- and post-exercise implementation periods. Rates per 1,000 person-days for UoF (10.0 in 2017 vs. 7.4 in 2018) and for PMs (36.7 vs. 22.9) were statistically different. For youths incarcerated both years, rates per 1,000 person-days for UoF (12.3 vs. 7.9), and for PMs (43.3 vs. 23.5) were statistically different. There was a reduction in behavior modifications in incarcerated youths after implementing the exercise program, but further studies are needed to confirm these results.

**Keywords:** adolescents, juvenile detention, exercise, health, physical activity

## Introduction

The United States has the highest proportion of incarcerated youth of any developed country (Barnert *et al.*, 2017). Incarcerated youth are disproportionately racial and ethnic minorities (Abram *et al.*, 2017). The Census of Juveniles in Residential Placement Databook, 2017 reported 43,500 incarcerated youth, of which 34% were White, 42% Black, 22% Hispanic, and 2%–3% American Indian, Asian, or Pacific Islander (National Center for Juvenile Justice, 2018).

Incarcerated youth are a vulnerable population for behavioral, mental, and physical health disorders. Forrest *et al.* (2000) show that incarcerated youth have higher

morbidity and mortality than the general adolescent population. Barnert *et al.* (2017) found that the cumulative incarceration duration for adolescents and young adults (<25 years) was associated with worse adulthood physical and mental health.

Youth in detention are more likely to have mental health disorders than age-equivalent youth in the general population (Fazel *et al.*, 2008). Conduct disorder prevalence is 10–20 times higher for girls and 5–10 times higher for boys; major depression is 4–5 times higher for girls and 2 times higher for boys; and psychoses are 10–20 times higher, with attention deficit hyperactivity disorder 2–4 times higher compared to general population youth.

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A longitudinal study found that 12 years after detention, females had more positive outcomes than males and White males were more likely to achieve positive life outcomes when compared to Black or Hispanic youths. Positive outcomes in this study referred to educational attainment, residential independence, gainful activity, desistance from criminal activity, mental health, abstaining from substance abuse, interpersonal functioning, and parenting responsibility (Abram *et al.*, 2017).

Mental health disorders incidence and adverse childhood event exposures are higher in incarcerated adolescents than the youth general population and may be associated with disruptive behavior (Barnert *et al.*, 2017). Detention center programming that improves the behavioral outcomes of incarcerated youths is important for this population.

Physical activity (PA) has been shown to prevent and treat mental and physical health conditions in youth (Centers for Disease Control and Prevention [CDC], 2022b). However, physical inactivity is a growing public health issue for adults and youth (Grant *et al.*, 2014). The U.S. Department of Health and Human Services (2018) recommends 60 minutes of moderate-to-vigorous PA for children and adolescents (6–17 years old) daily. As part of the 60 minutes, at least 3 days a week, youths should participate in vigorous aerobic activity and muscle and bone strengthening. Most U.S. youths do not meet the recommended activity levels. CDC reports that only about 24% of 6- to 17-year-olds met this recommendation (CDC, 2022a).

PA improves depressive symptoms in adolescents (Carter *et al.*, 2016). A systematic review included 30 studies on PA in youths published between 1980 and 2017 (Pascoe *et al.*, 2020). There is some evidence that PA improves mental health and could be used as an early intervention strategy. Lubans *et al.* (2016) identified evidence for several possible mechanisms. The strongest evidence was that improvements in physical self-perceptions induced by PA may enhance self-esteem and well-being (e.g., self-concept).

In addition, regular PA may influence cognition and well-being in youth through structural and functional changes in the brain, such as improved circulation and endorphins release. PA may also improve sleep, emotional regulation, and coping skills. Parker *et al.* (2019) showed the effectiveness of a brief PA intervention (denominated IMPACT trial) on youth depressive symptoms when compared to psychoeducation.

Youth in the juvenile justice system average 43.3 (standard deviation [SD] = 21.6) minutes of moderate-to-vigorous PA per weekday compared to the national guidelines recommending 60 minutes of moderate-to-vigorous aerobic PA per day (Brusseau *et al.*, 2018). Under- or untreated mental health disorders in incarcer-

ated youth may also contribute to the lower physical health status in this population (Barnert *et al.*, 2017).

Due to the living and security requirements of juvenile detention centers, youths in this setting generally have fewer opportunities for PA. MacMahon and Gross (1988) found that incarcerated youths who participated in an aerobic exercise program had greater improvement in self-concept, depressive symptoms, and fitness measures when compared to participation in less vigorous activity. Clark (2015) reported that organized training programs were more effective for improving fitness levels in children and adolescents when compared to general PA programs. Brusseau *et al.* (2019) tested the Sports, Play, and Recreation for Kids program in 86 incarcerated adolescent males (mean age 17 years) over a 9-month period and found a consistent reduction in sedentary time at 24 weeks, but a return to the baseline levels at the end of 36 weeks.

Faulkner *et al.* (2007) noted additional challenges to PA programs for incarcerated youth, reporting that vigorous PA involving power sports (e.g., boxing, wrestling, and martial arts) might be associated with delinquent behavior in male adolescents. PA programs for incarcerated youth require careful planning for developmentally and individually appropriate activities. Challenges to increasing PA include high-security facilities, tight schedules, behavioral issues, low participant cooperation, decreased motivation, lack of emergency services, parental presence for consent, effective PA programs, and unprepared facility staff (Barnert *et al.*, 2017).

In 2014, a local nonprofit organization called Upower started trauma-informed PA classes for underserved youths in Washington State. Coaches received training in trauma-informed and sport coaching practices. In December 2017, the program was implemented in a juvenile detention center to provide the youths with appropriate PA. The PA program was implemented as a part of the school day in 1-hour blocks equivalent to one period. Youths had the opportunity to participate in the program four to five times per week.

Each structured class began with a restorative circle, allowing program staff to check in with the youths, connect, and build relationships. Next, staff led youths in a dynamic workout, ranging from aerobic exercise, strengthening, and endurance training to skills-building. Every class ended with a group PA game. The class is intended for youths to learn ways to cope with trauma and build toward their future through structured workouts, team-building games, and staff support, with an emphasis on building social confidence, emotional regulation, positive identity, and leadership skills.

The study objective was to assess the effectiveness of this trauma-informed PA program in reducing the frequency of two methods of behavioral modification (BM) indicative of delinquent behavior used in the

juvenile detention center: use of force (UoF) and program modifications (PMs). UoF is defined as a detention staff member physically touching or placing hands on youths to break up fights or prevent youths from harming themselves or others. PMs refers to adjustments in the youths' programming schedule in response to maladaptive behavior. Examples of behaviors resulting in a PM range from minor infractions such as disrespect, disobedience, defiance of staff, or verbal altercations to major infractions such as arson, assault, or security breaches.

In this study, we compared the rates of these two BMs before and after the implementation of the Upower program. The research hypothesis was that the trauma-informed exercise program would be a potentially effective way to improve youth behavior, decreasing need for BMs (UoF and PMs) after implementation of the exercise program when compared to the pre-implementation period.

### Method

This was a secondary analysis of an existing administrative de-identified database on incarcerated youth. The study was reviewed by the university Institutional Review Board Human Subjects Division, which determined it was exempt status.

The trauma-based PA program was implemented at the facility in January 2018. Before the implementation, no organized fitness programming was offered, only open gym and free play for an hour a day in a basketball court. The following data were available for each incarceration that occurred in the facility: age, sex, race/ethnicity, length of stay (LoS), and the number of UoF and PMs during the incarceration. In addition, starting in 2018, data on the number of days of potential exposure to the trauma-based PA program were available for some youths.

Some youths were incarcerated multiple times and could have been in the facility in periods before and after the implementation of the program. Although there were no identifiers other than a study number, youths incarcerated in both time periods received the same study number before de-identification in the database and their records could be compared. Youths incarcerated starting in January 2018 were invited to participate in the program but could decline participation if they wished.

The number of days exposed to Upower was defined by the number of days a youth was able to participate. There were missing values for days of exposure to Upower, and it was not always clear whether a missing value represented a missed opportunity to collect the data or if it meant that the youth was not exposed to the Upower program at all (zero days of exposure).

With the available data, exposure to Upower was evaluated in two ways in order to explore its potential effect on BMs. First, UoF and PM rates of occurrences were compared between all youths incarcerated in 2017 (be-

fore implementation) and all incarcerated in 2018 (after implementation). This approach considers the change in rates at the population level and treats the two cohorts as two different populations (even if some youths were present in both cohorts). The second approach takes advantage of the data for youths who were incarcerated in both years and addresses the change in rates at the individual level. The details of the two approaches are explained below.

To evaluate the frequency of UoF and PMs, the number of youths and their respective LoS needed to be considered. For example, longer LoS might lead to more opportunities for UoF and PMs; therefore, the statistical analysis controlled for the time of incarceration. This was done using incidence rates defined as the ratio of the number of UoF or PMs that occurred during the year by the sum of the days spent in incarceration for all individuals incarcerated during that year. The denominator of the ratio is called "person-days" and was the time during which a youth is "at risk" of experiencing UoF or PMs. This approach assumes a Poisson distribution for the number of occurrences of an event per a certain period of time. For a more detailed definition, see Gertsman (2013).

At the population level, the rate of UoF in the year before implementation of Upower (2017) and during the first year after implementation (2018) per 1,000 days of incarceration was calculated. If the rate in 2017 is higher than in 2018, the ratio will be greater than 1. If the rates are the same, the ratio is 1, and if the rate in 2017 is smaller than in 2018, the ratio will be smaller than 1. To test whether the ratio is statistically different from 1, a ratio test using the software RStudio macro "rateratio," in help files for R *Testing the Ratio of Two Poisson Rates*, was performed (Fay, 2022). A similar analysis was performed for PM rates.

For the subgroup of youths who were incarcerated during 2017 and 2018, the data were analyzed in two ways. First, the rates at the group level using the ratio test as described above were compared. The rates of each individual before and after implementation of the PA program using paired *t*-tests were also used to compare the individual rates per 10 person-days of incarceration.

Some youths were incarcerated for a very brief length of time, and if the incarceration was in 2018, they were not in the facility long enough to have an opportunity to participate in the PA program. Therefore, as a sensitivity analysis, the above analyses were performed for all individuals in the sample, and then repeated for individuals who had at least 2 days of incarceration (in both cohorts) to adjust for the time needed for PA program exposure.

Significance level was set at 0.05 for each test, and no multiple comparisons of adjustment were made. Analyses were performed using SPSS version 26 for Mac and RStudio version 1.1.383.

### Ethics Approval and Consent to Participate

The study was reviewed by the University of Washington Institutional Review Board Human Subjects Division, which determined it was “non-human subjects.” Therefore, no consent was sought for this retrospective study.

### Results

In total, 1,285 unique youths ages 12–18 years old were incarcerated at least one time in either 2017, 2018, or both years. Table 1 shows the demographic characteristics of the youths and LoS data availability. There were 532 unique individuals incarcerated in 2017 only, 435 in 2018 only, and 318 in both years. In the latter group, only 294 had data on LoS during both incarceration periods.

Age was not consistently recorded in the administrative databases available for this study, and only a subset was reported. For both periods, most youths were male and 43% were Black, 18% were Hispanic, 27% were White, 10% were Native American or Asian/Pacific Islander, and 2% were unknown race. Individuals incarcerated in 1 year only had similar distributions of race, whereas those incarcerated in both years had lower percentages of White and Black and higher percentages of Hispanic, Asian/Pacific Islander, and unknown race.

**Table 1. Demographic Characteristics of Youths by Period of Incarceration**

	Incarceration period		
	2017 only	2018 only	Both periods
Number of youths	532	435	318
Number with LoS available in 2017	532	N/A	294
Number with LoS available in 2018	N/A	435	294
LoS in days, 2017, mean (SD)	26.3 (46.3)	—	53.0 (64.1)
LoS in days, 2018, mean (SD)	—	32.5 (55.1)	85.8 (99.4)
Age			
Number with missing age	530	356	190
Number with valid age	2	79	128
Mean age (SD)	17.0 (1.4)	15.2 (1.3)	15.7 (1.0)
Sex, % males (no missing values)	70.3	73.6	73.3
Race/ethnicity, % in each category			
Black	43.0	43.4	40.3
White	29.1	29.2	18.2
Hispanic	17.7	17.2	21.7
Asian/Pacific Islander	6.0	5.7	8.5
Native American	3.8	3.7	3.8
Unknown	0.4	0.7	7.5

LoS, length of stay; SD, standard deviation.

Table 2 shows the comparison of rates of UoF and PMs in the pre- and post-PA program implementation periods for all youths and those with at least 2 days of incarceration only. Mean LoS is high in both cohorts in both analyses. Note, however, that the medians were much smaller than the means, indicating that the high means are due to a smaller number of individuals who have longer LoS.

Also, when youths who had less than 2 days of incarceration were excluded, the rates of UoF or PMs were similar to the entire cohort, except for youths in 2018 experiencing PMs when incarcerated 2 days or more, which is smaller than in the entire 2018 cohort. In both analyses, the rates of UoF and PMs are statistically smaller in 2018 than in 2017. In the analysis adjusting for LoS, rates of UoF per 1,000 person-days were 10.0 in 2017 and 7.4 in 2018 ( $p < .001$ ), whereas rates of PMs were 36.7 and 22.9, respectively, ( $p < .001$ ).

Table 3 shows the analysis for youths who were incarcerated in both years, comparing them at the cohort level (year of incarceration). This subset of youths has a substantially higher LoS on average and median than the overall cohorts shown in Table 2. However, these youths had a decrease in their rates of UoF and PMs per 1,000 person-days. For the subgroup with LoS of 2 days or longer, rates per 1,000 person-days of UoF were 12.3 in 2017 and 7.9 in 2018 ( $p < .001$ ), whereas rates of PMs were 43.3 in 2017 and 23.5 in 2018 ( $p < .001$ ).

Table 4 shows the comparison of UoF and PMs rates within individuals, from 2017 to 2018. For this analysis, a rate per 10 person-days was used since LoS for each youth was used. The mean change for UoF of an individual youth was  $-0.02$  ( $SD = 0.24$ )—that is, 0.02 fewer UoF per 10 days of stay—in 2018 compared to 2017 (95% confidence interval [CI]:  $-0.11$  to  $0.07$ ). Mean change in PMs rate for an individual youth was  $-0.14$  ( $SD = 0.74$ )—that is, 0.14 fewer PMs per 10 days of stay—in 2018 compared to 2017 (95% CI:  $-0.22$  to  $-0.01$ ), and that change was statistically significant ( $p = .04$ ).

Table 4 also presents the percentage of individuals for whom the rates of UoF and PMs decreased, increased, or stayed the same. For UoF, the percentage of individuals for whom the rates decreased was similar to the ones for whom they increased. However, for PMs, the rate decreased for a larger percentage of individuals compared to those for whom it increased or remained the same.

### Discussion

The findings of this study should be considered preliminary and exploratory due to dataset limitations and confounding factors described. The rates of UoF and PMs were lower in 2018, when the trauma-informed PA program was implemented, compared to the prior year. For youths who were incarcerated in both the year before program implementation and after, only PMs rates were statistically smaller after Upower program implementation.

**Table 2. Comparison of Rates of Use of Force and Program Modifications in the Pre- and Post-Physical Activity Program Implementation Periods at the Cohort Level**

	<i>Cohort of incarceration</i>		<i>p (ratio test)</i>
	<i>2017</i>	<i>2018</i>	
Analysis including all individuals			
Sample size <sup>a</sup>	826	729	
LoS in days, mean (SD)	35.8 (54.8)	54.0 (80.5)	
Median (min, max)	9.7 (0.1, 569.5)	18.1 (0.01, 666.4)	
Person-days at risk <sup>b</sup>	29,603.6	39,354.1	
Number of events: “use of force”	304	300	
Number of events: “program modification”	1,117	904	
Rate per 1,000 person-days for			
UoF	10.3	7.6	<.001
PM	37.7	30.0	<.001
Analysis including individuals with LoS ≥2			
Sample size <sup>a</sup>	606	556	
LoS in days, mean (SD)	48.5 (59.1)	72.5 (86.1)	
Median (min, max)	28.1 (2.0, 569.5)	46.0 (2.0, 666.4)	
Person-days at risk <sup>b</sup>	29,382.9	39,166.3	
Number of events: “use of force”	294	289	
Number of events: “program modification”	1,079	896	
Rate per 1,000 person-days for			
UoF	10.0	7.4	<.001
PM	36.7	22.9	<.001

<sup>a</sup>Individuals who were incarcerated in both periods contributed to both periods separately.

<sup>b</sup>Person-days at risk = sum of the LoS in days of all individuals, which is equivalent to the number of person-days at risk for the event of interest (UoF or PM).

PM, program modification; UoF, use of force.

**Table 3. Comparison of Rates of Use of Force and Program Modifications in the Pre- and Post-Physical Activity Program Implementation Periods for Individuals Incarcerated in Both Years**

	<i>Year of Incarceration</i>		<i>p (ratio test)</i>
	<i>2017</i>	<i>2018</i>	
Analysis including all individuals			
Sample size <sup>a</sup>	294	294	
LoS in days, mean (SD)	53.0 (64.1)	85.8 (99.4)	
Median (min, max)	34.8 (0.1, 569.4)	52.8 (0.2, 666.4)	
Person-days at risk <sup>b</sup>	15,587.9	25,220.7	
Number of events: “use of force”	193	207	
Number of events: “program modification”	685	594	
Rate per 1,000 person-days for			
UoF	12.4	8.2	<.001
PM	43.9	23.6	<.001
Analysis including individuals with LoS ≥2			
Sample size <sup>a</sup>	227	227	
LoS in days, mean (SD)	66.7 (66.6)	102.8 (104.7)	
Median (min, max)	53.8 (2.0, 569.3)	72.8 (2.0, 666.4)	
Person-days at risk <sup>b</sup>	15,142.8	23,332.2	
Number of events: “use of force”	186	185	
Number of events: “program modification”	656	549	
Rate per 1,000 person-days for			
UoF	12.3	7.9	<.001
PM	43.3	23.5	<.001

<sup>a</sup>Individuals who were incarcerated in both periods contributed to both periods separately.

<sup>b</sup>Person-days at risk = sum of the LoS in days of all individuals, which is equivalent to the number of person-days at risk for the event of interest (UoF or PM).

**Table 4. Differences in Rates of Use of Force and Program Modifications for Youths Incarcerated in Both Periods for 2 or More Days ( $n = 227$ ), on Individual Level**

	<i>Difference in rates per 10-person days (second to first period)</i>	
	<i>Use of force</i>	<i>Program modification</i>
Mean (SD)	−0.02 (0.24)	−0.14 (0.74)
Median (min, max)	0.00 (−1.40, 1.35)	0.00 (−3.31, 4.08)
95% CI for mean difference <sup>a</sup>	−0.11 to 0.07	−0.22 to −0.01
<i>p</i> for paired <i>t</i> -test for mean difference = 0	.64	.04
Change in rates (% in category)		
Decreased rate	25.6	39.6
Stayed the same	51.1	32.2
Increased rate	23.3	28.2

First period: year 2017, second period: year 2018.

<sup>a</sup>95% CI calculated using 1,000 bootstrap samples. CI, confidence interval.

The secondary data analysis using the administrative database could not answer definitively whether the implementation of a trauma-informed PA program decreases the rates of UoF and PMs for incarcerated youths. However, whether using the information at cohort or individual level, and whether adjusting for LoS or not, the observed changes in rates were encouraging. Future research should incorporate a control group not exposed to PA program and prospective data collection to evaluate PA program effect on UoF and PMs.

Limitations include that for some variables, there was missingness of data. This was because demographics data were collected for administrative purposes and not for this specific study. In our analyses, when we compared rates per person-days at the cohort level, we assumed that Upower might have had an effect on the youths even when they did not directly participate, and that effect would be reflected in the overall rate of the entire cohort. It is possible that policy changes surrounding UoF and PMs that occurred during the time of PA program implementation may have confounded the assessment of the possible benefits.

Furthermore, LoS and exposure to the PA program are correlated (longer stay gives more opportunities for exposure) and might have introduced an additional confounding factor. We tried to mitigate these limitations by standardizing the rates by person-days in the analyses. Lastly, as the youths participated in a trauma-informed PA program, it could not be ascertained whether it was the PA alone, the trauma-informed teaching, or the combination that was most impactful for reducing the rates of UoF and PMs.

The current study findings indicate that further research is needed on the effects of PA programs for incarcerated youth. This could include prospective observational studies by sites that have PA programs compared to sites

that do not and comparing PA program types for incarcerated youth, with protocols for rigorous data collection of important variables including potential confounders. Outcomes that need further study as related to PA interventions include behavioral outcomes, academic performance, mood, rates of reincarceration or contacts with the criminal justice system, long-term health outcomes, and maintenance of PA into adulthood.

In conclusion, the present study showed a reduction in some BMs in incarcerated youths after the implementation of a trauma-informed PA program. This study provides important preliminary findings on the potential effects of an PA program in this underserved and at-risk population.

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### Authors' Note

Data are available to interested parties through data use agreements submitted to the corresponding author and The Sports Institute at the University of Washington School of Medicine.

### Consent for Publication

The corresponding author received approval for this retrospective data analysis from the University of Washington Institutional Review Board and subsequent ability to publish the aggregate de-identified results, and takes full responsibility for the data.

### Authors' Contributions

S.I. and M.R. contributed equally. C.L.M.D. conceived, designed, and assisted with the analysis and writing of the manuscript. M.A.C. performed the analysis, interpreted the results, and contributed to writing the manuscript. C.P. accessed and prepared the de-identified data for analysis and contributed to writing the manuscript. M.R., S.I., L.W., and C.L. contributed to writing the manuscript.

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