

**International Journal of  
PHYSICAL EDUCATION, FITNESS AND SPORTS**

**Electronic Supplementary Information**  
**The Physiological and Morphological Benefits of  
Shadowboxing**

Adam M. Croom <sup>a</sup>

<sup>a</sup> Cognitive Science Program, University of California, Berkeley, USA

\*Corresponding Author E-mail: [croom@berkeley.edu](mailto:croom@berkeley.edu)

DOI: <https://doi.org/10.54392/ijpefs2322>

Received: 01-05-2023; Revised: 16-05-2023; Accepted: 19-05-2023; Published: 23-05-2023

---

**Test-retest reliability of the Tanita BC-1500**

This section provides results from the test-retest reliability procedure conducted on 15 December 2021. This procedure was carried out 200 consecutive times on the same subject over a continuous 6-hour period. Results show that measurements for all variables are highly reliable for the Tanita BC-1500 based on established standards in the field [Shechtman, 2013]. Note that coefficients of variation are not used as an index of measurement reliability for metabolic age, physique rating, and visceral fat rating, since these ratings are not recorded on ratio scales [Shechtman, 2013]. SD = standard deviation, CI = confidence interval, CV = coefficient of variation.

- **Basal metabolic rate:** 2101.50 kcals, SD  $\pm$  7.56 kcals, 95% CI 2100.45-2102.55, CV = 0.35974304%
- **Daily calorie intake:** 3740.70 kcals, SD  $\pm$  13.49 kcals, 95% CI 3716.19-3748.87, CV = 0.36062769%
- **Total body weight:** 177.47 lbs, SD  $\pm$  0.42 lbs, 95% CI 177.41-177.53, CV = 0.236659717%
- **Body mass index:** 24.76, SD  $\pm$  0.06, 95% CI 24.75-24.77, CV = 0.242326332%
- **Body fat percentage:** 8.99%, SD  $\pm$  0.34%, 95% CI 8.95-9.04, CV = 3.781979977%
- **Total muscle mass:** 153.57 lbs, SD  $\pm$  0.60 lbs, 95% CI 153.48-153.65, CV = 0.390701308%
- **Total bone mass:** 8.00 lbs, SD  $\pm$  0.00 lbs, 95% CI 8.00-8.00, CV = 0%
- **Total fat mass:** 15.94 lbs, SD  $\pm$  0.64 lbs, 95% CI 15.85-16.03, CV = 4.015056461%
- **Fat free mass:** 161.54 lbs, SD  $\pm$  0.61 lbs, 95% CI 161.46-161.63, CV = 0.377615451%
- **Visceral fat rating:** 3.02 VFR, SD  $\pm$  0.14 VFR, 95% CI 3.00-3.04
- **Body water mass:** 116.09 lbs, SD  $\pm$  0.47 lbs, 95% CI 116.03-116.16, CV = 0.404858299%
- **Body water percentage:** 65.39%, SD  $\pm$  0.27%, 95% CI 65.35-65.43, CV = 0.412907172%
- **Left leg muscle mass:** 24.77 lbs, SD  $\pm$  0.20 lbs, 95% CI 24.74-24.80, CV = 0.80742834%
- **Right leg muscle mass:** 25.96 lbs, SD  $\pm$  0.11 lbs, 95% CI 25.94-25.97, CV = 0.423728813%
- **Left arm muscle mass:** 8.96 lbs, SD  $\pm$  0.08 lbs, 95% CI 8.95-8.97, CV = 0.892857142%
- **Right arm muscle mass:** 8.72 lbs, SD  $\pm$  0.10 lbs, 95% CI 8.70-8.73, CV = 1.14678899%
- **Trunk muscle mass:** 85.15 lbs, SD  $\pm$  0.45 lbs, 95% CI 85.09-85.21, CV = 0.528479154%
- **Left leg fat percentage:** 10.75%, SD  $\pm$  0.15%, 95% CI 10.73-10.77, CV = 1.395348837%
- **Right leg fat percentage:** 9.65%, SD  $\pm$  0.18%, 95% CI 9.63-9.68, CV = 1.865284974%
- **Left arm fat percentage:** 13.30%, SD  $\pm$  0.24%, 95% CI 13.27-13.33, CV = 1.804511278%
- **Right arm fat percentage:** 13.27%, SD  $\pm$  0.21%, 95% CI 13.24-13.29, CV = 1.582516955%
- **Trunk fat percentage:** 7.29%, SD  $\pm$  0.54%, 95% CI 7.22-7.37, CV = 7.407407407%

**Goals to focus on during shadowboxing sessions (+13)**

- **Train movements, not muscles.** "Train movements not muscles" represents a fundamental principle in functional training [Collins, 2012, pp. 19; McCall, 2012] so shadowboxing sessions should focus on movements (punches, kicks, elbows, and knee strikes) rather than muscles (biceps, triceps, chest, back). In the section below I have provided introductory drills (+6), techniques covering basic positioning, movement, defense, and offense (+58), and a variety of different striking combinations (+70). For visual demonstrations of these drills, techniques, and combinations, the reader can refer to video demonstrations available online by quality instructors from Boxing Works, Bang Muay Thai, Evolve MMA, Heritage Muay Thai, Warrior Collective, and elsewhere.
- **Last for the full 3-to-5-minute round before resting for 1 minute.** Due to the SAID (Specific Adaptations to Imposed Demands) principle or principle of specificity, the body will adapt to the specific demands that are placed on it [DeLorme, 1945; Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010;

Clark, Lucett, Sutton, 2013; Collins, 2012] so training programs should be designed to reflect the demands of practical tasks or sports-relevant goals [Croom, 2023]. Since rounds in boxing consist of 3 minutes of activity followed by 1 minute of rest, one may follow this temporal structure as part of their boxing-based shadowboxing program. Since rounds in MMA consist of 5 minutes of activity followed by 1 minute of rest, one may follow this temporal structure as part of their MMA-based shadowboxing program. This will contribute to energy systems development (ESD) that is optimal for your practical tasks or sports-relevant goals [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012]. If you start to fatigue before the round has ended, slow down or stop striking and focus on footwork, head movement, feints, and simply enduring until you have recovered and can continue striking, or until the round has ended. Practice managing your energy throughout each round and over the training session overall, so you become better at not gassing out prematurely. Imagine that you are engaged in a real combat situation, where stopping to sit down in the middle of a bout is not an option. By keeping your training realistic, your adaptations from training will be more sport-specific and have the most carry over to the functional activities in your specific sport [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2019]. This at least provides you with an initial reference point from which you can modify, if necessary, since training programs should always be customized to your individual training abilities and goals.

- **Last the full 30-to-60-minute session before stopping for the day.** The spirit of this goal is similar to the spirit of the previous goal. You want to last not only through individual rounds, but also throughout the entire bout or training session. Work on managing your energy over a 30-to-60-minute training period. Many fighters purposely wait until the later rounds to start advancing heavy attacks, since novices will tire themselves out in early rounds and not have enough energy reserve in their tank to keep up in the later rounds. With this in mind, work on managing your energy throughout the entire bout or training session. You want to remain cardiovascularly strong in the championship rounds.
- **Increase striking volume.** This will contribute to improving muscular endurance and energy systems development [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012]. In combat sports like boxing, kickboxing, Muay Thai, and MMA, you earn more points by landing more clean strikes on your target. To land more clean strikes, however, you need to be able to throw more strikes in general, so by focusing on increasing your striking volume in training you will thereby work to develop the specific adaptations required to increase your scoring in combat sports contexts. Throwing a high volume of strikes will also keep your partner or opponent busy defending rather than attacking (“offense is the best defense”), so being able to maintain a high output of strikes is defensively as well as offensively valuable.
- **Increase striking variety.** This will add more tools to your striking toolkit. In combat sports like boxing, kickboxing, Muay Thai, and MMA, you remain less predictable and earn more points by making greater use of all the strikes available in the sport. By focusing on increasing striking variety in training, you will thereby work to develop the specific adaptations required to increase your scoring in combat sports contexts. A well-rounded repertoire of striking-based movement patterns will also help to reduce the risk of overuse or injury from a more restrictive set of repetitive movement patterns [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012].
- **Improve single strikes.** This will contribute to improving neuromuscular efficiency, speed, power, balance, and overall striking technique [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012]. Having excellent technique makes your striking more effective while also requiring less energy (due to increased neuromuscular efficiency) and reducing the risk of injury (due to increased precision and consistency of movement patterns).
- **Improve specific combinations.** This will contribute to improving neuromuscular efficiency, speed, power, balance, and overall striking technique [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012]. A combination is more than the sum of its parts, so even if you have single strikes down you must still practice how those strikes go together into specific combinations. For example, a triple jab is fundamentally distinct from three single jabs both in rhythmic timing and power. Whereas three single jabs will have three jabs of equal timing and power (**1, 1, 1**), the triple jab will have two shorter and less powerful jabs followed by a third longer and more powerful jab all tied together as one uninterrupted movement sequence (**1-1-1**). By focusing on improving specific combinations in training, you make these combinations more readily available and more fluidly executable in your sport. Croom [2022] calls this process of motor learning and refinement the “cultivation of combat-relevant affordances”.
- **Increase defensive maneuvers.** The purpose of this is to incorporate defense as well as offense into your shadowboxing training and to improve neuromuscular efficiency, speed, balance, and overall defensive technique [Clark, Lucett, Corn, 2007; Clark, Lucett, Kirkendall, 2010; Clark, Lucett, Sutton, 2013; Collins, 2012]. Floyd Mayweather, an undefeated champion and one of the greatest boxers of all time, states that boxing or “the sweet science is [about] hitting and not getting hit”. At first it may be natural to focus on striking but reflect on how much defense you’re incorporating into your shadowboxing sessions and work to improve the amount of defensive techniques you incorporate. For example, if you threw 300 strikes but only executed one defensive maneuver (such as a pullback or rollunder) in your last

shadowboxing session, work to increase the number of defensive maneuvers in your next session (for example, at least 5-10 pullbacks and 5-10 rollunders).

- **Increase fakes and feints.** Fakes and feints are often used in combat sports to disrupt an opponent or to make your own strikes less predictable. Work on incorporating fakes and feints into your shadowboxing to disrupt your opponent and to set up your next strikes. If you get tired you can also use more fakes and feints to stay active, rather than just standing in one place like a sitting target.
- **Increase setups and traps.** The legendary boxer Mike Tyson said, "Everybody thinks this is a tough man's sport. This is a thinking man's sport. A tough man is going to get hurt real bad in this sport" [2020]. If you come straight out the gate trying to throw a cross at your opponent's chin with all the power that you have, your partner or opponent will likely see this coming and move. If your moves are so carelessly obvious, one will not likely be successful in combat sports. Instead, use setups and traps to land your strikes. For example, instead of going directly for the chin first, start by throwing two or three shots to the body to pull your opponent's guard down, then go for the chin after you have created that opening.
- **Improve striking in both orthodox and southpaw stances.** It is generally recommended to practice all of your techniques and drills in both stances - orthodox (right-handed stance angled with the left foot and left shoulder in front of the right foot and right shoulder) and southpaw (left-handed stance angled with the right foot and right shoulder in front of the left foot and left shoulder) - to maintain muscular symmetry on both sides of your body and to develop a more comprehensive skill set in mixed martial arts [Evolve MMA, 2018].
- **Keep your head off the line of attack by maintaining head movement.** Developing good defensive responsibility involves maintaining head movement so that your head stays off the line of attack. If you maintain head movement, this will also disrupt your partner or opponent's ability to focus and land clean strikes. In addition to fakes and feints, good head movement can be used to take the punching volume away from your partner or opponent while you recover and prepare your next attack.
- **Visualize and mentally simulate scenarios from training, sparring, and exemplary fights.** Use your shadowboxing session to visualize or mentally simulate scenarios from previous training sessions with a coach, sparring matches with a partner, martial arts classes you have taken, or highlights from exemplary fights [Croom, 2023]. You can get more from your training and combat sports experience by practicing what you watch, and by watching with a careful eye for techniques to incorporate into your own practice. By drawing upon real world scenarios - martial arts classes, sparring matches, one-on-one sessions with coaches, and highlights from exemplary fights - one is able to keep their training novel and realistic. Many people quit their exercise programs because traditional exercise programs are boring, however, the variety in shadowboxing may make it easier to maintain adherence and see results.

#### Drills (+6)

- Alternating straight punches (jab-cross, jab-cross)
- Alternating uppercuts (lead uppercut, rear uppercut)
- Alternating or skip knees (alternating rear knees; rear knee thrust lands in forward position)
- Alternating push kicks or teeps (alternating lead teeps; lead teep lands in backward position)
- Alternating roundhouse kicks (alternating rear roundhouse kicks; rear roundhouse kick lands in forward position)
- Footwork (moving forward, moving backward, moving left, moving right, pivoting on the lead foot turning inwards, pivoting on the lead foot turning outwards)

#### Basic positioning, movement, defense, and offense (+58)

- **Positioning and movement (+11)**
  - Stance (hip and foot positioning)
  - Guard (shoulder, arm, hand, and head positioning)
  - Lead arm control (using the lead arm to establish distance or control)
  - Move forward (lead foot steps forward first, then the rear foot follows)
  - Move backward (rear foot steps backward first, then the lead foot follows)
  - Move left (left foot moves leftward first, then the right foot follows)
  - Move right (right foot moves rightward first, then the left foot follows)
  - Pivot inward or turn in (pivot on the ball of the lead foot, turning inwards; turning inwards is rotating clockwise for orthodox and counterclockwise for southpaw)
  - Pivot outward or turn out (pivot on the ball of the lead foot, turning outwards; turning outwards is rotating counterclockwise for orthodox and clockwise for southpaw)
  - Turn (use your lead arm to turn your opponent on an angle)
  - Switching stances (swing the lead foot back so it is now the rear foot in the opposite stance)
- **Defense (+14)**
  - Pullback (moving the shoulders and head back from the punching range of your opponent; in one variation your feet do not move, in another variation your rear foot moves back-then-forward as your shoulder and head pull back-then-forward)

- Slip towards the lead side (for orthodox, slip towards the left to evade a straight punch; for southpaw, slip towards the right to evade a straight punch)
- Slip towards the rear side (for orthodox, slip towards the right to evade a straight punch; for southpaw, slip towards the left to evade a straight punch)
- Roll under towards the lead side (for orthodox, roll under towards the left to evade a hook; for southpaw, roll under towards the right to evade a hook)
- Roll under towards the rear side (for orthodox, roll under towards the right to evade a hook; for southpaw, roll under towards the left to evade a hook)
- Catching punches to the head (use your hands to catch or cushion straight punches)
- Catching punches to the body (use your elbows and lower arms to catch or cushion punches to the body)
- Parry kicks towards the lead side (use your hands to parry push kicks or teeps away towards the lead side of your body)
- Parry kicks towards the rear side (use your hands to parry push kicks or teeps away towards the rear side of your body)
- Dutch block kicks towards the lead side (use your arms to block kicks towards the lead side)
- Dutch block kicks towards the rear side (use your arms to block kicks towards the rear side)
- Checking kicks with the lead leg (use your legs and shins to block kicks towards the lead side)
- Checking kicks with the rear leg (use your legs and shins to block kicks towards the rear side)
- Fakes and feints (pretend or partially initiate one maneuver then stop or change maneuvers, which will prevent your opponent from being able to time and predict your attacks)
- **Punches (+14)**
  - Jab (straight punch to the head with the lead arm; straight left punch for orthodox, straight right punch for southpaw)
  - Jab to the body (straight punch to the body with the lead arm, bend your knees and bring your body down instead of standing up and punching downwards; straight left punch for orthodox, straight right punch for southpaw)
  - Cross (straight punch to the head with the rear arm; straight right punch for orthodox, straight left punch for southpaw)
  - Cross to the body (straight punch to the body with the rear arm, bend your knees and bring your body down instead of standing up and punching downwards; straight right punch for orthodox, straight left punch for southpaw)
  - Lead hook (lead arm is curved instead of straight and punches horizontally around the guard of your opponent towards their head; use hip rotation to generate power)
  - Lead hook to the body (lead arm is curved instead of straight and punches horizontally around the guard of your opponent towards their body; bend your knees and use hip rotation to generate power)
  - Rear hook (rear arm is curved instead of straight and punches horizontally around the guard of your opponent towards their head; use hip rotation to generate power)
  - Rear hook to the body (rear arm is curved instead of straight and punches horizontally around the guard of your opponent towards their body; bend your knees and use hip rotation to generate power)
  - Lead uppercut (lead arm is curved instead of straight and punches vertically up through the middle of the guard of your opponent towards their chin; use hip rotation to generate power)
  - Rear uppercut (rear arm is curved instead of straight and punches vertically up through the middle of the guard of your opponent towards their chin; use hip rotation to generate power)
  - Rear overhand punch (rear arm is curved instead of straight and angles over the guard of your opponent and downwards towards their head)
  - Gazelle hook or jumping lead hook (use hip rotation to generate sufficient power so that you can lunge forward as you throw your lead hook; a jumping lead hook)
  - Superman jab (jump forward and throw the jab while in midair)
  - Superman cross (jump forward and throw the cross while in midair)
- **Elbows (+7)**
  - Lead horizontal elbow (step or skip forward as you strike horizontally with the lead elbow)
  - Rear horizontal elbow (step or skip forward as you strike horizontally with the rear elbow)
  - Lead upward elbow (step or skip forward as you strike vertically with the lead elbow)
  - Rear upward elbow (step or skip forward as you strike vertically with the rear elbow)
  - Reverse upward elbow (step or skip forward as you strike with a reverse elbow; the hand is positioned below the elbow and facing downward in a reverse elbow whereas the hand is positioned above the elbow and facing upward in a traditional upward elbow)
  - Spinning back elbow (step or skip forward turning your lead shoulder inward and rotating your rear elbow outward in a clockwise direction for orthodox or counterclockwise direction for southpaw so that you hit your opponent with the rear elbow during rotation)
  - Flying rear elbow (jump forward and throw the rear elbow)

- **Kicks (+11)**
  - Lead teep or push kick (straight kick with the lead leg connecting with the ball of the foot)
  - Rear teep or push kick (straight kick with the rear leg connecting with the ball of the foot)
  - Lead roundhouse kick (rotational kick with the lead leg connecting with the shin; use hip rotation to generate power)
  - Rear roundhouse kick (rotational kick with the rear leg connecting with the shin; use hip rotation to generate power)
  - Lead inside leg kick (low kick with your lead leg towards the inside of the lead leg of your opponent)
  - Rear low kick (low kick with your rear leg towards the outside of the lead leg of your opponent)
  - Lead side teep or push kick (straight kick with the lead leg but angled right before contact)
  - Rear question mark kick (rear kick that starts as a low kick then circles around over the top in a question mark motion towards the head of your opponent)
  - Sliding lead push kick (lunge or slide forward while delivering the lead push kick)
  - Jumping rear roundhouse kick (jump forward while delivering a rear roundhouse kick)
  - Jumping switch teep or push kick (jump forward while delivering a switch teep or push kick)
- **Knees (+3)**
  - Lead knee (knee thrust with the lead knee)
  - Rear knee (knee thrust with the rear knee)
  - Flying rear knee (jump forward then throw the rear knee in midair)

**Combinations with an alternating pattern: LRLR and RLRL (+45)**

- Cross, lead hook, rear roundhouse kick
- Cross, lead hook, rear upward elbow
- Cross, lead knee, rear horizontal elbow
- Cross, lead roundhouse kick
- Cross, lead roundhouse kick, rear horizontal elbow
- Cross, slip towards the rear side, rear uppercut, lead hook, rear overhand punch
- Dutch block kick towards the lead side, lead hook, cross, lead hook, rear roundhouse kick
- Dutch block kick towards the rear side, cross, lead hook, cross, lead roundhouse kick
- Jab, cross
- Jab, cross, jab, cross, lead hook, rear horizontal elbow, lead push kick
- Jab, cross, lead hook
- Jab, cross, lead hook, rear low kick
- Jab, cross, lead hook, Superman cross
- Jab, cross, lead hook to the body
- Jab, cross, lead knee, rear horizontal elbow
- Jab, cross, lead roundhouse kick
- Jab, cross, pullback, cross
- Jab, cross, slip towards the rear side, cross
- Jab, cross, turn, rear roundhouse kick
- Jab, cross to the body
- Jab, cross to the body, lead hook, rear hook
- Jab, cross to the body, lead hook, rear low kick
- Jab, rear hook to the body
- Jab, rear low kick
- Jab, rear roundhouse kick
- Jab, rear uppercut, lead hook, rear overhand punch
- Jab, rear upward elbow, lead horizontal elbow, rear horizontal elbow
- Lead hook, cross, lead hook, rear roundhouse kick
- Lead hook, rear hook, lead knee
- Lead hook, rear hook, lead roundhouse kick
- Lead hook, rear hook to the body
- Lead hook, rear low kick, lead hook, cross, lead roundhouse kick
- Lead hook, rear roundhouse kick
- Lead hook to the body, rear uppercut, lead hook, cross
- Lead roundhouse kick, spinning back elbow
- Lead uppercut, cross, lead hook, rear low kick
- Parry kick towards the lead side, rear low kick, lead roundhouse kick
- Rear hook, lead hook, rear knee
- Rear hook, slip towards the rear side, rear uppercut
- Rear hook to the body, lead uppercut, cross, lead hook
- Rear roundhouse kick, check kick with the lead leg, spinning back elbow
- Rear roundhouse kick, lead hook

- Rear roundhouse kick, lead hook, rear question mark kick
- Rear uppercut, lead hook, cross
- Superman jab, rear low kick

#### **Combinations with a doubled-up pattern: LRRL and RLLR (+25)**

- Check kick with the rear leg, cross, lead hook, rear roundhouse kick
- Cross, lead hook, lead push kick, Superman cross
- Jab, cross, lead hook, lead hook to the body, rear uppercut
- Jab, cross, lead hook, lead uppercut
- Jab, cross, lead uppercut, cross, lead hook, cross, rear roundhouse kick, rear push kick
- Jab, cross, rear knee
- Jab, cross, rear push kick
- Jab, cross, rear roundhouse kick
- Jab, cross to the body, rear low kick
- Jab, jab, check kick with lead leg, rear knee, rear horizontal elbow
- Jab, jab, cross
- Jab, jab, cross, lead hook to the body, lead hook, cross
- Jab, jab, cross, lead horizontal elbow, flying rear elbow
- Jab, jab, cross, lead push kick, sliding lead push kick
- Jab, jab, lead knee, rear horizontal elbow, rear roundhouse kick
- Jab, jab, lead knee, rear upward elbow
- Jab, jab, rear push kick, rear question mark kick
- Jab, jab, rear roundhouse kick, cross
- Jab, jab, rear upward elbow, rear horizontal elbow
- Jab, lead push kick, fake, rear horizontal elbow
- Jab, lead uppercut, cross, jumping rear roundhouse kick
- Jab, lead uppercut, rear overhand punch
- Jab, rear hook to the body, rear uppercut
- Lead hook to the body, lead hook, cross, rear knee
- Rear uppercut, lead hook, rear push kick, flying rear knee

#### **Nutrition and recovery program**

The participant in this case study followed a consistent nutrition program based on nutritional principles developed by registered dietitians and leading sports performance specialists [Athletes' Performance, 2014; Berardi, Andrews, 2017]. EXOS (formerly Athletes' Performance) has developed clear and effective nutritional principles for their professional athletes that focuses on four key requirements: *Fuel*, *Build*, *Protect*, and *Prevent* [Athletes' Performance, 2014]. *Fuel* refers to carbohydrates, which are the primary fuel source for the brain and physical activity. Examples of food sources for *fuel* include oatmeal, brown rice, high fiber cereal, quinoa, and whole grain bread. *Build* refers to protein, which builds muscle tissue and maintains the immune system. Examples of food sources for *build* include salmon, tuna, chicken, turkey, lean red meat, low fat dairy, and eggs. *Protect* refers to fats, which contain powerful antioxidants for cellular repair (of joints, organs, skin, and hair), aid in nutrient absorption (vitamins A, D, E, and K), and release energy slowly to stabilize energy levels, blood sugar, and keep individuals satiated. Examples of food sources for *protect* include avocado, almonds, walnuts, pecans, and seeds. *Prevent* refers to vegetables and fruits, which provide natural vitamins, minerals, and antioxidants that contribute to the repair of the body. Examples of food sources for *prevent* include beets and tomatoes (red food sources generally support heart and lung health), blueberries and plums (deep blue and purple food sources generally support brain, heart, and cellular health), carrots and sweet potatoes (orange food sources generally support skin health and DNA protection), broccoli and spinach (green food sources generally support eye and bone health), and garlic and onions (white food sources generally support the immune system). For the duration of this 3-week shadowboxing study, the food sources for the participant included salmon nigiri, tuna nigiri, Barbacoa Sabor pork jerky, Blue Diamond almonds, bananas, blueberries, strawberries, Chobani complete yogurt shakes, Muscle Milk protein shakes, Gatorade G series thirst quenchers, Red Bull energy drinks, and Suja Organic cold pressed juices: Sweet Beets (apple, carrot, beet, banana, orange) and Mighty Dozen (apple, celery, cucumber, kale, collard greens). Recovery, or the process of adapting to and overcoming the stresses imposed by the training environment, is essential to any general health and fitness or sports performance program [Athletes' Performance, 2014]. As coaches Mark Verstegen and Pete Williams [2004] write in *Core Performance*, "Work + Rest = Success." The participant in this case study therefore followed a consistent recovery program to optimize recovery from exercise, which consisted of 8 to 9 hours of uninterrupted sleep per night.

#### **References**

Athletes' Performance. (2014). EXOS Performance Specialist Course. Athletes' Performance, Tempe.  
<https://exoslearn.inspire360.com/exoslearn/exos-performance-specialist-course>



- Berardi, J., Andrews, R. (2017). The Essentials of Sport and Exercise Nutrition Certification Manual. Precision Nutrition, Toronto.
- Clark, M.A., Lucett, S.C., Corn, R.J. (2007). NASM Essentials of Personal Fitness Training. Wolters Kluwer, Philadelphia.
- Clark, M.A., Lucett, S.C., Kirkendall, D.T. (2010). NASM Essentials of Sports Performance Training. Wolters Kluwer, Philadelphia.
- Clark, M.A., Lucett, S.C., Sutton, B.G. (2013). NASM Essentials of Corrective Exercise Training. Wolters Kluwer, Philadelphia.
- Collins, A. (2012). The Complete Guide to Functional Training. Bloomsbury, London.
- Croom, A.M. (2023). The impact of shadowboxing on the psychological well-being of professional martial artists. Discover Psychology, 3(1), 4. [DOI]
- DeLorme, T.L. (1945). Restoration of muscle power by heavy resistance exercises. The Journal of Bone and Joint Surgery, 27(4), 645-667.
- Evolve MMA. (2018). Can you switch stances in boxing? Evolve Daily. <https://evolve-mma.com/blog/can-you-switch-stances-in-boxing>
- McCall, P. (2012). Train movement - not muscles. American Council on Exercise (ACE) Fitness. <https://www.acefitness.org/resources/pros/expert-articles/2794/train-movement-not-muscles>
- Shechtman, O. (2013). The coefficient of variation as an index of measurement reliability. In S.A.R. Doi, G.M. Williams (Eds.), Methods of Clinical Epidemiology. Springer, Berlin. [DOI]
- Tyson, M. (2020). "Everybody thinks this is a tough man's sport. This is not a tough man's sport. This is a thinking man's sport. A tough man is gonna get hurt real bad in this sport". Instagram. <https://www.instagram.com/p/CFAHb54F53m>
- Verstegen, M., Williams, P. (2004). Core Performance. Rodale Books, Emmaus.