THE EFFECTS OF HOLOGRAM WRISTBANDS AND PLACEBO ON ATHLETIC PERFORMANCE

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Abstract:

The purpose of this study was to investigate the effect of hologram wristbands and placebo on athletic performance measures: acceleration, power, strength, balance and flexibility. Eighteen physically active healthy young adults participated (15 men, 3 women; age: 18.4±0.6 years; weight: 74.5±13.73 kg; height: 177±8.5 cm). Acceleration was measured via the five-metre sprint using a wireless speedtrap; power was measured via the standing long jump; strength was measured via the handgrip dynamometer; balance was measured via the standing stork test with eyes closed; and flexibility was measured via the sit-and-reach test. A double blind, placebo controlled, randomized design with repeated measures was utilized. All participants undertook four different treatment conditions, consisting of: 1) told wristband/given wristband, 2) told wristband/given placebo, 3) told inert wristband/given wristband, and 4) no wristband, which was the control group. Results were analysed using a one-way analysis of variance with repeated measures. A p value of .05 was used to establish statistical significance. There were no significant differences in acceleration, power, strength, balance or flexibility across any of the four conditions (p>.05). The results indicate that hologram wristbands did not have an immediate effect on athletic performance and no placebo effects were found in any areas of athletic performance.

Key words: *alternative medicine, athletic performance, magnetic therapy*

Introduction

Athletes are continually trying to enhance their performance. The exposure and use of a large variety of ergogenic aids that can potentially give them an advantage appears to be on the increase (McClung & Collins, 2007). Training paradigms such as intensity, density and frequency and nutrition are significant features in achieving the full capabilities of an athlete; however, this is not enough for some (Schall, Ishee, & Titlow, 2003). The drive to reach optimum athletic performance is tempting athletes to use unverified and potentially hazardous supplements and methods (Kim, Otzel, Kim, & Janelle, 2006). The majority of these products are badly regulated and have inadequate research to substantiate the claims (Gulick, Agarwai, Josephs, Reinmiller, & Zimmerman, 2011). Therefore, the pursuit of safe and effective ergogenic aids endures. The most recent products gaining popularity are performance jewellery, which ranges from magnetic wristbands to hologram wristbands and necklaces (Porcari, et al., 2011).

One of the most marketed products which are endorsed by numerous elite athletes is the hologram wristband. They claim to use holograms embedded with energy waves that react positively with the body's natural energy field to improve balance, strength and flexibility (Power Balance®, 2011). The apparent theory behind this is based on an area in Complementary and Alternative Medicine (CAM) called energy medicine (Bringman, Kimura, & Schot, 2011). Sensitive forms of energy or bio-fields fill the body and these can be controlled to improve health and performance (Warber, Cornelio, Straughn, & Kile, 2004). However, according to Bringman et al. (2011) bio-field energies are not yet measurable, so how this can be quantified and harnessed in a hologram is still yet to be proved. The idea of bio-energy is not well described and various academics within the CAM field have differing understandings of the notion (Hintz, et al., 2003). The idea is meant to generally describe the origin of healing across a range of practices including reiki, distance healing, external qigong, and therapeutic touch; however, it does not identify a particular type of energy (Hintz, et al., 2003). This is further confused by the fact that the range of practices within the bio-energy field are purported to use close range as well as long distance range energy transfer which would not correspond to the same classification of energy (Hintz, et al., 2003). There is also no evidence yet to the authors' knowledge that would explain and substantiate how this bio-energy is transferred into performance jewellery.

There are only three apparent research studies that have investigated the athletic performance effects of hologram wristbands (Bringman, et al., 2011; Porcari, et al., 2011; Verdan, et al., 2011). Bringman et al. (2011) investigated the effects of an ionic bracelet on a range of sport-related domains, muscular strength, power, sensorimotor and perceptuomotor integration and concentration. They concluded that the ionic bracelet showed no instant benefits in any of the areas tested. Porcari et al. (2011) evaluated whether wearing a Power Balance® wristband could improve trunk flexibility, balance, strength and lower body power. This study aimed to mimic the tests used by Power Balance®. This creates issues with the study's methodology due to the subjectivity of the assessment procedure. These tests are hard to standardize due to the need of the tester to place force, using their own body weight, on various positions on the participant (Power Balance®, 2011). Therefore the sensitivity of these tests is questionable. There were also other issues regarding methodology such as no warm-up or practice trials. The research concluded that there were no significant differences in any of the tests between the Power Balance® and the fake wristband. Finally, Verdan et al. (2011) investigated the effects of the Power Balance® wristband on strength, flexibility and balance. They took into account the need for a control group and tested participants with the Power Balance® wristband, a placebo wristband and no wristband (control). The study found no evidence of significant differences in strength, flexibility or balance using the Power Balance® wristband. There were also no placebo effects found in the study, which according to Porcari et al. (2011) were thought to be one of the wristband's main powers.

The scientific evidence behind the Power Balance® wristband is extremely ambiguous, yet this has not perturbed athletes who continue to endorse their claims. Verdan et al. (2011) suggest that the potential improvements athletes might feel wearing the wristband are due to the placebo effect, rather than the change in the body's energy flow. It is only recently that the true scale of the placebo effect on sports performance has been researched (Beedie & Foad, 2009). With emerging evidence of performance enhancement from the deceptive admi-nistration of various supplements: steroids (Maga-naris, Collins, & Sharp, 2000); 'super oxygenated water' (Wright, et al., 2009); sodium bicarbonate (Mclung & Collins, 2007) and caffeine (Pollo, Carlino, & Benedetti, 2008). Furthermore, Foad, Beedie, and Coleman (2008), Beedie (2007) as well as Duncan, Lyons, and Hankey (2009) established that the positive belief of taking or using a performance-enhancing aid was enough to enhance performance, the previously mentioned ergogenic aids are fairly well established, whereas the ambiguity of the power balance band could effect build the belief in its ability to enhance performance. Therefore, the aim of the present study is to ascertain whether any performance enhancement can be gained from wearing performance jewellery and to establish if it can create a placebo effect on performance.

Methods

Participants

Eighteen volunteers participated in this study (15 men, 3 women; age: 18.4±0.6 years; body weight: 74.5±13.73kg; body height: 177±8.5cm). The subjects were all physically active (2.6±1.3 days moderate/vigorous physical activity a week) Sports Science College students. The participants that volunteered in the study were within the demographic aimed at by Power Balance® and other performance jewellery brands. Participants were injury-free at the time of data collection and provided written informed consent. University Ethics Committee approval for the study's experimental procedures was obtained and followed the principles outlined in the Declaration of Helsinki.

Procedure

A double-blind, placebo controlled, randomized, and repeated-measures design was utilized for this investigation. The participants were informed they were volunteering in a study examining the effects of two new performance enhancement wristbands on athletic performance and were provided with information regarding their potential effects. They all received the same information. The participants were tested wearing a Power Balance® wristband, a Power Balance® wristband with the holograms detached (placebo) and with no wristband. The wristbands were covered with tape to blind participants and test supervisors. All the participants completed all experimental conditions:

1. Told Wristband/Given Wristband (W/W) – told they were receiving the wristband and received it.
2. Told Wristband/Given Placebo (W/P) – told they were receiving the wristband but actually received inert wristband in disguised form; placebo condition.
3. Told Inert Wristband/ Given Wristband (I/W) – told they were receiving inert wristband, but actually received wristband in disguised form.
4. No Wristband – Control (C) – without wristband.

Conditions: Told Wristband/Given Wristband (W/W) and Told Wristband/Given placebo (W/P) allowed for an assessment of the physiological/mechanical outcomes compared to placebo. Conditions: Told Wristband/Given Wristband (W/W) and Told Inert Wristband/Given Wristband (I/W) provided an assessment of only physiological/mechanical aid effects. Lastly, conditions: Told Wristband/Given Placebo (W/P) and No Wristband – Control (C) allowed for an assessment of expectancy effects in the absence of physiological/mechanical aids.

A structured five-minute warm-up was performed by all the participants before testing. It consisted of three minutes of stationary cycling, followed by bodyweight squats and lunges (ten repetitions each). The participants then undertook the main performance tests. Before they undertook the test, they had a practice attempt and they had two official attempts. A one-minute rest was given between attempts. The highest scores for each test in all experimental conditions were used for statistical analysis. The participants were randomly asked to come in for testing on one occasion; all tests for all conditions were completed on that visit.

During each condition the participants undertook five tests:

1. Acceleration Testing: Participants performed two trials of a five-metre sprint test. Time was controlled using a wireless speedtrap (Brower Timing System, Utah, USA). Participants were required to have a standardized stance of feet parallel and shoulder width apart. Starting was volitional, the timing gates were activated when the participant's body went through the start gate and stopped when the body went through the end gate.
2. Power Testing: Participants performed two trials of the standing long jump (SLJ) for maximum distance. This was assessed on a tape-measured mat; participants were prompted to jump as far as possible using a countermovement jump. Distance was measured from the zero mark to the nearest landing point of the participant's foot (Markovic, Dizdar, Jukic, & Cardinale, 2004; Papadopoulos, et al., 2011; Almuzaini, 2000; Almuzaini & Fleck, 2008).
3. Strength Testing: Participants performed two trials of the handgrip dynamometer (Takei A5001, Niigata, Japan) for maximum grip strength on each hand. They performed the test standing with feet hip-width apart and with their elbow flexed to 90 degrees against their sides (Bohannon, 2004, 2006).
4. Balance Testing: Participants performed two trials of the standing stork test on each leg. Participants were required to stand on one leg whilst placing the sole of the other foot by the kneecap of the standing leg and place hands on hips. On the command 'go', the participants closed their eyes and the stopwatch was started. The participants were told to hold this position as long as possible. The time ended when the raised leg touched the floor, eyes were opened or hands were taken away from the hips. This method was adapted from previous research (Ribadi, Rider, & Toole, 1987; Balint, & Spulber, 2011; Muehlbauer, Roth, Bopp, & Granacher, 2012; Verdan, et al., 2011).
5. Flexibility Testing: Participants performed two trials using the sit-and-reach test. Participants sat on the floor with legs fully extended and heels touching the sit-and-reach box. The participants placed one hand on top of the other and slowly reached forwards along the box as far as they could.

To try and ensure a high standard of validity and reliability, standardized tests were chosen where possible; i.e. Brower Timing System Speedtrap, standing long jump, handgrip dynamometer and the sit-and-reach test (Baechle & Earl, 2008; McArdle, Katch, & Katch, 2010). Due to the adaptation and creation of one unstandardized test, the standing stork balance test, a pilot research group completed the testing protocol for the standing stork test as well as the standing long jump, handgrip dynamometer, and the sit-and-reach test on two separate occasions under the same conditions, to test for retest reliability. Using Pearson's correlation coefficients for statistical analysis, strong correlations were found for all tests (standing long jump $r=.99$; handgrip dynamometer $r=.99$; standing stork test $r=.99$; sit-and-reach $r=.91$).

Data analysis

Descriptive statistics (M±SD) were calculated. The Shapiro-Wilk statistic for each test was undertaken to check whether the data was normally distributed. To examine any effects of hologram wristbands one-way analysis of variance (ANOVA) with repeated measures was used for statistical analysis on each dependent variable. In circumstances where sphericity had been infringed, Greenhouse-Geisseser degrees of freedom were applied. A p value of .05 was used to establish statistical significance. Partial effect sizes were calculated using an Eta^2 (η^2). The Statistical Package for Social Sciences (SPSS), version 20, and Microsoft Excel 2011 were used for all analyses.

Results

The purpose of this study was to examine the effects of hologram wristbands on a series of objective athletic tests.

Acceleration

A one-way ANOVA was conducted on the five-metre sprint data. No significant differences were observed between the conditions tested when performing the five-metre sprint test ($F_{3,51}$=1.724, p=.174, η^2=.092). The M±SD sprint times for each condition were: W/W: 1.25±0.12s; W/P: 1.26±0.15s; I/W: 1.26±0.12s; C: 1.23±0.12s (Figure 1), therefore the wristband had no effect on five-metre sprint performance.

Power

A one-way ANOVA found there were no significant differences between the conditions used when performing the standing long jump test ($F_{3,51}$=0.355; p=.781; η^2=.020). Therefore there was no effect of the wristband on long jump performance with the M±SD distances for each condition being: W/W: 2.22±0.34m; W/P: 2.22±0.33m; I/W: 2.20±0.36m; C: 2.19±0.36m (Figure 2).

Strength

A one-way ANOVA demonstrated there were no significant differences between the conditions used when performing the handgrip dynamometer test on the right hand ($F_{3,51}$=0.727; p=.541, η^2=.041) as well as no effect on the left hand ($F_{3, 51}$=1.119; p=.350, η^2=.062). Therefore, the wristband had no effect on grip strength performance (Table 1).

Balance

There were no significant differences between the conditions used when performing the standing stork test on the right leg ($F_{3,51}$=0.113, p=.952, η^2=.007) and on the left leg ($F_{3,51}$=.672, p=.573, η^2=.038). Therefore, the wristband had no effect on balance on either leg (Table 1).

Flexibility

There were no significant differences between the conditions used when performing the sit-and-reach test ($F_{3, 51}$=1.681, p=.183, η^2=.090). The M±SD for each condition were: W/W: 22.94±7.63cm; W/P: 23.39±7.28cm; I/W: 23±7.90cm; C: 22.1±7.50cm and therefore the wristband had no effect on lower back flexibility.

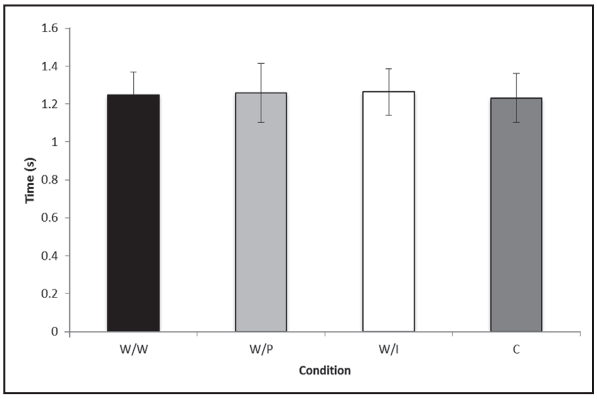

Figure 1. M±SD 5m sprint times for each condition.

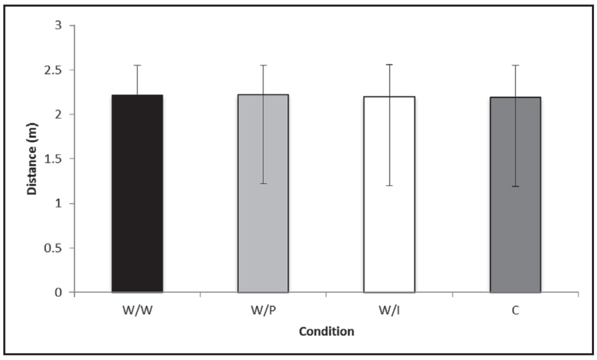

Figure 2. M±SD of power between conditions.

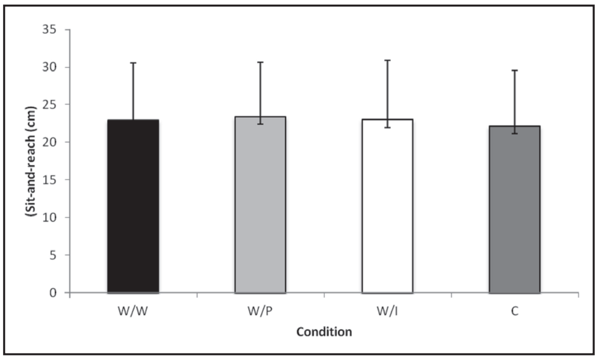

Figure 3. M±SD sit-and-reach scores between conditions.

Table 1. M±SD of grip strength (both left and right hands) and balance (both left and right legs) for all conditions

	M(±SD)			
	W/W	**W/P**	**W/I**	**C**
Grip strength – right hand (kg)	40.8 (±9.87)	42.11 (±8.03)	41 (±8.65)	42.16 (±9.12)
Grip strength – left hand (kg)	39.88 (±10.87)	41 (±10.29)	39.61 (±8.63)	41.55 (±10.08)
Balance - right leg (s)	12.72 (±12.66)	12.78 (±8.63)	13.63 (±18.46)	14.43 (±10.67)
Balance - left leg (s)	19.4 (±26.09)	20.00 (±16.83)	14.05 (±9.61)	22.72 (±36.08)

Discussion and conclusions

Establishments in the performance jewellery industry contend that hologram wristbands will enhance athletic performance by improving balance, strength and flexibility (Power Balance®, 2011). They have used powerful marketing campaigns, which have been supported by frequent anecdotal evidence from coaches and athletes alike, to try and verify these claims. To date, however, there is limited empirical research that has been performed to evaluate the effectiveness of performance jewellery on athletic performance. Therefore, the purpose of this study was to establish if any performance-enhancing effects could be established using a hologram wristband and also if any placebo effects could be measured.

The results from this study indicate no significant differences ($p>.05$) between any of the four conditions (W/W, W/P, I/W and C) throughout all of the tests for acceleration, power, strength, balance and flexibility. These results are consistent with Bringman et al. (2011), Porcari et al. (2011) and Verdan et al. (2011) and offer more evidence to imply the ineffectiveness of hologram wristbands on athletic performance. Of further interest is that no improvements in performance were seen through placebo responses, which is fundamentally important as the placebo effect was suggested as being the key performance enhancement mechanism for the hologram wristband (Porcari, et al., 2011).

The physiological/mechanical mechanisms that emanate from hologram wristbands are alleged to be an increase in energy waves, and the frequency of them, that react with the body's natural energy to improve balance, strength and flexibility (Power Balance®, 2011). This is rather ambiguous and avoids distinguishing the exact physiological effects that would occur in the body whilst wearing one. Warber et al. (2004), Bringman et al. (2011) and Verdan et al. (2011) documented that the hologram wristband purportedly carries electromagnetic fields of energy and that natural bio-energetic frequency patterns can be manipulated through electromagnetics to treat the body. Nevertheless, this still does not classify the physiological/mechanical responses that would be expected to occur for participants to improve balance, strength and flexibility as claimed by Power Balance® (2011). The current study used standardized tests for acceleration, power, strength, balance and flexibility, which all require a vast amount of physiological/mechanical mechanisms for effective performance. Some of the physiological/mechanical elements that would affect performance levels on the current study's tests would be: muscle fibre type, muscle cross-sectional area and muscle pennation angles, fascicle length and muscle stiffness, rate of force development and elastic energy storage, adenosine triphosphate and phosphocreatine storage capacity as well as sensorimotor control and proprioceptive ability (McArdle, et al., 2010; Baechle & Earle, 2008; Zatsiorsky & Kramer, 2006). The intricate details of each test component are beyond the scope of this paper; however, the physiological/mechanical elements that would affect them are commonly measured in sports science research. Here then is perhaps where the performance-enhancing claims of hologram wristbands fall down. To date, there is no evidence to show that any of the measurable physiological/mechanical mechanisms that effect athletic performance can be improved by wearing hologram wristbands. Therefore it would appear that the theory and marketing behind performance-enhancing jewellery is trying to draw tenuous links to quantum physics in regards to bio-field energy and electromagnetics, to try and establish some scientific basis for the product's claims. This is also hypothetically why no placebo effects were evidenced in this study. Placebo effects are strongly linked to expectation levels in participants (Beedie, 2007; Foad, et al., 2008; McClung & Collins, 2007; Beedie, 2010; Pollo, Carolino, & Benedeti, 2011), and also the biological properties of the real ergogenic aid (Pollo, et al., 2011; Beedie, 2010). Therefore if there is confusion and uncertainty about a product's purported ability such as hologram wristbands, expectation levels will be affected and any possible placebo effects will potentially be negated.

In relation to the assertion that the real power of hologram wristbands is that of the placebo effects they generate, this has not been supported in this research. No placebo effects were exhibited for any of the athletic components tested. This possibly suggests that the individual participants may have adopted scepticism over the claimed science and mechanics behind the wristbands, which in turn, may have affected their ability to generate any kind of strong psychological expectations that performance enhancements could have been gained. An important point to note with regard to placebo effects is that any rational assumptions from any research that involves a participant performing to an improved level after consuming/using an inert substance/aid is that there is hypothetically a large amount of unexploited psychological potential in that person. It is therefore the responsibility of sports science practitioners and coaches to recognize and acknowledge the potential psychological consequences of athletic performance if performers rely on hologram wristbands heavily. For example, if an athlete's performance were successful when wearing the wristband during a major competition, could this then pose a risk with the athlete overrating the effects of the band and underrating the effects of traditional methods of training that are considered to be more scientifically sound? Potentially this could affect future attitudes to training. Conversely, is there a risk of performance being jeopardized if an athlete's wristband were misplaced on the day of a major competition? It is suggested that instead of depending on a hologram wristband to unlock further psychological assets in athletes, more valid and reliable approaches to sports psychology interventions should be utilized.

This investigation set out to measure the purported effects of hologram wristbands and placebo on athletic performance. It should be noted that the Power Balance® wristband was utilized for this study and that this is only one of a vast amount of products in the performance jewellery market. There is also sparse information on the design and structure of these wristbands. Therefore the application of this study to alternative performance jewellery products on the market is therefore inadequate. Although the scientific claims behind hologram wristbands are linked to Complementary and Alternative Medicine, this research does not challenge other energy therapies. Future researchers interested in this area could develop on this study by targeting different population demographics to make it more relevant to the wider population, perhaps specifically investigating the effects on trained populations compared to untrained. All the evidence so far found on hologram wristbands is based on immediate effects, thus research into the longer-term outcomes of wearing hologram wristbands would be of interest. To prevent any claims of potentially disruptive testing protocols such as taping directly over the hologram wristband, a less intrusive blinding procedure should be employed.

In conclusion, the present study supports previous research and adds strength to the hypothesis that no performance-enhancing effects can be gained from wearing hologram wristbands. It is suggested that performance jewellery establishments utilize clever marketing campaigns and heavily subjective tests that enable participants to improve their performance through a learning effect of the exercise test rather than through any physiological/mechanical processes. Hologram wristbands did not demonstrate evidence of immediate effects on any of the fundamental athletic performance components (acceleration, power, strength, balance and flexibility). Therefore those wanting to boost their acceleration, increase their power and strength, and improve their balance and flexibility would be best advised to concentrate on enhancing these components through reliable scientific evidence-based methods of training such as plyometric training, resistance training, balance and flexibility training, rather than utilizing a hologram wristband to do so.

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UČINCI NARUKVICA S HOLOGRAMOM I PLACEBA NA SPORTSKU IZVEDBU I USPJEŠNOST

Cilj je ovog istraživanja bio istražiti učinke narukvica s hologramom i placeba na parametre sportske uspješnosti: ubrzanje, eksplozivnu snagu, jakost, ravnotežu i fleksibilnost. Osamnaest tjelesno aktivnih mladih odraslih osoba sudjelovalo je u istraživanju (15 muškaraca i 3 žene; dob: 18,4±0,6 godina; tjelesna težina: 74,5±13,73 kg; tjelesna visina: 177±8,5 cm). Ubrzanje je mjereno testom sprint na 5 metara pomoću bežičnog mjerača brzine; eksplozivna snaga je mjerena testom skok udalj s mjesta; jakost šake je mjerena ručnim dinamometrom; ravnoteža testom stajanja na jednoj nozi zatvorenih očiju, a fleksibilnost testom *sjedni i dohvati*. Korišten je dvostruko slijepi, placebo kontrolirani dizajn eksperimenta sa slučajnim odabirom ispitanika i ponovljenim mjerenjima. Svi ispitanici bili su podvrgnuti četirima različitim uvjetima tretmana koji su se sastojali od situacija u kojima je ispitanicima: 1) rečeno da imaju narukvicu/dobili su narukvicu, 2) rečeno da imaju narukvicu/dobili su placebo, 3) rečeno da su dobili neaktivnu narukvicu/dobili su pravu narukvicu te 4) nisu dobili narukvicu – ti su ti ispitanici predstavljali kontrolnu grupu. Rezultati su obrađeni jednostrukom analizom varijance s ponovljenim mjerenjima. Za utvrđivanje statističke značajnosti korištena je p vrijednost od 0,05. Nisu zabilježene značajne razlike u ubrzanju, eksplozivnoj snazi, jakosti, ravnoteži ni fleksibilnosti između sva četiri testirana uvjeta izvedbe ($p>0,05$). Rezultati pokazuju da narukvice s hologramom nisu imale akutnog učinka na sportsku uspješnost, a nije detektiran ni placebo učinak ni u jednom od testiranih područja sportske izvedbe.

Ključne riječi: *alternativna medicina, sportska izvedba, magnetska terapija*