

A CHANCE THROUGH SPORT: QUANTITATIVE ASSESSMENT OF PHYSICAL ACTIVITY LEVEL IN JAIL

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ABSTRACT

Background: Sport activity has numerous positive effects, both emotionally and physically, especially inside a difficult environment such as prisons. However, overcrowding and inadequate structures often prevent a good level of sport practice inside jails. While qualitative instruments like questionnaires have been used to evaluate sport in prisons, no previous study has performed an instrumental assessment on physical activity levels and functional skills of people in jails. The aim of this study is to quantify the level of fitness and the quantity of sport activity practiced inside the detention center “Bollate Prison”, in the metropolitan area of Milan, Italy.

Materials and Methods: Thirty-six inmates wore an instrumented wristband continuously measuring their activity (steps, calories spent, sleep, and more) for five days, while reporting their perceived activity in a diary. The time spent in moderate-vigorous activities was computed and any inmate with an average of 30 minutes of moderate-vigorous activity per day was considered active.

Results: Only 3 out of 36 participants resulted to carry on an “active” lifestyle, with an average time of moderate-vigorous activity of 10 min/day for the whole studied cohort. An average of around 13000 steps/day was measured. The Training Load, computed as the hours of sport activity reported in the diary times the perceived effort, was on average 510 a.u..

Conclusions: The sport activity measured in the studied population resulted lower than the level suggested by the World Health Organization standards; only three participants met the criteria to be considered as active. Moreover, inconsistency was noted between measured and perceived activity (average reported Training Load).

Keywords: Physical activity, physical fitness, wearable device, prison, jail.

DOI: 10.19193/0393-6384_2023_5_168

Received March 15, 2022; Accepted January 20, 2023

Introduction

It is not straightforward to estimate the number of prisoners who regularly practice sport activities in Italy. Previous reports suggest that this fraction could be about 5%. Overcrowding, inadequate structures and unfeasible spaces constitute obstacles to the spread of physical activity in jail⁽¹⁾. In Italy, cultural, recreational and sports activities are included in the Penitentiary Regulations (Law 354/1974) among the main educational interventions⁽²⁾. An agreement with the National Olympic Committee (“Sport in carcere“ program, 2013) paved the way

for collaborations between Penitentiary Institutions and sport Federations, which however are isolated, occasional, and highly dependent on the specific local conditions among a heterogenous landscape⁽³⁾. Thus, the adoption of training activities and sport practice is far from being a systematic and consistent approach. The International Charter for Physical Education and Sports (November 1978) affirms that “physical activity and sport practice are fundamental rights for every individual. The physical, psychological and quality-of-life related beneficial effects that can be achieved by introducing sports activities in prison have been addressed in

the latest 20 years, by embracing the perspective of jailed people^(4,8). Results proved the emotional and social advantages related to sport practice, that helps imprisoned people to rebuild a positive image of her/himself, to fight despair, to keep a psychological balance and respect of social rules, to frame the routines of daytime, and ultimately to seek a new project within society⁽⁹⁾. In addition, countering the hypokinesia of jailed conditions brings in clear health benefits, especially in terms of a higher energy expenditure, control of body mass, and an overall better physical fitness^(2,4,6). In sum, physical activity in jail helps to develop a “healthy body in an unhealthy environment“ and opens to active re-socialization and re-education⁽¹⁾. The main results obtained by sports programs delivered in jail have been documented to date mainly with qualitative instruments like questionnaires^(3,4).

In particular, Mannocci and coworkers (2017) conducted an interesting multicentric research to understand the physical activity (estimated as Metabolic Task Equivalents, METs) in a wide cohort of about 600 prisoners in five Italian Institutes. No previous study, however, has performed an instrumental assessment on physical activity levels and functional skills of people in jail; it has been proposed that these outcomes might be strictly related to the sports-related structures available⁽³⁾. Therefore, additional knowledge on this topic might be obtained if objective data could be retrieved on the quality and quantity of physical activity. These are going to be addressed in this study by means of wearable activity monitors, able to track day and sleep time features across multiple days.

These data will be combined with self-reported data to provide a more complete picture of a population whose functional and physical activity levels are still not properly characterized. This study is part of the ACTS (A Chance Through Sport) project. ACTS (<https://www.acts.polimi.it>) is a social project conducted by Politecnico di Milano with the aim of promoting sport activity in prisons, making it a tool for resocialization, improvement of psychophysical well-being and redevelopment of detention spaces, affected by severe material deficiencies and minimal interpersonal opportunities.

Materials and methods

Study population and procedures

The study was conducted in the “Carcere di Bollate“, a house of imprisonment in the area

surrounding Milano (northern Italy). The prisoners were selected under the supervision of the prison police officers, in order to collect a representative sample of the prison's population, considering age, sex, duration of the prison stay. The studied cohort included 36 participants (26 men, average age of 38±13 years; 10 women, average age 37±8 years). All prisoners participated voluntarily in the study, which was conducted according to the 1964 Declaration of Helsinki. Informed consent was obtained for each participant. In order to quantify sport activities and fitness inside the institute, participants were asked to wear a wristband activity monitor (namely, Honor Band 5, Huawei Technologies Co., Ltd., Shenzhen, China) for around 5 days; during this period, they were reporting their activities on a daily diary. They were instructed not to modify their usual daily routine to get a realistic representation of their daily life inside the prison. Furthermore, they were asked not to remove the wristband to enable continuous data recording during the whole duration of the experiment.

At the end of the 5 days, each wristband was synchronized with a phone using the Huawei Health platform (version 8.0.51.300) and the diary recovered to perform the analyses. The researchers were never in direct contact with the prisoner for both security, health (Covid-19 pandemic) and privacy issues: the diary and wristband were retrieved from the inmates by police guards and handed over to the researchers afterwards. The experimenters did not know any personal data of the prisoners, aside from age, sex, height and weight. The data was completely anonymized, and it was not possible for the researchers to deduct the identity of the prisoners.

Diary data

For each day, the participants were asked to record in the diary the time spent in the following actions:

- Activities performed while seated;
- Walking;
- Heavy work;
- Sport activity and its type (such as gym, running, cycling etc.).

Participants were also asked to report the perceived effort of the daily physical activity according to the RPE (Borg10) scale^(10, 11). From this data, we computed the Training Load (TL) according to the formula⁽¹¹⁾:

$$TL = T_s \cdot E_p$$

where T_s is the time spent in performing sport

activity (measured in minutes) and where E_p is the effort perceived according to the Borg's scale. TL is expressed as Arbitrary Units (a.u.). A Training Load higher than 600 a.u. was considered overtraining as previously suggested in the literature⁽¹²⁾.

Furthermore, to quantify the energy expenditure for walking and heavy work, we computed the MET-min scores by multiplying the minutes spent in each activity for the Metabolic Equivalent Task (MET) of that activity⁽¹³⁾. The MET is a physiological measure estimating the energy expenditure of physical activities, where 1 MET represents the basal metabolic rate. In our study, we considered MET = 3 for walking (defined as walking, 2.5 mph, level, firm surface) and MET=4 for heavy work. This value was chosen as the average value of MET=3.5 (for standing, moderate effort, lifting items continuously, 10-20 lbs, with limited walking or resting), and MET=4.5 (for standing, moderate effort, intermittent lifting 50 lbs, hitch/twisting ropes)⁽¹³⁾.

Physiological data

The wristband device recorded the numbers of steps and the calories spent daily. Moreover, it reported the minutes of naps (sleep periods lasting less than 3 hours) and a sleep quality score computed through a built-in proprietary algorithm that considered the quantity of sleep and its type (REM, deep, light sleep). The sleep quality score was expressed on an integer scale from 0 (worst) to 100 (excellent). The reference for a normal sleep duration was 6-10 hours, with a percentage of deep sleep of 20-60%, less than 55% of light sleep and 10-30% of REM sleep. The algorithm considered, also, the smoothness of the deep sleep and the number of sleep interruptions (0-2 normal range). The sleep score algorithm also considered the respiration quality (a sleep quality score >80 is, usually, associated to a number of irregular respirations lower than 10 per hour). Finally, the wristband continuously monitored the heart rate (HR) using a photoplethysmographic sensor. For each prisoner we considered the max HR observed in the 5 days as a measure of the intensity of workouts.

To measure the intensity of the daily physical activity, we considered five different levels of intensity based on the target heart rate:

- Very light activity: HR=50%-60% of the maximum heart rate (MHR);
- Light activity: HR=60%-70% of the MHR;
- Moderate activity: HR=70%-80% of the

MHR;

- Intense activity: HR = 80%-90% of the MHR;
- Vigorous level: HR higher than 90% of the MHR.

The MHR was computed according to the age of each participant, using the Tanaka's formula⁽¹⁴⁾:

$$MHR = 208 - (0.7 * age)$$

We focused on the three higher levels of intensity, measuring for each participant the daily time (from 6 a.m. to 11 p.m.) spent in activity levels going from moderate to vigorous. A subject who performed a moderate-vigorous activity for more than 30 minutes per day was considered "physically active"⁽¹⁵⁾.

Statistical methods

Descriptive statistics such as frequencies and percentages were computed for qualitative (categorical) variables, whereas continuous variables were described as mean (standard deviation).

Results

The data of 9 participants were lost due to errors in the wristband use or in the synchronization with the Huawei Health app. In Table 1, the population characteristics are reported for the whole population (36 prisoners) and the population with available wristband data (27 prisoners).

	Whole population	Wristband population
	N=36	N=27
Males	26 (72%)	18 (67%)
Age [years]	38 (11)	36 (11)
BMI [Kg/m ²]	24.0 (5.1)	22.9 (5.0)
Reclusion Time [days]	910 (665)	969 (721)

Table 1: Characteristics of the studied cohort.

Data as: mean (standard deviation).

The sports activities indicated in the daily journal are reported in Table 2. The most common activity was exercise in the gym, that was reported in 50% of the declared sports activities. It was observed an average of almost 2.5 hours (Standard Deviation, SD=2 h) of activity while seated. The prisoners declared an average of almost 3 hours/day of walking (SD=2.5 h) and an average time of 46 min/day (SD=59 min) spent doing heavy work. The inmates reported an average time of 114 min/day (SD=89 min) of sport activity, with an average perceived exertion of 4 (SD=2).

Activity	Percentages
Gym	50%
Running/cycling	17%
Martial arts	8%
Yoga/pilates	6%
Soccer/rugby	6%
Others:	13%
- Not specified	7%
- Jumping rope	1%
- Floor exercises	1%
- Boxing	3%
- Walking	1%

Table 2: Reported practiced sport activities. Percentages reported the number of cases in which a specific activity was reported in the diary in respect to the total number of reported sports activities.

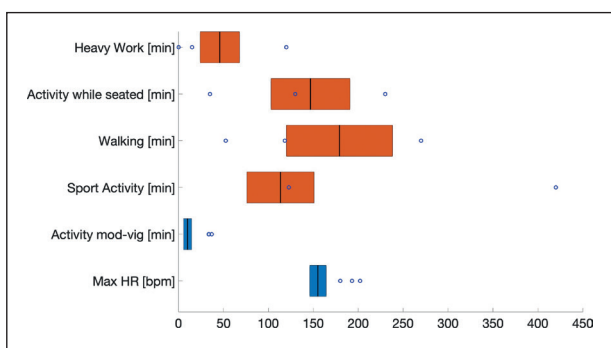


Figure 1: Activity Time. The 95% confidence intervals for the daily time spent in different activities and other variables are reported. The metrics computed from the diary are in orange, while the ones from the wristband in blue. Little time is spent in activity described as moderate to vigorous, with only 3 subjects with a value higher than 30 minutes (blue dots). The maximum HR recorded by the wristband is also depicted. In “Sport Activity” only two dots are represented because one of the active prisoners did not report the hours of sport activity performed. Whereas, in “Activity mod-vig” all three points are present, with the first two overlapped.

The average TL (510 a. u., SD=441) was lower than the overtraining threshold of 600 a.u., even if 9 participants (25%) had at least one day with a declared training load >600 a.u. In addition, we observed an average of 12713 daily steps (SD=4986 steps), with a total of 470 Kcal/day spent (SD=270 Kcal/day). However, only an average of 10 min/day (SD=11 min) were spent in moderate to vigorous activities. An average of 50 min/day (SD=34 min) were spent in naps. The average night sleep score was 78 (SD=4). Only 3 out of 27 participants wearing the wristband resulted active, according to the World Health Organization (WHO) guidelines. Their average time spent in moderate to vigorous activities was 35 min/day (SD=2 min/day), with an average number of steps of 12198 (SD=6672 steps),

slightly lower than the whole population.

In Figures 1 and 2, the 95% confidence intervals of the metrics computed on the whole population are shown to highlight the subjects that were at the extremity of the values’ distribution, while the average value is represented by a black line.

In particular, Figure 1 reports the daily time spent in different activities, whereas Figure 2 the corresponding estimated energy expenditure. Parameters based on the self-reported diary are depicted in orange, while the blue ones indicate the metrics measured by the wristband. “Active” participants are marked with a blue circle.

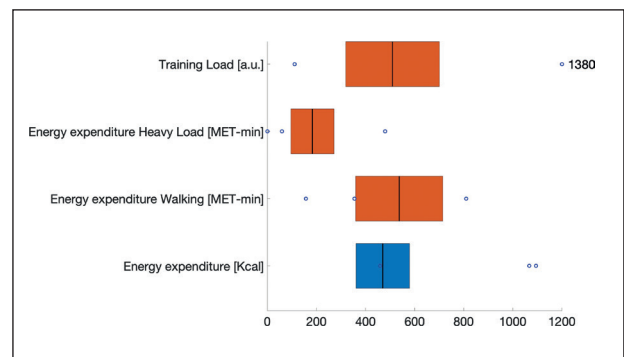


Figure 2: Energy Expenditure. The 95% confidence intervals for Training Load and energy expenditures while walking, doing heavy work and global. The metrics computed from the diary are in orange, while energy expenditure measured by the wristband is in blue. In “Training Load” only two dots are represented because one of the active prisoners did not report the hours of sport activity performed.

Discussion

This descriptive research first provides quantitative data which lead to relevant insights on physical activity conditions in prison. Overall, we observed an inconsistency between the performed physical activity and the awareness (self-perception) of the actual workload sustained⁽¹⁶⁾. In that, time devoted to heavy work (50 min/day, of average) and in sports activities (~90 min/day) fit with the latest WHO guidelines⁽¹⁵⁾, but are inconsistent with other parameters describing lifestyle, such as sedentary (seated) activities and walking. Let us consider the reported sleep activity, the 2 hours and half of sedentary activities and the 3 hours per day of walking. These findings imply that, on average, only slightly more than 5 hours (including walking) could have been spent in physical activities per day. These parameters can be considered fair for the general population, but might be limited for people in jail,

who are not homogeneously involved in common daily activities such as family assistance, travel to/back work, fitness club, shopping or house works.

This is even more surprising when considering the three participants who fell in the “active lifestyle” category sometimes reported lower values on walking and heavy work, and more time spent seated. Rather, these three prisoners clearly emerged for vigorous activities and peak HR (see Figure 1), suggesting that their interpretation of “physical fitness” is limited to practice weightlifting in the gym (notably, the number of steps taken during the day is not greater than other inmates). Clearly, this is not enough to embrace a healthy lifestyle, and considering themselves as “sportive people” just for attending the gym might be the evidence of an unclear self-perception⁽¹⁷⁾, or of their unique chance to practice sport. Reported perception also evidences this inconsistency⁽¹⁸⁾: Training Load values of about 600 are known as close to overtraining^(11, 12), with a moderate-strong level of exertion reported-while the duration of moderate-to-vigorous activities was limited to 10 minutes. The measured heart rate in that “active” cluster is in line with the performed sports activities, while in the other sedentary participants, we observed noticeably sparse high values. This point would be worth of an in-depth clinical evaluation to investigate possible cases of hypertension related to the specific physical and psychological environmental conditions.

Study limitations

A study in a prison presented several challenges and restrictions. First, the access to the prison was not straightforward, but every information passed through the police officers. Second, participants do not dispose of a mobile phone, thus the synchronization with a mobile brought by the experimenters once every 5 days was needed. These two entail that it was not possible to directly check participants’ compliance nor the accuracy of their diary reporting.

Conclusions

This study proposed a descriptive research with the use of both subjective (diary) and quantitative data (wristband) to obtain relevant insights on physical activity levels in prison. Only 3 out of the 27 (11%) inmates with wristband data resulted active according to the WHO standards.

Moreover, an inconsistency between perceived fitness (reported Training Load in the diary) and real sport activity (measured by the wristband) was noted. Our study found that much has to be done to allow for an adequate environment within prisons. We argue that these data would support governing bodies to promote an intervention not only to include facilities to enable sports activities in jail but also to involve sports professionals and experts.

Only doing so, sport practice would meet adequate volume, intensity, consistency and variety, and in turn it could ensure both physical and psychological health.

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Acknowledgements:

The courtesy and immense availability of the Penitentiary Police personnel of the “Bollate” prison house is gratefully acknowledged.

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