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THE SEATED MEDICINE BALL THROW PERFORMED BY LAW ENFORCEMENT RECRUITS – NORMATIVE DATA AND TRAINING IMPLICATIONS

The data presented in this paper was released with consent from the law enforcement organization in question for the purpose of conducting this descriptive analysis. Based on the archival nature of this analysis, the institutional ethics committee approved the use of pre-existing data (HSR-17-18-370).

INTRODUCTION

The work of a law enforcement officer has the potential to be very physically demanding. During a shift, law enforcement officers may be required to perform different tasks that can place great stress on the individual (e.g., vehicular pursuit, body/casualty drags, offender apprehension, firearm discharges) (12,48,52). The importance of upper- and lower-body power for the performance of policing job tasks has been highlighted in survey-based job task analyses involving law enforcement subject matter experts (19,25). As a result, the assessment of power by law enforcement training staff should assess power in their recruits, as this could aid program design and ultimately lead to more effective policing.

The measurement of lower-body power has occurred within law enforcement-specific fitness testing. For example, law enforcement personnel often use the vertical jump as a metric for lower-body power (41) in their physical fitness testing (14,47). Part of the reason behind this is that lower-body power contributes to important job tasks, such as obstacle clearance (12,38), foot pursuits (38), and body/casualty drags (46). However, upper-body power is assessed less frequently, despite its potential importance for law enforcement job tasks (e.g., grappling, wrestling, and striking) (5,6,13,27,30,49). An example upper-body test that has practical application for law enforcement personnel is the seated medicine ball throw (MBT) (32). While there are other fitness assessments that could provide a measure of upper-body power, such as Olympic-style lifts and upper-body Wingate tests, the MBT is relatively easy to perform and measure, and does not place undue physical stress on an individual (18,53). An assessment such as the MBT could also be valuable for law enforcement recruits, given the wide range of fitness capabilities in this population

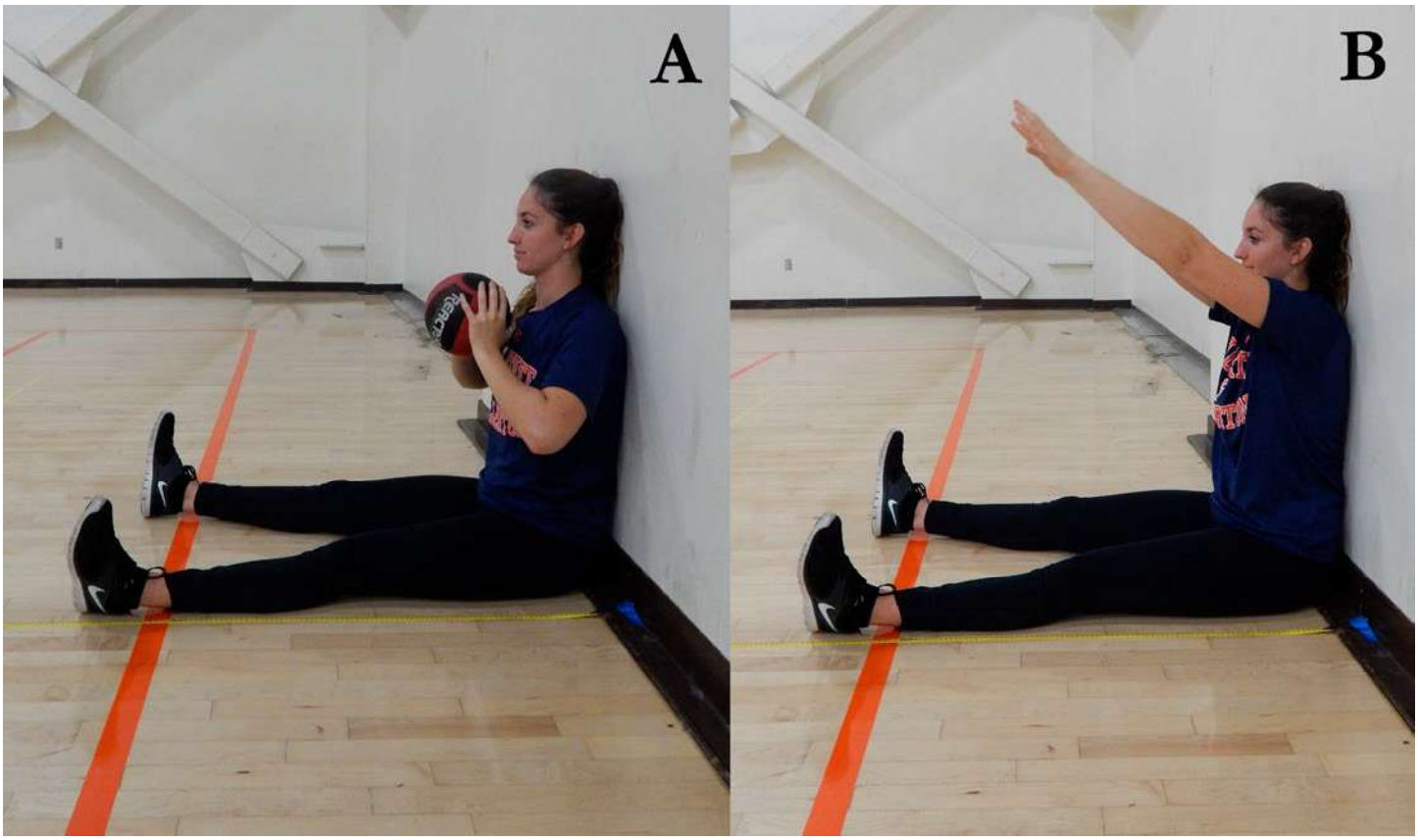

FIGURE 1. MEDICINE BALL THROW - START AND END POSITIONS

(31,35). The focus of this article it is to identify an assessment that could provide an appropriate method for obtaining an upper-body power metric. It should be noted that the focus is not to state that the MBT should be used as a barrier for entry into a police department or training academy, but rather provide training staff a potential effective assessment tool.

THE SEATED MEDICINE BALL THROW (MBT)

Several studies have illustrated that the MBT is a reliable and valid assessment. For example, across medicine ball weights from 1 – 5 kg, the MBT has been shown to be reliable when performed by college sport science students (intra-class correlation coefficients [ICC] = 0.93 – 0.97), undergraduate college students (ICC = 0.97-0.99), adult women (ICC between examiners = 0.84; ICC within examiners = 0.77), and older adults (ICC = 0.989 – 0.994) (2,17,20,56). Cronin and Owen found that when the MBT was performed with a 0.4-kg netball by experienced women netball players, there were significant ($p \leq 0.009$) relationships with the impulse ($r = 0.810$), peak power ($r = 0.803$), and mean power ($r = 0.775$) measured from a 10-kg bench throw, and with the one-repetition maximum (1RM) bench press ($r = 0.709$) (11). MBT distance with a 3-kg ball correlated with peak power from the upper-body Wingate anaerobic test when performed by male athletes from power sports (e.g., boxing, wrestling) (26). In male and female college students, the 2-kg and 3-kg MBT related to combined ($r = 0.738$), left-hand grip strength ($r = 0.737$), and right-hand ($r = 0.713$) grip strength, which were used as metrics for upper-body strength (54). Further, the 2-kg MBT has been recommended as a functional upper extremity strength exercise when analyzed in handball players (15). Collectively, these studies demonstrate reliability and validity for the MBT across different loads used in the assessment.

While validation studies may be lacking in law enforcement personnel, the 2-kg MBT has been featured in numerous studies specific to law enforcement recruits (8,21,30,33,34,36,37,38,40). The procedures for the MBT in law enforcement testing have been described by Lockie et al. (32). A tape measure should be run perpendicular from a wall for up to 20 m (66 ft). The participant should sit on the ground with their head, shoulders, and lower back against a wall, and legs extended horizontally in front of the body (Figure 1A). This position must be maintained throughout the throw (i.e., the head, shoulders, and lower back cannot leave the wall during the throw). The medicine ball should be held with two hands in a manner similar to a basketball or netball chest pass (11,16). The medicine ball should be brought close to the chest such that the elbows are at the sides of the body (Figure 1A). The participant should then project the ball as far as possible at an approximate 45° angle by extending the arms; the head, shoulders, and lower back should not move from the wall (Figure 1B). Chalk can be used to lightly dust the ball, which will help with grip and marking the ground where the ball lands following the throw. The measurement is taken as the perpendicular distance from the wall to the point of first contact with the ground by the ball.

There has been analysis as to whether the MBT relates to law enforcement-specific job tasks. Lockie et al. compared a battery of general fitness tests, including the MBT, with the Work Sample Test Battery in law enforcement recruits (38). The Work Sample Test Battery, which must be completed to an appropriate standard by Californian recruits in the United States, consists of five tests completed for time: a 99-yard (90.53-m) obstacle course, a 165-lb (74.84-kg) body drag, a climb over a six-foot chain link fence, a climb over a six-foot solid wall, and a 500-yard (457.2-m) run (38,39). Lockie et al. found that the MBT significantly ($p < 0.01$) correlated with the 99-yard obstacle course ($r = -0.26$) and chain-link fence climb ($r = -0.20$) (38). Although the strength of the correlations was small, the relationships did suggest that a further MBT distance related to faster times for the obstacle course and chain-link fence climb. Upper-body power could assist a law enforcement officer during tasks where they need to clear an obstacle, as they need to push themselves up and over the obstacle.

Better upper-body power, as measured by the MBT could prove beneficial when a law enforcement officer has to physically engage with a suspect. In these instances, the law enforcement officer may be required to wrestle, grapple, and strike an offender in order to execute an arrest (5,6,13,27,30,49). The law enforcement officer will need to draw on skills similar to combat sports. Although there is little research that has directly measured how the MBT could relate to policing job tasks, there is research that has linked the MBT with combat sports. Medicine ball throws have often been used in training for combat sport athletes, with the expectation that upper-body explosiveness will be enhanced (55). Indeed, the MBT could be considered a high-velocity expression of power by the upper body (23). Striking, such as punching or palm strikes, are forceful and high-velocity actions (3). Punch acceleration in male and female boxers has an association ($r = 0.652 – 0.736$) with power measured during a bench throw, which has a similar action to the MBT (42). Marques et al. used a 3-kg MBT to measure upper-body power specific to judo athletes and wrestlers, as these competitors are required to suplex and throw their opponents (43). Moreover, 3-kg MBT performance was involved with predictive equations for Brazilian jiu-jitsu athletes relative to lever throw frequency, frequency of effective actions, and overall effectiveness during simulated fights (9). Although the majority of law enforcement research that included a MBT used a 2-kg ball, it could be surmised that those individuals who could project the 2-kg ball a further distance could have better power that would be reflected in job tasks such as striking, punching, grappling, and throwing (8,21,30,33,34,36,37,38,40). Future studies could investigate whether the power generated via throws with different medicine ball weights, such as between 1 – 5 kg, could relate to law enforcement job tasks (56). Nevertheless,

these studies collectively highlight how MBT performance could provide some indication for how law enforcement personnel could be able to express upper-body power in combat situations where it is needed.

Lockie et al. found that recruits who graduated from a law enforcement training academy had a significant ($p < 0.001$) 15% greater MBT when compared to recruits who did not successfully complete academy training (34). When considering male recruits only, those who graduated also had a significant 13% greater MBT compared to the unsuccessful recruits (28). Moreover, MBT distance featured in predictive equations relative to academy graduations for all recruits combined and male recruits, but not the female recruits by themselves. Nonetheless, Lockie et al. suggested that it would be beneficial for law enforcement recruits to enter academy training with well-developed upper-body power, especially considering the training demands they would likely experience (e.g., suspect pursuit and arrest, striking, and grappling) (34).

The reviewed information highlights that: a) the MBT has been used to assess upper-body power in law enforcement recruits, b) this assessment is a valid and reliable test when performed with different medicine ball weights, c) greater upper-body power as measured by the MBT could assist with policing job tasks such as obstacle clearance and combat skills, and d) having superior upper-body power could also benefit a recruit's ability to tolerate the demands of academy training. As a result, it would be beneficial to establish standards for the MBT specific to law enforcement recruits, as this could guide training practices for training staff.

PERCENTILE RANKINGS FOR THE MBT

The process for calculating normative data for the MBT was similar to previous articles from *TSAC Report* analyzing the 75-yard pursuit run and 165-lb body drag specific to law enforcement recruits (28,29). To provide example standards for the MBT, data was collated from 12 academy classes, which included 949 recruits (age: 27.18 ± 6.00 years; height: 1.73 ± 0.10 m; body mass: 80.11 ± 14.11 kg). There were 780 men (age: 27.15 ± 5.91 years; height: 1.75 ± 0.10 m; body mass: 83.29 ± 12.67 kg) and 169 women (age: 27.27 ± 6.44 years; height: 1.62 ± 0.07 m; body mass: 65.53 ± 10.80 kg). For all classes, the MBT was conducted according to established procedures (8,21,30,33,34,36,38,40). Recruits completed two trials, with the best trial used for analysis. Microsoft Excel (Microsoft Corporation™, Redmond, Washington, USA) was used to calculate the percentile ranks for the MBT.

The percentile ranking data for all recruits combined is shown in Table 1, with the number of males and females in each rank also displayed. Normative data specific to male and female recruits is shown in Tables 2 and 3, respectively, with the number of recruits in each rank included in the tables. To reiterate, the normative data

TABLE 1. PERCENTILE RANKINGS FOR THE MBT WHEN COMPLETED BY ALL LAW ENFORCEMENT RECRUITS (MEN AND WOMEN COMBINED)

PERCENTILE RANK	MBT DISTANCE (M)	MALES (N = 780)	FEMALES (N = 169)
90 – 100	≥7.49	100	0
80 – 89	6.96 – 7.48	94	1
70 – 79	6.61 – 6.95	84	0
60 – 69	6.33 – 6.60	100	1
50 – 59	6.06 – 6.32	99	0
40 – 49	5.69 – 6.05	93	2
30 – 39	5.31 – 5.68	91	4
20 – 29	4.80 – 5.30	71	22
10 – 19	4.10 – 4.79	39	30
<10	≤4.07	9	82

TABLE 2. PERCENTILE RANKINGS FOR THE MBT WHEN COMPLETED BY MALE LAW ENFORCEMENT RECRUITS

PERCENTILE RANK	MBT DISTANCE (M)	NUMBER
90 – 100	≥7.66	82
80 – 89	7.14 – 7.64	77
70 – 79	6.80 – 7.13	77
60 – 69	6.52 – 6.79	75
50 – 59	6.31 – 6.51	74
40 – 49	6.08 – 6.30	81
30 – 39	5.79 – 6.07	83
20 – 29	5.47 – 5.78	79
10 – 19	5.02 – 5.46	76
<10	≤5.00	76

TABLE 3. PERCENTILE RANKINGS FOR THE MBT WHEN COMPLETED BY FEMALE LAW ENFORCEMENT RECRUITS

PERCENTILE RANK	MBT DISTANCE (M)	NUMBER
90 – 100	≥5.00	18
80 – 89	4.72 – 4.93	17
70 – 79	4.52 – 4.71	16
60 – 69	4.28 – 4.50	18
50 – 59	4.13 – 4.25	13
40 – 49	3.98 – 4.10	19
30 – 39	3.79 – 3.96	18
20 – 29	3.61 – 3.78	16
10 – 19	3.32 – 3.60	18
<10	≤3.30	16

was not created to provide cut scores; rather, it was designed to establish some practical standards for the MBT as a measure of upper-body power in law enforcement recruits. Nonetheless, it is interesting to compare MBT data for recruits who were successful in academy training and those who were not. There are some notable sex differences when considering the MBT normative data. When considering the data of all recruits combined, the top 70% of the recruits in the MBT are comprised almost entirely of males; almost 80% of the women were in the bottom three percentiles (34). When reviewing the sex-specific normative data, the top percentile ranking for the women (MBT distance ≥ 5.00 m) would still position these women towards the bottom in the rankings for men. These results are not surprising, as women tend to have lesser performance in strength and power tests compared to men, which is in part affected by the generally smaller body size and muscle mass inherent for women (4,24,45). The data from the females may also place the results from Lockie et al., who found the MBT did not delineate between females who graduated or did not finish academy training, in further context (34). Even women who have good upper-body power likely enter academy training behind most men when it comes to this physical quality. What the current data also emphasizes is the need for women entering a career in law enforcement to make a special effort to develop their upper-body power to assist with job tasks that demand this quality.

IMPLICATIONS

There are several training implications that can be drawn from this analysis. Should a training staff use the MBT, they will be able to compare their recruits with these standards for overall recruits, men, and women. This will allow staff to note strengths and limitations for their incoming recruits and could assist with training program design. With appropriate training, positive changes in upper-body strength and power can be achieved in both trained and untrained populations in 8 – 12 weeks (22,44,50,51). Depending on the agency, a law enforcement training academy can last for several months (7,10). Accordingly, with proper planning and periodization, staff could incorporate upper-body strength and power training into their programs with the potential for performance improvements in recruits. Future research could investigate whether specific upper-body strength and power training improves recruit performance in an assessment such as the MBT, and how this could affect the recruit's ability to perform occupational tasks.

The MBT percentile ranking data also highlighted upper-body power limitations in women compared to men. This is not to state that women, or low-performing men, should be excluded from law enforcement training academies based on MBT performance. Indeed, like what has been shown in other normative data studies specific to law enforcement, there were women who outperformed men in the MBT (28,29,35). Rather, what these data highlight is the need for female recruits to specifically focus on developing their upper-body strength and power, as they may be behind most of the males in their academy class. Training staff should consider utilizing strength and power training programs specific to their female recruits to develop these qualities such that there would be benefits to law enforcement tasks that require forceful and explosive pushing (e.g., during apprehension of an offender).

LIMITATIONS

To the author's knowledge, only one agency has formally used the MBT as part of general fitness testing for their recruits (8,21,30,33,34,36,37,38,40). The MBT was not being used for any punitive reasons; rather, it was to provide a novel metric for upper-body power. The use of the MBT prior to a training academy allowed for staff to use the information to help with their training program design. There may be other law enforcement organizations that utilize the MBT, but there is limited research that has been published by other groups. Nonetheless, this reinforces the importance of the current article in that the application of the MBT specific to law enforcement recruits has been documented, and staff from other organizations have a starting point from which to contextualize the performance of their personnel. There is currently no data available for law enforcement recruits or incumbent personnel with regards to additional metrics such as throw velocity (1). While MBT distance does provide a useful metric, it would be beneficial for future research to incorporate other measures for a MBT, including not just velocity, but force, time, and momentum metrics (8,21,30,33,34,36,37,38,40). Future research in law enforcement recruits could also compare the MBT to other upper-body power tests (e.g., upper-body Wingate tests, Olympic-style lifts, plyometric push-ups performed on a force plate) to ascertain predictive effectiveness relative to factors such as academy graduation and job performance. As an example, a 60-s arm ergometer test was involved in equations that predicted academy graduation in law enforcement recruits (34).

It is also imperative to recognize that training the power qualities ultimately measured by an assessment such as the MBT may help with developing the capacity of recruits for explosive pushing movements. The training staff will still need to develop the technique required in job tasks where upper-body power can be expressed. Development of effective techniques required to push heavy objects, wrestling/grappling, and striking, are obviously still required for the law enforcement recruit. This also does not consider other confounding factors of situations where a law enforcement officer could or should express their upper-body power (e.g., use of force to apprehend an offender). Regardless, enhancing the upper-body strength and power of the law enforcement recruit should ultimately be beneficial for their job performance and career.

CONCLUSION

The data details the distances from the MBT as performed by male and female law enforcement recruits. This data can be used to inform fitness training programs implemented by academy staff. Recruits that are ranked lower in the MBT could benefit from specific upper-body strength training, as well as specific upper-body power training. Female recruits should benefit from upper-body strength and power training, as women tend to perform less in the MBT than men. Although there has been no direct research that has linked law enforcement job tasks with the MBT, enhancing upper-body power should be beneficial for job tasks that require explosive pushing movements, such as moving heavy objects, wrestling with offenders, and striking.

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