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Willingness to Pay and Accept for Hosting Olympic Games in Germany



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ATHENS INSTITUTE FOR EDUCATION AND RESEARCH

A World Association of Academics and Researchers

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Athens Journal of Sports

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The current issue is the third of the seventh volume of the *Athens Journal of Sports*, published by the [Sport, Exercise, & Kinesiology Unit](#) of the ATINER under the aegis of the Panhellenic Association of Sports Economists and Managers (PASEM).

Gregory T. Papanikos, President, ATINER.



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Leadership Applications for Sport and Recreation Service Leaders

By Ioanna Maria Kantartzi* & George Karlis‡

Sport and recreation are closely linked service-oriented professions. Sport and recreation professionals and practitioners often share ideas and knowledge to increase understanding of leadership means and capacities to better serve. The purpose of this paper is to examine leadership while presenting applications for "good leadership" for the sport and recreation service industries. To fulfill this purpose, this paper introduces the notion of leadership and its styles. This paper concludes with five applications for "good leadership" for current and future sport and recreation leaders: (1) awareness of constant on-going change, (2) have a democratic approach, (3) effective communication skills, (4) maintain an open-door policy, and (5) enhance quality of life. Although this list of applications is not all-inclusive, it does depict critical attributes that sport and recreation service leaders should possess today and in the future.

Keywords: Leadership, sport, recreation, sport and recreation services

Introduction

During the 20th century, research on leadership expanded at a rapid pace from multidisciplinary perspectives. Although much of the research conducted has come out of the field of business and administration, leadership has been researched in other fields of study such as politics, psychology, sociology, community development, sport, and recreation. Early 20th century research on leadership looked at the relationship between leadership and personality (Van Seters and Field 1990). As Greenwood (1996) posits, the historical evolution of leadership was initially linked to an understanding of personality traits. Later, in the 1960s, research on leadership focused largely on understanding human relations and human interactions and the impact these had on work and motivation (Greenwood 1996).

Sport and recreation are two service-oriented professions that have a lot to contribute in the understanding of what leadership is and how it can be best practiced. In the early part of the 20th century, sport and recreation continued to gain in importance, particularly with the expansion on urbanization and municipal recreation services (Karlis 2016). As cities grew, the need for recreation and other public services expanded. Thus, leaders came to the forefront to help guide, establish, and implement these services.

In the past 100 years, leadership has come a long way. Leadership helps us understand how important it is to lead, guide, and direct; it also helps us recognize the importance of planning, organizing, directing and implementing services.

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Existing research reveals, however, that there is not only one way to understand what leadership is, as it is a notion that has been defined in many different ways. Research in sport and recreation indicates that there are many different styles of leadership that can be implemented in sport and recreation services and settings (Karlis 2020).

The purpose of this paper is to, through a leadership review, examine leadership while also present applications for "good leadership" for the sport and recreation service industries. To fulfill this purpose, this paper introduces leadership and its styles, while concluding with five applications for "good leadership" for current and future sport and recreation leaders: (1) awareness of constant on-going change, (2) have a democratic approach, (3) effective communication skills, (4) maintain an open-door policy, and (5) enhance quality of life.

Introducing Leadership

Bolden et al. (2011), indicated that leadership is the combination of social influence, guidance, structural behaviours, activities, and relationships towards the achievement of shared aims. All these leadership characteristics shape a "property" of an effective systemic design in which leadership development includes commitments among the members of a community, as they are working together and are accountable to each other. This interconnection of community members indicates that social behaviour is an important development tool of "good leadership".

Leadership is a behavioural shaped notion. It is determined and largely shaped by norms and values of society, organizations, institutions, as well as the norms and values of people. *Normative leadership* for instance, refers to approaches of leadership that describe the most effective styles of leadership intervention. The *normative leadership* notion is applied to behavioural and situational leadership situations, but also to transformational, servant, and distributed organizations leadership styles (Bolden et al. 2011). The implementation of a normative leadership approach is largely shaped and determined by situation and culture.

Bolden et al. (2011) define leadership as a notion that consists of a number of essential characteristics. These include: (1) leadership as a factor contributing towards organizational performances, (2) leadership as a source of power on achieving goals (3) leadership as a set of competences which can be developed and assessed, (4) leadership as a strategic vision setting out the organization's future, (5) property and product of organizational culture, and, (6) leadership as a practice that is shaped by organizational context (Bolden et al. 2011). Thus, leadership is a tool for achieving collective groups' structure, organizing and reaching goals, and managing organizational performance.

A further conceptualization of leadership by Van Knippenberg and Hogg (2003) takes a more sociological approach. For Van Knippenberg and Hogg (2003) leadership refers to the patterns of social interactions between and amongst a group of people in organizations. Focus is given to the importance of the

leadership process in directing people to increase productivity. As stated by Chemers (2003) the sociological approach of leadership focuses on the interrelationship and communication patterns used to achieve organizational and individual goals.

Pierce and Newstrom (2006) also define the concept of leadership and introduce different types of leadership styles. Leadership has a simple definition as it refers to the behaviour of individuals in which leaders provide guidance, and exert influence to their followers (Pierce and Newstrom 2006). Leadership is the relationship between the leader and a situation, that is, leadership and followers (Pierce and Newstrom 2006).

From the aforementioned conceptualizations of leadership it can be posited that one overarching perspective of leadership does not exist, as there are many ways of viewing the meaning of leadership. Perhaps a broader way of conceptualizing leadership is to identify its defining characteristics. Pierce and Newstrom (2006) do this while indicating that there are eleven approaches of leadership: (1) leadership as a focus of group processes, (2) leadership as personality and its effects, (3) leadership as an act or behaviour, (4) leadership as an instrument of goals, (5) leadership as an emerging effect of interaction, (6) leadership as a different role, (7) leadership as the initiation of structure, (8) leadership as the art of inducing compliance, (9) leadership as the exercise of influence, (10) leadership as a form of persuasion, and (11) leadership as a power relationship. The concept of leadership is thus complex and viewed according to many different perspectives (Bolden et al. 2011).

Leadership Styles

Many different leadership styles have been employed in sport and recreation organizations (Karlis 2020). For the purposes of this paper, eight popular leadership styles in sport and recreation services are presented. These include: (1) democratic, (2) autocratic, (3) laissez-faire, (4) strategic, (5) transformational, (6) transactional, (7) coach-style, and (8) bureaucratic (Becker 2020).

The democratic style is the most popular and common style of leadership employed (Becker 2020, Sharma and Singh 2013). This is largely attributed to the fact that leaders are supportive of listening to their teams' opinions, with decisions made in a democratic way. The democratic leadership style allows accessibility of employees and, in some cases, to service participants to voice opinions and get involved in decision-making. It is thus a favourable approach for organizational commitment and positive group dynamics.

On the contrary, in the autocratic leadership style, decisions and leadership actions come primarily and directly from leaders without consultation of subordinates. The autocratic leadership style is based on a hierarchy in which decisions come from above, and are made from executives or managers in leadership positions. Studies have shown that this style may have a negative impact on performance (Dolly and Nonvelum 2018). However, this style does have effective outcomes for larger sized organizations.

The laissez-faire leadership style is the least intrusive form of leadership (Becker 2020). Laissez-faire is a French term that can be translated to "let them do" (Becker 2020). Often in the laissez-faire approach, members of an organization who do not have a leadership title will come forth and take the lead of certain initiatives. This style is known as absence of leadership, and may reduce the level of productivity (Tosunoglu and Ekmekci 2016).

The strategic style of leadership is one in which leaders not only accept burdens but also take measures to make sure that working conditions are appropriate for organizational members. According to Becker (2020) the strategic style of leadership may be applied in different situations, in different contexts, and needs to be treated carefully as its success depends on how many subordinates a leader can support at one time. According to Stumpf and Mullen (1991), the strategic leadership style stresses that the leader will be able to tap into concepts and skills, and process them in time to implement effective leadership.

The style that may be more effective than the others is the transformational leadership style. In the transformational leadership style, employees recognize individual tasks and weekly goals. However, the leader tries to get more out of their employees by expanding their capacity beyond their comfort zone. The leader challenges employees by giving them more and different goals and objectives, ultimately to make the organization more productive. The transformation leadership style can be an encouraging and a highly productive leadership approach, as it helps individuals to understand their limits and accomplish their goals (Becker 2020). The leader plays the role of the change agent while inspiring the subordinates to be more creative. Some of the main characteristics of this leadership style include influence, individualized consideration, intellectual stimulation and inspiration motivation (Ghasabeh 2017).

Leaders utilizing a transactional leadership style not only try to organize individuals, but also give them bonuses for achieving their goals. This bonus giving approach is employed by the transactional leadership style with a main goal to motivate individuals to better achieve personal and organizational goals as well as contribute to the development of the organization. Thus, this style provides a win-win scenario for both workers and the organization (Becker 2020). The transactional leadership style contributes to the satisfaction level of the subordinates and possibly to greater work performance efforts (Hussain et al. 2017).

The coach-style leadership style is an approach that has many similarities to sports coaching. In this style, leaders attempt to identify the strengths and limits of individuals while developing subordinates to achieve greater productivity in the organization. Coach-style leadership identifies means to make the organization work more cooperatively. Thus, the coach-style leadership approach emphasizes the importance of individual and team success (Becker 2020). Apart from its motivational character, in this style leaders hold responsibility and accountability in the leading process (Moen and Federici 2012).

Finally, the bureaucratic leadership style, according to Becker (2020), is infrequently effective, as all individuals have to work in accordance to stated guidelines. This means that every piece of the organizational puzzle needs to be

connected and worked to the organizational goals and objectives. Thus, leaders lead to ensure working tasks abiding with organizational policies and practices.

A number of factors are important and relevant to consider when it comes to the success of a leadership style in sport and recreation organizations and services. Factors such as size, type of organizations (private, public, non-profit), goals to be achieved, resources at hand (human, material, and financial), etc., all play a key role in determining what leadership style is best employed. Each case specific situation needs to be carefully considered in determining the leadership style that is best (Yukl 2004).

Applications for "Good Leadership" for Current and Future Sport and Recreation Service Leaders

Society and its people have come a long way in the last century, and so have the needs and expectations of sport and recreation services and their leaders. A lot is expected of a sport and recreation leader today. To fulfill these high expectations sport and recreation leaders may benefit by recognizing certain principles of "good leadership". Below, are some principles of "good leadership" that have been put together to guide current and future sport and recreation service leaders in delivering services.

Awareness of Constant On-Going Change

We are living in an ever-changing world. Technology and mass communication have a lot to do with the way we have changed, and the way that our sport and recreation needs, and expectations have changed as well. Sport and recreation leaders need to be cognizant at all times that we live in a generation of change. Sport and recreation needs constantly change. Clients of sport and recreation services have expectations to be served and have their sport and recreation needs served. As there is a plethora of sport and recreation needs in society as a whole, a "good leadership" principle that current and future sport and recreation leaders need to possess is an awareness of constant on-going change.

Have a Democratic Approach

As sport and recreation is a people service industry, the best leaders are the ones who listen to the people being served and the people affected by the sport and recreation services offered. Listening however is not enough. Sport and recreation leaders need to get those served involved in decision-making. Having a democratic approach means welcoming participatory input and allowing opportunity for sport and recreation participants to engage in decisions that have to do with the provision of sport and recreation services. Affording participants of sport and recreation services the opportunity to get involved goes a long way in enhancing the quality and satisfaction level of the sport and recreation service and experience.

Thus, a very important principle of "good leadership" for current and future sport and recreation leaders is to have a democratic approach to leadership.

Effective Communication Skills

As the world changes, so does our means of communicating. We now have social media, emails, text messages, etc., which means that we can communicate with a mass group of people faster than ever before. Effective written communication skills are thus more important than ever. Being able to orally communicate in the official language(s) of your host nation is just as important. Despite the means used to communicate, sport and recreation leaders must have the ability to recognize and overcome any expressive and receptive blocks of communication. Sport and recreation leaders need to recognize that effective communication skills take effort and that time needs to be devoted to ensuring that messages are relayed and received as intended. The "good leadership" principle of effective communication skills is one that current and future sport and recreation service leaders need to constantly work on developing and perfecting.

Maintain an Open-Door Policy

The best sport and recreation service leaders are the ones that are accessible. Sport and recreation services leaders who are accessible are the ones available to answer questions, solve problems, and guide and direct. Thus, a sense of responsibility comes with being the leader. Sport and recreation service leaders need to be equipped with answers to questions, meaning that these leaders need to be well prepared and well informed on organizational details, resources, and services offered. Yet, this open-door policy goes beyond answering questions, it extends to making clients of services and co-workers feel important, that is, to recognizing that the sport and recreation leader is there for them.

Enhance Quality of Life

Sport and recreation leaders need to ensure that the environment for sport and recreation and the services of sport and recreation are positive. The success of the sport and recreation organizations depends on sound leadership, as this comes with continuous service and facility evaluation. Sport and recreation service leaders need to conduct regular formal and informal evaluations to ensure that the sport and recreation organization and its services are operating in a positive fashion and enhancing quality of life of all involved, including the participant.

Conclusion

Today, everything is important in sport and recreational services; from the way that services serve the public to the way that people in leadership positions support individuals in achieving their personal goals. Sport and recreation services are people-oriented services. Focus is on individuals or groups of people, who wish to achieve their personal goals and further develop their lifestyle. Successful sport and recreation services are those that are well managed with "good leadership". "Good leadership" is the tool that helps both the sport and recreation services and individuals, to achieve individual, collective, and organizational goals.

Leadership has a great impact on all. Change is inevitable, and leaders are thus called to take on greater challenges than ever. Being a good, efficient, and effective leader is no easy task. It is a skill and talent that cannot be learned only in the classroom, but it rather takes time, knowledge, and experience to develop.

This paper, while focusing on the sport and recreation service industries provided a general overview of the concept of leadership and leadership styles. It concluded with suggestions for "good leadership" for current and future sport and recreation service leaders. Although by no means is the list of five applications all inclusive; this list does depict critical attributes that sport and recreation service leaders must possess today and, in the future, to govern services towards enhancing the quality of life of society.

More research is needed to help understand current trends and directions of the sport and recreation service leadership, as little research has been conducted in the field. Future research should expand on examining case studies of leadership experiences in sport and recreation service organizations to recognize what is happening and what needs to be changed. Future research should focus on the differences in sport and recreation leadership styles in the three sectors –public, private, and non-profit– as it would also make an important contribution to research on leadership and the recreation service industry as well.

References

- Becker B (2020) *The 8 most common leadership styles & how to find your own*. HubSpot Blog. Retrieved from: <https://blog.hubspot.com/marketing/leadership-styles>.
- Bolden R, Hawkins B, Gosling J, Taylor S (2011) *Exploring leadership: individual, organizational & societal perspective*. Oxford: Oxford University Press.
- Chemers MM (2003) *Leadership effectiveness: functional, constructivist and empirical perspectives*. In D Van Knippenberg, MA Hogg (eds), *Leadership and Power, Identity Processes in Groups and Organizations*. Sage Publications.
- Dolly KC, Nonyelum OP (2018) Impact of autocratic leadership style on job performance of subordinates in academic libraries in Port Harcourt, Rivers State, Nigeria. *International Journal of Research - GRANTHAALAYAH* 6(10): 212–220.
- Ghasabeh MS (2017) Transformational leadership: building an effective culture to manage organizational knowledge. *Journal of Values Based Leadership* 10(2): Article 7.
- Greenwood RR (1996) Leadership theory: a historical look at its evolution. *The Journal of Leadership Studies* 3(1): 3–16.

- Hussain ST, Abbas J, Lei S, Haider MJ, Akram T (2017) Transactional leadership and organizational creativity: examining the mediating role of knowledge sharing behaviour. *Cogent Business & Management* 4(1): 1361663.
- Karlis G (2016) *Leisure and recreation in Canadian society*. 3rd Edition. Toronto: Thompson Educational Publishing.
- Karlis G (2020) *Sport, recreation and community development*. Champaign, IL: Sagamore-Venture.
- Moen F, Federici RA (2012) The effect from coaching based leadership. *Journal of Education and Learning* 1(2): 1–14.
- Pierce JL, Newstrom JW (2006) *Leaders and the leadership process. readings, self-assessments & applications*. 4th Edition. Boston, MA: Mc Graw-Hill Irwin.
- Sharma LJK, Singh SK (2013) A study on the democratic style of leadership. *International Journal of Management & Information Technology* 3(2): 54–57.
- Stumpf SA, Mullen TP (1991) Strategic leadership: concepts, skills, style and process. *Journal of Management Development* 10(1): 42–53.
- Tosunoglu H, Ekmekci OT (2016) Laissez-Faire leaders and organizations: how does Laissez-Faire leader erode the trust in organization. *Journal of Economics, Finance and Accounting* 3(1): 89–99.
- Van Knippenberg D, Hogg MA (2003) *Leadership and power, identity processes in groups and organizations*. London: Sage Publications.
- Van Seters DA, Field RHG (1990) The evolution of leadership theory. *Journal of Organizational Change Management* 3(3): 29–45.
- Yukl G (2004) *The future of leadership research: challenges and opportunities*. *German Journal of Human Resource Research* 18(3): 359–365.

Sports Genomics and Sport Doping

By Bogdan-Alexandru Hagiu* & Cristina-Mihaela Ghiciuc[‡]

A topical issue is the need to identify new possibilities for doping, in order to protect the athlete's privacy. We consider it useful to explore the relationship between gene variants that predispose to sports performance and special sensitivity to certain doping substances. For this purpose, we conducted a study in the literature. Among the substances banned from athletes, there are some whose effect is amplified in carriers of gene variants that confer special sports skills anyway: meldonium (athletes with overexpression of PEPCK-C), corticotrophins and their releasing factors (carriers of the allele that produces alpha-actinin-3), caffeine (athletes carriers of PPARA genotypes intron 7 rs4253778 CC and Leu162Val rs1800206 CG), somatotrope (polymorphism rs8192678 of PPARGC1A, polymorphism rs11549465 C>T of HIF1A gene), beta-blockers (carriers of the ACE DD genotype), insulin and its mimetics (rs11549465 C>T polymorphism of the HIF1A gene), cannabinoids (α , β and γ isoforms of PPAR), stimulants and narcotics (carriers of RBFOX1 rs7191721 G), anabolic steroids (athletes carrying EPOR that provide an advantage for physical effort). A number of drugs, supplements, hormones, flavonoids, vitamins and experimental therapeutic substances that are not on the WADA 2020 list may be the subject of future studies regarding their potential as doping substances, given that they have a stimulating action on exercise capacity in the case of particular genomes: cortisol blockers (carriers of the allele that produces alpha-actinin-3), carbohydrate and lipid supplements (polymorphism rs8192678 of PPARGC1A), quercetin (genotypes PPARA intron 7 rs4253778 CC and și PPARA Leu162Val rs1800206 CG), AMPD inhibitors (AMPD1 Gln12 carriers), folates (carriers of the MTHFR polymorphism rs1801131 C), nitrates (variants of NOS3 rs2070744 T), saroglizatar and lobeglitazone (carriers of the Pro12Ala polymorphism), thyroid hormones (variant EP441s, variant TSHR C), Tribulus terrestris (AR variant).

Keywords: Gene variants, potential doping

Introduction

In the literature it has been discussed that analysis and the developed guiding reference are necessary to highlight the need for scientists/clinicians to be well-versed in ethics and data protection policy to advance sport and exercise genomics without compromising the privacy of athletes and the efforts of international sports federations (Tanisawa et al. 2020). However, it can be considered that in order to establish some rules, in addition to the correlations between nutrition and genomics in sports (Guest et al. 2019) and the possible links between gene variants that favor sports talent and doping possibilities must be known. There are

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functional proteins with potential for genetic doping (erythropoietin, insulin-like growth factor, growth hormone, myostatin, vascular endothelial growth factor, fibroblast growth factor, endorphin and enkephalin, α actinin 3, peroxisome proliferator-activated receptor-delta (PPAR δ) and cytosolic phosphoenolpyruvate carboxykinase (PEPCK-C) but also genes with high potential for abuse (PPAR δ and PEPCK-C) (van der Gronde et al. 2013). There were identified 11 genetic markers that create skills for endurance (ACE I, ACTN3 577X, PPARA rs4253778 G, PPARGC1A Gly482) and for strength exercises (ACE D, ACTN3 Arg577, AMPD1 Gln12, HIF1A 582Ser, MTHFR C, rs2070744 T, PPARG 12Ala), and also an number of markers that have been highlighted in athletes of different nationalities, belonging to different sports (CREM rs1531550 A, DMD rs939787 T, GALNT13 rs10196189 G, NFIA-AS1 rs1572312 G, R and TSHR rs7144481 C) (Ahmetov and Fedotovskaya 2015). There have been situations when a single gene variant leads to increased athletic performance, such as erythropoietin receptor (EPOR) or androgen receptor (AR), or when the athletic advantage is the prerogative of hormonal excesses or deficiencies (virilizing adrenal hyperplasia, deficiency genetics of growth hormone, myostatin deficiency) or even genetic diseases (partial familial lipodystrophy, which affects the female gender, some varieties being produced by LMNA gene damage) (Rogol and Pieper 2017). Considering these aspects, the paper aims, based on data from the literature, to identify substances that can act on gene variants that increase sports performance, so as to amplify their effects. Once these substances were identified, we set out to establish, based on the critical analysis of the literature, which of them are on the WADA 2020 list and which can be subsequently introduced on the list of substances banned from athletes carrying particular gene variants.

Method

A literature search was conducted to identify doping substances or those with doping potential to which athletes wearing gene variants that facilitate performance are more sensitive, using articles especially from PubMed, published between 2001 and 2020. In principle, the keywords *athletic*, *doping*, *drugs*, and *genes* were used, but the publications derived from the relevant identified works were also searched, following the questions "Which gene variants influence sports performance?" and "What changes in drug metabolism induce those genes?"

Review of the Literature

Cytosolic phosphoenolpyruvate carboxykinase (PEPCK-C) does not singularly control the rate of hepatic gluconeogenesis, and an activation of the tricarboxylic acid cycle is also required (Burgess et al. 2007).

The ACTN3 gene encodes the α -actinin-3 protein, which stabilizes the contractile apparatus at the Z-lines, and the ACTN3 R577X polymorphism could be a new target for readthrough therapy that may affect human athletic and

muscular performance (Harada et al. 2018).

In footballers, the presence of the allele that produces alpha-actinin-3 shows higher values of testosterone after the game compared to the control group, as well as cortisol, a fact related to the increased values of markers of muscle microtrauma and hormonal stress, both probably produced by more speed and power actions during the game (Coelho et al. 2019).

Cortisol has not been shown to be effective in increasing performance, but athletes have an anabolic/catabolism balance at lower values than untrained individuals, as indicated by the testosterone/cortisol ratio (Dvorak et al. 2006).

The effects of sports training on the genotype PPARA intron 7 rs4253778 CC are increased concentrations of low-density lipoproteins and blood glucose, and on the genotype PPARA Leu162Val rs1800206 CG - decrease in the concentration of high-density lipoproteins (HDL) (Maciejewska-Skrendo et al. 2019). However, the results of quercetin supplementation in these careers may be different from those recorded in endurance runners, in which quercetin reduced lipid peroxidation but did not improve performance (Scholten and Sergeev 2013).

Also, career athletes of the PPARA intron 7 rs4253778 CC and Leu162Val rs1800206 CG genotypes could metabolize caffeine differently, a substance with action on lipid metabolism, banned by WADA (Macchiarella et al. 2017).

Regarding the peculiarities of carbohydrate metabolism, the influences of growth hormone and insulin on sports performance should not be neglected (Sonksen 2001).

Even if the effect is minimal, the rs8192678 polymorphism of peroxisome proliferator-activated receptor- γ co-activator 1- α (PPARGC1A) may contribute to the development of metabolic syndrome (Csépi et al. 2017), so carriers may have differences in the metabolism of quercetin, carbohydrate and lipidic supplements, caffeine, insulin and somatotropes.

Angiotensin (ACE) converting enzyme allele ACE-D in patients with heart failure has an increased ACE activity, and the effects of beta-blockers and high doses of ACE inhibitors have been shown to be more pronounced in those with the ACE DD genotype (McNamara et al. 2004). If the results can be extrapolated to healthy individuals, given that beta-blockers can reduce tremor in some sports, such as shooting and golf (Hughes 2015), it turns out that ACE DD carriers may benefit from using beta-blockers as doping substances.

The role of AMPD1 Gln12 in increasing sports performance can be explained by the fact that pharmacological inhibition of AMPD potentiates energy-producing cellular enzymes, without influencing glucose transport (Plaideau et al. 2014).

The rs11549465 C>T polymorphism of the HIF1A gene facilitates glucose metabolism (Gabbasov et al. 2013), which means that carriers of this variant would require lower doses of caffeine, insulin or somatotrope to increase athletic performance.

The MTHFR gene (methylene tetrahydrofolate reductase) is crucial in folate metabolism (Kao et al. 2014), which may mean a more efficient use of folic acid supplements in carriers of the MTHFR rs1801131 C polymorphism.

There are variants of NOS3 rs2070744 T which, possibly due to influences on striated muscle metabolism, affect nitrite/nitrate levels in patients with idiopathic

intolerance to environmental factors (De Luca et al. 2015).

For CrossFit-trained athletes, the effects of six days of nitrate supplementation are reduced metabolic cost of exercise, increased peak strength and increased maximum strength (Kramer et al. 2016). Nitrate supplementation may also bring some benefits in antioxidant defense and blood pressure regulation after aerobic exercise (Menezes et al. 2019).

Regarding the association of exercise skills and Pro12Ala polymorphism of the gamma receptor gene of peroxisome proliferation activation, 12Ala allele carriers have increased insulin sensitivity, leading to more efficient use of glucose in active skeletal muscle (Maciejewska-Karłowska et al. 2013).

PPAR δ not only has high potential for abuse, but retains glucose reserves, being worthy of consideration for the potential of PPAR δ -targeted exercise mimetics in the enhancement of athletic performance (Fan et al. 2017).

The functions of the PPAR gene open up new potential perspectives for doping in sport. Thus, fibrates (PPAR- α agonists) and thiazolidinediones (PPAR- γ agonists) are used extensively in clinical practice to correct dyslipidemia and lower blood glucose, but two PPAR- α/γ agonists, saroglitazar and lobeglitazone, have also been manufactured (Han et al. 2017).

Some isoforms of PPAR (α , β and γ) can be activated by cannabinoids (O'Sullivan 2016). Cannabis has a potential impact on athletes' health, but also on performance, both during training and competition. The potential beneficial effects of cannabis as part of a pain-relieving protocol, including reducing emotion-related symptoms, deserve further attention (Ware et al. 2018).

The RBFOX1 gene (RBFOX1 rs7191721 G being a genetic marker identified in elite athletes (Ahmetov and Fedotovskaya 2015), is a coordinating factor of transcriptional programs necessary for neuronal development (Fogel et al. 2012), so it can be assumed that RBFOX1 rs7191721 G carriers require lower doses of doping substances with neuronal tropism (stimulants, narcotics, cannabinoids, banned according to WADA 2020), to increase athletic performance.

The TSHR gene causes the synthesis of receptors that attach to thyroid stimulating hormone (TSH), so it is possible that the reactivity of individuals with TSHR variant rs7144481 C (which increases sports skills) to thyroid hormones is higher, resulting in improvement performance (Ahmetov and Fedotovskaya 2015).

Erythropoietin and agents that affect erythropoiesis are banned by WADA 2020, and this can be particularly noticeable for carriers of the genetic variant with erythropoietin receptors (EPOR) that provide athletic advantage, and for those with androgenic receptor (AR) variants that amplify the action. Hormone would theoretically require lower doses of steroid anabolic agents.

Experimentally, in rats, EPOR has been shown to correlate with chronic post-lesional pain, with the respective receptors being expressed along the spinal axis in increased amounts after musculoskeletal trauma (Cohrs 2018).

Moreover, a study conducted on breast cancer cell lines revealed that membrane-acting androgens modify the transcription of the erythropoietin receptor (EPOR), leading to erythropoietin-initiated actions (Pelekanou 2010).

Experimentally, in rats that performed high-intensity exercise, it was found that treatment with *Tribulus terrestris* extract promotes increased muscle mass and

performance by increasing testosterone and IGF 1 plasma levels, but also receptors for those hormones in the striated muscles (Wu et al. 2017).

Discussion

Athletes with overexpression of PEPCK-C also have an increased requirement for Krebs cycle constituents to sustain effort, from this point of view it is important to mention meldonium (a substance banned by WADA including in previous years), which reduces endogenous synthesis and biological activity of carnitine (Lippi 2017).

Cortisol blockers could be used in carriers of the allele that produces alpha-actinin-3 to act with increased efficiency in order to increase muscle mass. Cortisol blockers are not on the list of substances banned by WADA 2020, instead corticotrophins and their releasing factors, yes.

Quercetin (which may favor PPARA intron 7 rs4253778 CC and PPARA Leu162Val rs1800206 CG genotypes for sports performance) is not included in the WADA 2020 list of prohibited substances. Caffeine (which may influence the sports performance of PPARA intron 7 rs4253778 CC and Leu162206 CG rP genotypes) is included in the 2020 Monitoring Program, not being considered a prohibited substance. Somatotrope, a hormone that can influence the adaptation to effort of the genotypes mentioned above, is on the list of banned substances WADA 2020.

Carbohydrate and lipid supplements, which could elicit a particular response to exercise adaptation in individuals with the rs8192678 polymorphism of peroxisome proliferator-activated receptor- γ co-activator 1- α (PPARGC1A), are not on the WADA 2020 list.

WADA 2020 indicates beta-blockers as being banned intracompetitively, but also out of competition for some sports. It should not be forgotten that ACE DD carriers may benefit from the use of beta-blockers as doping agents.

The data presented show that substances with the pharmacological property of inhibiting AMPD can increase athletic performance. A new generation of AMPD inhibitors is being tested (Zabielska et al. 2015) which may be potential doping substances in sports.

Insulin and its mimetics are on the list of prohibited substances (WADA 2020), and the rs11549465 C> T polymorphism of the HIF1A gene requires lower doses of insulin to increase athletic performance, as in the case of caffeine and somatotrope. Also, lower doses of insulin than those used for doping non-career individuals may, in carriers of the 12Ala allele, favor athletic performance. Folates are not on the WADA 2020 list, but folic acid supplements can be used more effectively in carriers of the MTHFR rs1801131 C polymorphism.

If data on NOS3 rs2070744 T variants affecting nitrite / nitrate levels in patients with idiopathic intolerance to environmental factors can be extrapolated to healthy subjects for whom the gene enhances athletic performance, those gene variants may also influence the effects of nitrate supplementation (their potentiation). Nitrates are not on the WADA 2020 list of banned substances, but

could exert amplified effects on increasing athletic performance in those variants of NOS3 rs2070744 T.

PPAR agonists (saroglitazar and lobeglitazone) could be used to increase athletic performance due to the induction of hyperglycaemia, especially in carriers of the Pro12Ala polymorphism. Saroglitazar and lobeglitazone are not on the WADA 2020 list, but have doping potential for carriers of particular PPAR variants.

Cannabinoids, with the exception of cannabidiol, are banned by WADA 2020. Cannabinoids may potentiate the hyperglycemic effects of PPAR activation by specific agonists, saroglitazar and lobeglitazone, and the doping action is amplified. RBFOX1 rs7191721 G carriers may require lower doses of doping substances with neuronal tropism (stimulants, narcotics, cannabinoids, banned under WADA 2020) to increase athletic performance.

Although thyroid hormones are not found on the WADA 2020 list, they play fundamental roles in muscle physiology (Bloise et al. 2018) and may favor TSHR rs7144481 C carriers for achieving athletic performance.

It is possible that the carriers of the EPOR variant that offers an athletic advantage may require lower doses of analgesic substances. The 2017 WADA prohibited list specifies that narcotics and cannabinoids are banned in competitions, but not other analgesics (Vernec et al. 2017), a fact maintained on the WADA 2020 list.

It would be possible to extrapolate that athletes, with EPOR that provide an advantage for physical effort, show not only better oxygenation of active skeletal muscle, but also an increased sensitivity to some anabolic steroids. Anabolic agents are banned under WADA 2020.

If *Tribulus terrestris* multiplied androgen receptors with increased potential for amplifying messenger proteins, as is the case with carriers of gene variants of AR that promote athletic performance, the effectiveness of this supplement to increase athletic performance would be much higher, perhaps gaining the value of a doping substance (*Tribulus terrestris* is not on the WADA 2020 list).

Of course, in order to evaluate the importance of these correlations on the re-evaluation of the list of banned substances in sports, future studies of pharmacokinetics and even pharmacodynamics are needed, in correlation with the further identification of new genotypes that favor sports talent. It is thus necessary to study in particular the time of elimination of prohibited substances or with prospects to be added to the list of prohibited substances in the respective subjects, as well as the possibilities of identification (sensitive tests). Another direction is the identification of gene variants that intervene in the metabolism of doping or potentially doping substances and the investigation of the effect of their coexistence with genomes that favor sports talent.

For example, for testosterone, variants ESR2 (rs928554) and SHBG (rs1799941) result in a smaller number of copies of AR (Celec et al. 2013). For cannabinoids, H316Y and Q63R / H316Y polymorphic receptors exhibited higher constitutive activity than the CB2 wild-type receptor (Carrasquer et al. 2010). In addition to PPAR γ , there are many gene variants that alter insulin resistance, including IRS1, COBLL1-GRB14, PPP1R3B, PDGFC, UHRF1BP1 and LYPLAL1

(Brown and Walker 2016). Genetic variants that alter the associations between dietary factors and sports performance have been highlighted for caffeine (CYP1A2 (rs762551), ADORA2A (rs5751876)) and folate (MTHFR (rs1801133)) (Guest et al. 2019).

Conclusions

The analysis of data from the literature suggests the existence of two categories of substances that have the potential to increase sports performance in individuals who have a genome that promotes sports talent:

- Drugs and hormones banned in sports, with an amplified action on some gene variants: meldonium, corticotrophins and their releasing factors, caffeine, somatotrope, beta-blockers, insulin and its mimetics, cannabinoids, stimulants, narcotics, anabolic steroids.
- Drugs, supplements, hormones, flavonoids, vitamins and experimental therapeutic substances that are not on the WADA 2020 list, but which may be the subject of future studies regarding their potential as doping substances: cortisol blockers, carbohydrate supplements, lipid supplements, quercetin, AMPD inhibitors, folates, nitrates, saroglizatar, lobeglitazone, thyroid hormones, analgesics, *Tribulus terrestris*.

References

- Ahmetov II, Fedotovskaya ON (2015) Current progress in sports genomics. *Advances in Clinical Chemistry* 70(Aug): 247–314.
- Bloise FF, Cordeiro A, Ortiga-Carvalho TM (2018) Role of thyroid hormone in skeletal muscle physiology. *The Journal of Endocrinology* 236(1): R57–R68.
- Brown AE, Walker M (2016) Genetics of insulin resistance and the metabolic syndrome. *Current Cardiology Reports* 18(8): 1–8.
- Burgess SC, He T, Yan Z, Lindner J, Sherry AD, Malloy CR et al. (2007) Cytosolic phosphoenolpyruvate carboxykinase does not solely control the rate of hepatic gluconeogenesis in the intact mouse liver. *Cell Metabolism* 5(4): 313–320.
- Carrasquer A, Nebane NM, Williams WM, Song ZH (2010) Functional consequences of nonsynonymous single nucleotide polymorphisms in the CB2 cannabinoid receptor. *Pharmacogenetics and Genomics* 20(3): 157–166.
- Celec P, Tretinárová D, Minárik G, Ficek A, Szemes T, Lakatošová S et al. (2013) Genetic polymorphisms related to testosterone metabolism in intellectually gifted boys. *PloS One* 8(1): e54751.
- Coelho DB, Pimenta EM, Rosse IC, Veneroso C, Pussieldi GA, Becker LK et al. (2019) Alpha-actinin-3 R577X polymorphism influences muscle damage and hormonal responses after a soccer game. *Journal of Strength and Conditioning Research* 33(10): 2655–2664.
- Cohrs G, Goerden S, Lucius R, Synowitz M, Mehdorn HM, Held-Feindt J et al. (2018) Spatial and cellular expression patterns of erythropoietin-receptor and erythropoietin

- during a 42-day post-lesional time course after graded thoracic spinal cord impact lesions in the rat. *Journal of Neurotrauma* 35(3): 593–607.
- Csép K, Szigeti E, Vitai M, Korányi L (2017) The PPARGC1A - GLY482SER polymorphism (RS8192678) and the metabolic syndrome in a central romanian population. *Acta Endocrinologica* 13(2): 161–167.
- De Luca C, Gugliandolo A, Calabrò C, Currò M, Ientile R, Raskovic D et al. (2015) Role of polymorphisms of inducible nitric oxide synthase and endothelial nitric oxide synthase in idiopathic environmental intolerances. *Mediators of Inflammation* 7(Mar): 245308.
- Dvorak J, Feddermann N, Grimm K (2006) Glucocorticosteroids in football: use and misuse. *British Journal of Sports Medicine Suppl 1* 40(Jul): i48–i54.
- Fan W, Waizenegger W, Lin CS, Sorrentino V, He MX, Wall CE et al. (2017) PPAR δ promotes running endurance by preserving glucose. *Cell Metabolism* 25(5): 1186–1193.
- Fogel BL, Wexler E, Wahnich A, Friedrich T, Vijayendran C, Gao F et al. (2012) RBFOX1 regulates both splicing and transcriptional networks in human neuronal development. *Human Molecular Genetics* 21(19): 4171–4186.
- Gabbasov RT, Arkhipova AA, Borisova AV, Hakimullina AM, Kuznetsova AV, Williams AG et al. (2013) The HIF1A gene Pro582Ser polymorphism in Russian strength athletes. *Journal of Strength and Conditioning Research* 27(8): 2055–2058.
- Guest NS, Horne J, Vanderhout SM, El-Sohemy A (2019) Sport nutrigenomics: personalized nutrition for athletic performance. *Frontiers in Nutrition* 6(8): 1–16.
- Han L, Shen WJ, Bittner S, Kraemer FB, Azhar S (2017) PPARs: regulators of metabolism and as therapeutic targets in cardiovascular disease. Part II: PPAR- β/δ and PPAR- γ . *Future Cardiology* 13(3): 279–296.
- Harada N, Hatakeyama A, Okuyama M, Miyatake Y, Nakagaw T, Kuroda M et al. (2018) Readthrough of ACTN3 577X nonsense mutation produces full-length α -actinin-3 protein. *Biochemical and Biophysical Research Communications* 502(3): 422–428.
- Hughes D (2015) The world anti-doping code in sport: update for 2015. *Australian Prescriber* 38(5): 167–170.
- Kao AC, Rojnic Kuzman M, Tiwari AK, Zivković M, Chowdhury NI, Medved V et al. (2014) Methylenetetrahydrofolate reductase gene variants and antipsychotic-induced weight gain and metabolic disturbances. *Journal of Psychiatric Research* 54(1): 36–42.
- Kramer SJ, Baur DA, Spicer MT, Vukovich MD, Ormsbee MJ (2016) The effect of six days of dietary nitrate supplementation on performance in trained CrossFit athletes. *Journal of the International Society of Sports Nutrition* 13(1): 1–7.
- Lippi G, Mattiuzzi C (2017) Misuse of the metabolic modulator meldonium in sports. *Journal of Sport and Health Science* 6(1): 49–51.
- Macchiarella A, Amato A, Sacco A, Rabboni M, Contrò V, Proia P (2017) Nutritional supplement habits: the survey on a Sicilian group. *Trends in Sport Sciences* 3(24): 123–127.
- Maciejewska-Karłowska A, Sawczuk M, Cieszczyk P, Zarebska A, Sawczyn S (2013) Association between the Pro12Ala polymorphism of the peroxisome proliferator-activated receptor gamma gene and strength athlete status. *PloS One* 8(6): e67172.
- Maciejewska-Skrendo A, Buryta M, Czarny W, Król P, Stastny P, Petr M et al. (2019) The Polymorphisms of the Peroxisome-Proliferator Activated Receptors' Alfa Gene Modify the Aerobic Training Induced Changes of Cholesterol and Glucose. *Journal of Clinical Medicine* 8(7): 1043.
- Menezes EF, Peixoto LG, Teixeira RR, Justino AB, Puga GM, Espindola FS (2019) Potential benefits of nitrate supplementation on antioxidant defense system and blood

- pressure responses after exercise performance. *Oxidative Medicine and Cellular Longevity* (Mar): 1–10, 7218936.
- McNamara DM, Holubkov R, Postava L, Janosko K, MacGowan GA, Mathier M, Murali et al. (2004) Pharmacogenetic interactions between angiotensin-converting enzyme inhibitor therapy and the angiotensin-converting enzyme deletion polymorphism in patients with congestive heart failure. *Journal of the American College of Cardiology* 44(10): 2019–2026.
- O'Sullivan SE (2016) An update on PPAR activation by cannabinoids. *British Journal of Pharmacology* 173(12): 1899–1910.
- Pelekanou V, Notas G, Sanidas E, Tsapis A, Castanas E, Kampa M (2010) Testosterone membrane-initiated action in breast cancer cells: Interaction with the androgen signaling pathway and EPOR. *Molecular Oncology* 4(2): 135–149.
- Plaideau C, Lai YC, Kviklyte S, Zanou N, Lofgren L, Andersen H, et al. (2014) Effects of pharmacological AMP deaminase inhibition and Ampd1 deletion on nucleotide levels and AMPK activation in contracting skeletal muscle. *Chemistry & Biology* 21(11): 1497–1510.
- Rogol AD, Pieper LP (2017) Genes, gender, hormones, and doping in sport: a convoluted tale. *Frontiers in Endocrinology* 8(Oct): 251.
- Scholten SD, Sergeev IN (2013) Long-term quercetin supplementation reduces lipid peroxidation but does not improve performance in endurance runners. *Open Access Journal of Sports Medicine* 4(Mar): 53–61.
- Sonksen PH (2001) Insulin, growth hormone and sport. *The Journal of Endocrinology* 170(1): 13–25.
- Tanisawa K, Wang G, Seto J, Verdouka I, Twycross-Lewis R, Karanikolou A et al. (2020) Sport and exercise genomics: the FIMS 2019 consensus statement update. *British Journal of Sports Medicine* (Mar): bjsports-2019-101532.
- van der Gronde T, de Hon O, Haisma HJ, Pieters T (2013) Gene doping: an overview and current implications for athletes. *British Journal of Sports Medicine* 47(11): 670–678.
- Vernec A, Pipe A, Slack A (2017) A painful dilemma? Analgesic use in sport and the role of anti-doping. *British Journal of Sports Medicine* 51(17): 1243–1244.
- Ware MA, Jensen D, Barrette A, Vernec A, Derman W (2018) Cannabis and the health and performance of the elite athlete. *Clinical Journal of Sport Medicine: Official journal of the Canadian Academy of Sport Medicine* 28(5): 480–484.
- World Anti-Doping Agency – WADA (2020) *The world anti-doping code international standard: prohibited list*. Retrieved from: https://www.wada-ama.org/sites/default/files/wada_2020_english_prohibited_list_0.pdf. [Accessed July 2020].
- Wu Y, Yang H, Wang X (2017) The function of androgen/androgen receptor and insulin growth factor-1/insulin growth factor-1 receptor on the effects of *Tribulus terrestris* extracts in rats undergoing high intensity exercise. *Molecular Medicine Reports* 16(3): 2931–2938.
- Zabielska MA, Borkowski T, Slominska EM, Smolenski RT (2015) Inhibition of AMP deaminase as therapeutic target in cardiovascular pathology. *Pharmacological Reports: PR* 67(4): 682–688.

The Effects of Core Training on High School Baseball Performance

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Introduction: Core stability and core resistance training (RT) have recently received a lot of attention for improving functional movement and athletic performance. Core strength as it relates to sports performance is the ability to transfer energy through the core during rapid, discrete motor skills. Purpose: The purpose of this study was to explore the effectiveness of a RT program that targets the muscles of the core in order to increase force production in torsional movements such as throwing and hitting in baseball. Methods: Twenty-four male high school (HS) baseball players participated in a six week, off-season, core RT program. The participants were randomly assigned to a control group that attended baseball-specific workouts twice a week for 6-weeks that included throwing, pitching, and hitting (CG: n=12) or the core RT group (RTG: n=12). The RTG participated in a 6-week core RT program (Pallof press, oblique twists, figure 8's, standing medicine ball toss) in addition to baseball-specific practice twice a week. Throwing velocity (TV) and Ball-Exit Velocity (BEV) were assessed prior to and following the 6-week study intervention with a Stalker Sport II radar gun (mph). BEV was the speed of the ball immediately after being struck by the baseball bat. The dependent variables were compared within each group with dependent T-tests. A gain score was also calculated for each dependent variable and compared between the RTG and the CG with independent T-tests ($\alpha < 0.05$). Results: Neither the CG nor the RTG experienced an increase in TV following the 6-week RT intervention. The CG did not improve BEV ($p > 0.05$) following the intervention period. However, the RTG did experience a significant increase in BEV ($p < 0.05$) following the 6-week core RT period. Conclusion: Within the parameters of this study, a 6-week core RT program led to increased BEV among HS baseball players.

Keywords: Core stability, core training program, high school baseball, ball-exit velocity, hitting

Introduction

Coaches work together to improve performance and frequently reflect upon questions like, “How should you train a baseball player to hit further? Throw harder? Run faster?” and “How can I best prepare my athlete to compete at the next level?” Players want to know the answers. In baseball, players desire and coaches demand the 5 tools: 1) speed, 2) arm strength, 3) fielding, 4) hitting for average, and 5) hitting for power (Kohmura, Aoki, Yoshigi, Sakuraba, & Yanagiya, 2008). Players that possess a more complete set of tools are more likely to get recruited, drafted, and financially compensated.

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Major League Baseball (MLB) has implemented a tool known as “Statcast” in 2015 to analyze and quantify baseball metrics including aspects of pitching, hitting, fielding, base running, and more (Statcast, 2016). According to MLB news writer Paul Casella (2015), Statcast will change the way fans, coaches, and athletes view the game by providing an immediate statistical analysis for any movement on the field. This innovative technology has enabled analysts of the game to compare players with a greater degree of objectivity and reliability. Although few have access to this state-of-the-art technology, it has influenced the way players train, coaches recruit, and scouts evaluate performance. Meaning, throwing velocity (TV) and ball-exit velocity (BEV) are two current performance measures that may be a better predictor of sports performance outcomes than other traditional statistics such as: batting average, earned-run average, wins, or standardized fitness testing. Designing a resistance training (RT) program that could improve these metrics would appear to be of value to players and coaches.

Core RT has recently received a lot of attention for improving functional movement and athletic performance. However, there is limited research that quantifies the effectiveness core RT has on specific motor skills in sports. The term trunk and core are often used interchangeably and can be defined as the connection between the lower and upper extremities. Kenney, Wilmore, & Costill (2015) define the core as a group of trunk muscles that surround the spine and abdominal viscera and include the abdominals, gluteals, hip girdle, paraspinals, and other accessory muscles. Stabilizers of the core such as the quadratus lumborum, transversus abdominis, multifidus, and internal oblique collaborate to produce intra-abdominal pressure around the spine, creating stabilization and stiffness of the spinal column (Akuthota, Ferreiro, Moore, & Fredericson, 2008). The erector spinae, external oblique, and rectus abdominis are the long, superficial muscles of the trunk that are capable of producing a great amount of force. The core is called upon for a variety of movements to create stability and balance in daily living and sports performance. The core is engaged to some degree in Olympic lifts, a variety of squats/lunges, and other major push or pull movements (Hedrick, 2004).

Core strength refers to the force production of the core muscles. It is difficult to assess the strength of the core because the muscles that comprise the core are not suited for maximal load testing (example one repetition maximum). Therefore, dynamic endurance tests such as: trunk curls, partial curl-ups, and sit-ups are administered to assess the endurance of the abdominal muscles and to identify abdominal weaknesses (Heyward, 2010). Core strength as it relates to sports performance is the ability to transfer energy through the core during rapid, discrete motor skills such as: punching, kicking, jumping, throwing, and swinging. According to Kibler, Press, & Sciascia (2006) core stability is defined as the ability to control the position and motion of the trunk over the pelvis to optimize movement and performance. Albeit, the muscles that compose the trunk are often neglected as a primary agonist in an RT program. Including core-specific exercises in an athlete’s RT program is recommended to prevent injury and maximize athletic movement (Hibbs, Thompson, French, Wrigley, & Spears, 2008). The physiology of the core is very complex because it serves two purposes,

stabilization and force production in three planes: flexion/extension, lateral trunk flexion, and trunk rotation (Hedrick, 2004). Hibbs et al. (2008) states that there is not one single exercise that activates and challenges all of the core muscles. Kibler et al. (2006) explains that the core musculature plays a critical role in kinetic chain activities by generating and transferring energy from large to small body parts.

McGill (2010) has been performing core RT with athletes and rehabilitating patients and recommends core RT for improving balance, strength, and endurance to prevent injury and maximize performance. McGill & Karpowicz (2009) identified exercises and progressions that adequately stimulate the trunk such as: curl-ups, bird dogs, and side bridges to improve spine stabilization. Medicine ball exercises that emphasize rotational movements improve force production in the transverse plane (Szymanski, Szymanski, Bradford, Schade, & Pascoe, 2007a).

Kenney et al. (2015) discusses the specificity principle in which a RT program must stress the physiological systems critical for optimal performance in a given sport to achieve desired training adaptations in that sport. Baechle & Earle (2008) have identified core RT as an assistance exercise, less important for improving sport performance, but rather a common application for injury prevention and rehabilitation. Yet, the results of an EMG analysis of the delivery of a pitch indicated 75-100% recruitment of the abdominal obliques, abdominal rectus, and lumbar paraspinal muscles contralateral to the pitcher's arm (Watkins et al., 1989). Muscular activation of 75-100% indicates that muscles of the core play a significant role in trunk rotation and force production during the delivery of a pitch. Shaffer, Jobe, Pink, & Perry (1993) studied the muscle activity (EMG) during a baseball swing and found that hitting is a sequence of coordinated muscle activity; in which force originates in the hips, energy is transferred through the trunk, and terminates with the arms. Haugen, Haugvad, & Røstad (2016) searched for scientific publications of RT used in athletic populations and found that many different sports will include core RT, but fail to describe a detailed exercise prescription of the RT. According to Willardson (2007) increasing core stability and strength should be a priority for all sports conditioning programs, but certainly applies to sports that are played on unstable surfaces or may require the athlete to perform skills in unstable body positions.

In baseball arm strength is measured using TV. Coaches should evaluate every players' TV because some defensive positions require more arm strength than others. It is a common misconception that the pitcher has the best arm, when in reality, position players can throw with just as much velocity, if not more. The overhand throwing motion uses a proximal to distal sequence to maximize TV. Hirashima, Kadota, Sakurai, Kudo, & Ohtsuki, (2002) collected kinematic data during maximal TV trials using electrodes to determine the sequence of muscle contraction during the throwing motion. The researchers found that the external oblique contralateral to the throwing arm contracts prior to the ipsilateral side during the rotational movement of the throw, while the rectus abdominis is most prevalent during the follow through (spinal flexion) phase. Machado, García-Ruiz, Cortell-Tormo, & Tortosa-Martínez (2017) found that increasing core strength contributed to the development of the kinetic chain and concluded that a 10-week core RT program significantly improved the TV of handball players.

Although TV is a major component to playing defense in baseball, scoring more runs than the other team is how to win the game. Some batters are known as contact hitters and others as power hitters, but all successful hitters reach base safely (Baseball, 2016). Nonetheless, the aim of all hitters is to hit the ball hard. BEV is a relatively new term in baseball used to measure how fast the ball is leaving the bat. Meaning, a pitch might enter the strike zone at 145 kph (90 mph), but leave the bat at 160.9 kph (100 mph). According to a Statcast analysis by Posnanski (2017), a positive correlation exists between BEV, batting average, and slugging percentage. This stresses the importance of BEV because the faster the ball leaves the bat, the tougher it is to defend. Kohmura et al. (2008) conducted a correlation analysis from a field test that evaluated batting, fielding, base running, and physical fitness testing, revealing that back strength and medicine ball throwing are related to batting performance. This is consistent with Szymanski et al. (2007b) who reported a significant increase in bat swing velocity due to improvement in angular hip velocity, torso rotational strength, and hand speed. Furthermore, torsional exercises like the hitter's throw are recommended for hitters to enhance the way the body uses the kinetic chain to improve the rate of force development during rotational movements (Szymanski et al., 2007b).

Studies by Shaffer et al. (1993) and Watkins et al. (1989) both suggest a need for core RT in respective baseball training regimens to maximize sport-specific skill outcomes based on the EMG of hitting and throwing. McGill (2010), Hibbs et al. (2008), and Willardson (2007) all agree that core RT should be a part of an athlete's training regimen to optimize performance and minimize injury. Following the principle of specificity, implementing a core RT program that challenges the body in a way that is sport-specific should result in the greatest training adaptations. Hence, the purpose of this study was to design an RT program that targets the muscles of the trunk and core that also meets the demands of hitters, pitchers, and position players to increase force production in torsional movements such as throwing and hitting a baseball. It was hypothesized that high school (HS) baseball players' TV (throwing velocity) and BEV (ball-exit velocity) would increase as a result of a 6-week core RT program.

Methods

Participants

The volunteering participants were HS students (ages 14-18) and members of the baseball team at Granger HS, Utah, USA. A University Institutional Review Board approved the study (SUU: IRB approval #30-112018b) and consent/assent forms prior to any engagement with participants. The participants were informed of the purpose of the study and what the research entailed during orientation. Each participant and guardian gave written consent and assent to participate in the study. The subjects' acknowledged that participation was completely voluntary and that they could withdraw from the study without penalty at any time.

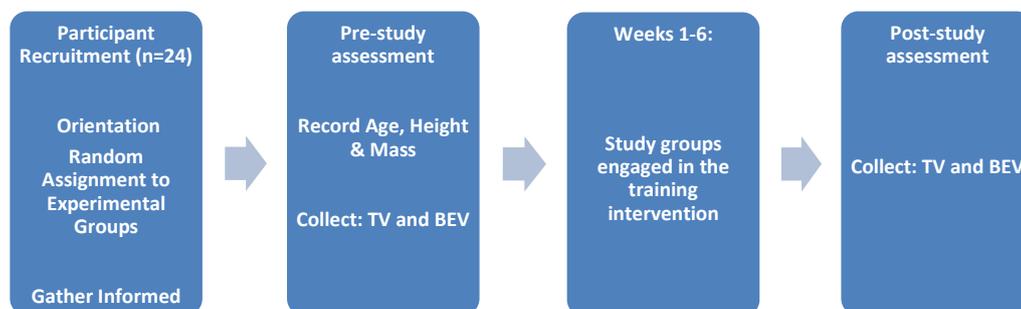
Instruments and Apparatus

All of the training and testing took place at Granger HS, Utah, USA. The RT was held in the weight room and all testing was completed in the auxiliary gymnasium. All of the training equipment used in this study such as: medicine balls, resistance bands, and free weights were provided by the HS. Stalker radar guns have been used in many studies, as well as professional baseball stadiums because the technology integrated into each gun has led to the highest performance and accuracy over the last 30 years (Stalker Radar, 2017). Hence, the instrument used to measure pre and post-assessment of TV and BEV was the Stalker Sport II radar gun (Applied Concepts Inc., Plano, TX). Equipment used during testing such as: nets/cages, batting tees, baseballs, and artificial mounds were made available by the HS baseball program. Schutt baseball hitting tees were used in the BEV assessment. Additionally, all of the baseballs used in this study were game balls in accordance with the National Federation of State High School regulation (NFHS).

Procedures

The participants were randomly assigned in a stratified manner (based on grade) to the control group (CG) or the resistance training group (RTG). The CG practiced Tuesdays and Thursdays from 7-9 P.M. for six weeks. Practice consisted of baseball-specific training only, which included drills for throwing, fielding, pitching, and hitting. The RTG participated in a 6-week RT program after school twice a week, in addition to the aforementioned practice. Prior to and following the training intervention, both groups had their TV and BEV assessed (Figure 1).

Figure 1. Study Timeline. TV= Throwing Velocity. BEV= Ball-exit Velocity



The Training Protocol

The RTG completed a 6-week core RT program. The RTG met twice per week for one hour in the weight room of Granger HS (Utah, US). Subjects had to attend and participate in 11 of 12 sessions to be included in the study. Each session included a warm-up, the RT, and a cool-down. Table 1 provides the exercises the participants performed twice a week, for six weeks.

The warm-up included a light 400m jog, followed by dynamic stretching (knee-to-chest, leg swings, lunges w/ twist). The RT program was broken up into

seven groups of exercises. The first group of exercises was a series of weighted walks emphasizing core stability. To complete a set of weighted walks, the subjects had to walk 27.43m holding dumbbells at approximately 50% of their body weight; weighted walks with one dumbbell were then performed with 25% of their body weight. Individuals that could not maintain form with the prescribed weight decreased the weight of the dumbbell and those who could complete all of the sets with proper form increased the weight by 2.27 kgs the following week. The participants were prescribed 1-4 sets, 27.43m in distance, for each type of walk (farmer walks, suitcase walks, waiter walks, crossover walks, and zombie walks)(Fig. 2a). Group of exercises 2-5 exposed the participants to a variety of endurance-based movements performed with body weight or dumbbells that challenge the core in different planes. During exercises 2-5, each pair of exercises included 1-3 sets of 12-20 repetitions and were completed as supersets to reduce rest time and to maintain intensity. These exercises include V-sits holds (Figure 2 b), bird dogs, iron butterflies, lunges with weighted twists, Romanian deadlifts, ab-rollouts, back extensions (Figure 3 a, b), and hanging leg raises. The 6th group of exercises required a resistance band for the rotational and anti-rotational movements of the Pallof press and the oblique twists. Once the participant was able to complete 3 sets of 12 each side, they could move up to a more difficult resistance band. The last group of exercises (group 7) utilized a 1.81-5.44 kg medicine ball to complete 1-3 sets of the figure 8's and standing medicine ball toss (Figure 4). The subjects completed 8-12 repetitions of the figure 8's and 4-8 repetitions of the standing medicine ball toss, in each direction.

Following the RT, a short cool-down period included static stretching and walking. Immediate individual feedback was provided as necessary and general feedback was provided during the debriefing period at the end of each RT session. For each training session attended, participants completed a workout log provided by the administrator. The main purpose of the workout log was to track personal progression and to follow the exercise sequence.

Table 1. RT Program

Warm Up	Group 1*	Group 2*	Group 3*	Group 4*	Group 5*	Group 6 ⁺	Group 7 ^o	Cool Down
400 meter jog	Farmers walks Suitcase walks Waiter walks	V-sit holds	Iron butterflies	Romanian deadlift	Back extension	Pallof press	Figure 8's	Statics Stretching
Dynamic stretching	Crossover walks Zombie Walks	Bird Dogs	Lunges w/ weighted twist	Ab-Rollouts	Hanging leg raises	Oblique twists w/ bands	Standing medicine ball toss	Walking

Note: *Body weights or dumbbells utilized. + Resistance bands utilized. o Medicine balls utilized.

Figure 2. (a) Cross over Walk (b) V-sit Hold



(a)

(b)

Figure 3. Back Extension (a) Flexed (b) Extension



(a)

(b)

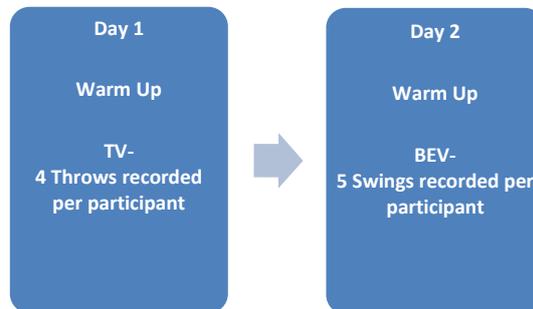
Figure 4. Standing Medicine Ball Toss (a) Load (b) Explode

The Testing Protocol

The data collection process and procedures for the pre and post-test were administered in the same manner. It took 2 days to collect the baseball team's TV and BEV trials (Figure 5). A baseball specific warm-up was included prior to each day of testing. All participants warmed-up with a short-jog, followed by a sequence of dynamic stretching, and finished by playing catch with a partner.

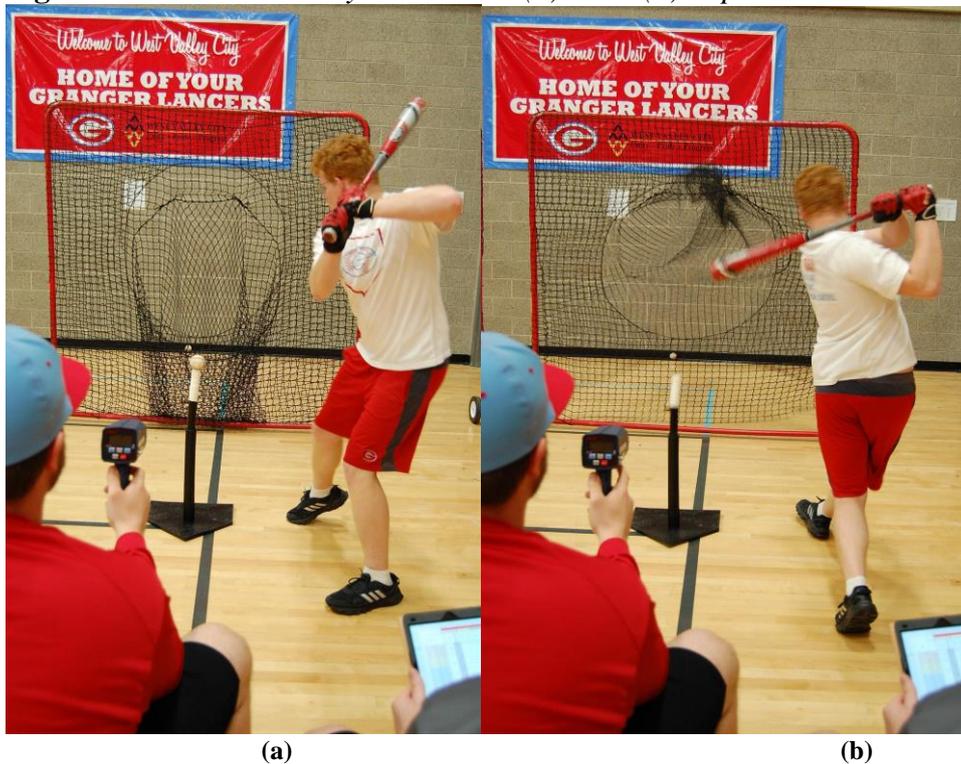
Day 1, all subjects, regardless of position made 4 throws across the gym to a catcher to measure TV. The distance of the throw was 27.43m as indicated by a tape marking on the floor. A ground ball was rolled to the players and using appropriate footwork such as a "crow's hop" the participants fielded the ball and then delivered the ball with maximum TV to the catcher. Subjects rotated after each trial to provide adequate recovery time between throws. The radar gun was operated from behind the catcher. The 4 TV trials were recorded directly from the radar gun display into an Excel spreadsheet. The average of the 4 TV trials was used for statistical analysis.

Figure 5. Testing Protocol Timeline. TV= Throwing Velocity. BEV= Ball-exit Velocity



Day 2 the BEV was assessed by hitting the ball off a batting tee and into a net. BEV is most valid and reliable when the ball is moving directly at or away from the radar gun. Therefore, the radar gun was stationed behind the batting tee (in the catcher's position) at pitch height (Figure 6 a,b). Hitters took 5 swings off of the tee and the velocities were recorded and averaged for statistical. The subjects were required to hit the ball towards centerfield for the swing to count. The subjects were allowed to use their own bat for the BEV test, but it had to meet NFHS regulation (BBCOR .50, psi, barrel size, and length-weight ratio). Batters adjusted the Schutt hitting tee to their preferred height to maximize BEV.

Figure 6. Ball-exit Velocity Assessment (a) Load (b) Explode



Reliability

The Stalker Sport II radar gun was the instrument selected to collect TV and BEV. During testing, the Stalker Sport II radar gun was set to follow the recommended settings for baseball scouts found in the owner's manual, which included a low speed of 48.28 kph (30 mph) and range setting of 3 (maximum sensitivity). Additionally, the radar gun was stationed directly in front or behind the ball to eliminate angle errors. Stalker radar guns have been reported to measure within 0.10 (one-tenth) of a mile per hour (Stalker Radar, 2017). Harasin, Dizdar, & Marković (2006) examined the reliability of a Doppler radar gun and reported the intraclass reliability coefficient of ICC=0.97.

Design and Analysis

The TV and BEV were the dependent variables (DVs) measured. The DVs were compared prior to and following the study intervention period within each experimental group using dependent t-tests. A gain score was also calculated for each DV and compared between experimental groups with independent t-tests. Statistics were recorded and analyzed using MS Excel 2013. The Excel spreadsheet of data was peer reviewed for accuracy per Al Tarawneh and Thorne (2017). The statistical significance for the study was $\alpha < 0.05$.

Results

There were 24 HS male baseball players between 14-18 years old that participated in this study. All participants adhered to and completed the study without complication. Descriptive participant information can be found in Table 2.

Table 2. *Participation Descriptive Information*

	Number	Age (years)	Height (cms)	Mass (kg)
RTG	12	15.4 ± 1.1	170.8 ± 8.4	74.6 ± 19.2
CG	12	15.6 ± 1.3	172.5 ± 7.8	75.8 ± 21.8

Mean ± standard deviation. RTG= Resistance Training Group. CG= Control Group

Neither experimental group statistically improved TV following the 6-week study intervention period ($p > 0.05$). Likewise, the CG did not improve BEV following the 6-week study intervention period ($p > 0.05$). However, BEV significantly improved ($p < 0.05$) in pre to post-assessment in the RTG. The gain score for the BEV was significantly greater for the RTG than the CG (see Table 3). Note that Table 3 is in units of miles per hour, as that is the standard in baseball.

Table 3. Throwing Velocity and Ball-Exit Velocity (MPH)

	TV			BEV		
	Pre-Ave.	Post-Ave.	Gain	Pre-Ave.	Post-Ave.	Gain
RTG	64.5 ± 4.5	65.2 ± 4.0	0.6 ± 1.9	69.7 ± 6.6	72.8 ± 5.8 [†]	3.1 ± 2.3*
CG	59.3 ± 8.2	60.2 ± 6.3	1.0 ± 3.4	66.4 ± 7.9	67.7 ± 7.3	1.2 ± 3.2

Means ± standard deviation for dependent variables. TV= Throwing Velocity. BEV=Ball-Exit Velocity. RTG= Resistance Training Group. CG=Control Group. [†]Significant improvement pre to post intervention within the RTG p<0.05. MPH-miles per hour. *RTG BEV gain score significantly greater than the CG (p<0.05).

Discussion

The purpose of this study was to design a RT program that targets the musculature of the core that also meets the demands of hitters, pitchers, and position players to increase force production in torsional movements. The intent of the RT program was to improve core stability and strength using free weights, resistance bands, and medicine balls to increase TV and BEV of HS baseball players. A primary objective of this study was to improve sport-specific training methods to peak baseball performance. It was hypothesized that the HS baseball players' TV and BEV would increase as a result of the 6-week core RT program.

The results of the study were mixed with respect to the research hypothesis. Both groups on average improved TV and BEV from pre to post-assessment, however, only the BEV for the RTG demonstrated a significant improvement from pre to post-assessment (p<0.05). The subjects within the RTG improved their BEV by 4.99 kph (3.1 mph) following the 6-week core RT program. The RTG's BEV gain score was almost significantly greater than the CG's BEV (p<0.056). The difference in gain scores from the RTG to the CG was 3.06 kph (1.9 mph). Meaning, on average players hit the ball approximately significantly harder than the CG following the 6-week RT training intervention. Posnanski (2017) claims good hitting in the MLB begins with a BEV of 148 kph (92 mph) and suggested that an increase of 1.61 kph (1 mph) in BEV would increase a hitter's batting average by .025 and slugging percentage by 0.050. Assuming Posnanski's (2017) postulate is true, the results of the current study suggest that implementing a similar core based RT program could improve a hitter's batting average and slugging percentage in a very meaningful manner. Based on Posnanski's postulate, a hitter could expect an increase in batting average of 0.048 and slugging percentage of 0.095 by engaging in a similar core RT program. As a team, this increase in hitting performance could contribute to a more productive scoring offense leading to more wins.

Previous research related to hitting in baseball has focused on the: biomechanics of a baseball swing (Shaffer et al., 1993; Welch, Banks, Cook, & Draovitch, 1995), the change in bat speed after swinging over and underweight bats (DeRenne, Buxton, Hetzler, & Ho, 1995), and the effect of specific RT programs on bat swing velocity (Hughes, Lyons, & Mayo, 2004); none of which report on BEV. There is little data specifically related to BEV in baseball because it is a relatively new term and has not been investigated. As such, the data collected in

the current study cannot be compared to a normative datum. Closely related research has focused on bat speed as the variable of interest. Szymanski, DeRenne, & Spaniol (2009) reviewed prior research that focused on RT as related to improving bat swing velocity and found torso rotational strength to be a significant performance variable in hitting. Although bat swing velocity and BEV are two different variables, hitters should be trained in the same way because bat swing velocity creates BEV. Implementing a RT program that improves torso rotational strength should increase bat swing velocity, presumably leading to a higher BEV. Per Posnanski's postulate, greater BEV should lead to an improved batting average and slugging percentage.

The TV gains of the RTG and CG showed no significant improvement based on a 6-week study intervention. Our findings are consistent with Newton & McEvoy (1994) who did not improve TV with a medicine ball training intervention that prescribed dynamic exercises such as: chest pass, overhead throws, and medicine ball toss. Van Den Tillaar's (2004) review categorized various RT studies (RT with 3x6 RM, RT with Pyramid scheme, RT between 8-12 RM, RT lower than 12 RM) related to the velocity of overarm throwing and reported that various forms of RT modalities such as: bench press, throwing overweight/underweight baseballs, throws with a pulley device, and medicine ball training could improve TV. More specifically, Van Den Tillaar (2004) concluded that RT consisting of 3 sets of 6-RM or between 8 and 12-RM (bench press) lead to significant increases in TV and that medicine ball training did not positively improve TV. More recently, Manchado et al. (2017) found that a 10-week core RT program increased TV of handball players. Even though the subjects were handball players, the exercises prescribed (curl-up with twist and frontal bridge with Swiss ball) focused on strengthening the lumbo-pelvic region to maximize the efficacy of the overhand throw; similar to our study that prescribed dynamic and static movements such as: V-sit holds, ab-rollouts, hanging leg raises, etc. Although there are inconsistencies in RT prescription for improving TV, the muscle recruitment pattern (EMG) recorded during the delivery of a pitch explains the sequential muscle activity of the trunk during overhand throwing, which indicates that training the core should be advantageous for throwers (Watkins et al., 1989; Hirashima, 2002). Hedrick (2004) claims the trunk is the most important muscle group to train in order to improve athletic performance because the muscle actions of the core provide stabilization and force/power production. Likewise, Hibbs (2008) states there is not one single exercise that activates and challenges the entire musculature of the core. Hence, it seems that the optimal method of RT for increasing TV is yet to be determined, but it appears core exercises should be included.

Muscle action and muscle group specificity were two current concepts defined by Fleck & Kraemer (2014) that contributed to the design of the core RT program used in the current study. In accordance with the specificity principle, the closer training is to the sport, the greater chance there will be a positive transfer to that specific sport (Kenney et al. 2015). Although the muscles of the core are involved during a swing and a throw, the mechanics of each movement differ. The rotational exercises (Lunge w/ weighted twist, oblique twists with resistance

bands, and standing medicine ball toss) selected for this RT program were designed to maximize force production during a baseball swing. For example, the standing medicine ball toss looks and feels like an at-bat, but provides athletes with an opportunity to practice using the kinetic chain by transferring energy sequentially from the lower body, through the core, and to the hands. The kinetic chain theory is supported by Kibler et al. (2006) who believes that the muscles of the core link the body together to create a kinetic chain capable of producing significant amounts of force and power. The RTG's gain score for BEV is likely due to the rotational exercises performed with resistance bands and medicine balls, and is supported by the kinetic chain concept and specificity principle. As previously stated, the throwing motion is a complex series of coordinated muscle contractions, requiring movement in the transverse and sagittal plane. The lack of significant improvement in TV could be due to the unique biomechanics of throwing a baseball. Additionally, our program included stabilization and flexion/extension exercises (weighted walks, birddogs, back extensions, etc.) that addressed all phases of an overhand throw, but the RT may not have been similar enough to the overhand throwing motion to increase TV. Whereas, DeRenne, Buxton, Hetzler, & Ho (1994) significantly improved TV by throwing with a combination of standard, light, and heavy baseballs 3 days a week for 10 weeks.

The primary limitations in this study were sample size, population, and experience. For the TV and BEV assessments the sample size was 24 student-athletes which was limited by the number of baseball players at Granger HS, UT. Additionally, student-athletes aged 14-18 were a challenging population to work with. Among this age group, lack of time and availability were limiting factors when designing the RT program to fit the schedule of the student-athletes. Despite the fact that all the students completed the program, uncontrollable factors could have hindered sports performance such as nutrition, sleep, or missed practice. Another limitation relates to the experience of the athletes. All of the subjects in the study were amateur and their previous level of fitness varied. All athletes had continuous exposure to baseball practice and it is possible some athletes had considerable improvement in TV and BEV unrelated to the RT provided. Finally, a longer intervention period may have yielded statistical differences as related to the dependent variables.

Another point of interest regarding the current study is the use of a batting tee for the purpose of collecting the BEV. The batting tee is one of the most common fundamental training tools used for developing a mechanically sound baseball swing. Coinciding with Newton's 2nd law of motion, the BEV off of a batting tee will only have the velocity of the bat swing, whereas the BEV of a batted-ball from a live pitch will have a resulting velocity of the pitched ball and the swing. Meaning, a potential limitation of using the tee to measure BEV is that peak BEV will be lower off of a tee than a pitched ball. However, measuring BEV off a tee, rather than a live pitch is more reliable because the ball is not moving and the hitter determines the location of the collision between the bat and ball. Hitting the ball off of the tee creates a closed environment for the hitter, though different from live pitching, it trains hitters to create maximal force production upon a motionless baseball using proper form. This is likely to carry over to hitting performance in a

game because the hitter can produce higher quality swings as a result of training off a batting tee.

Moving forward, researchers should compare core RT to other methods of RT to help shape the most appropriate RT program for baseball players; especially since the experimental and clinical data are limited in this population. Future research should report BEV and TV in order to define an appropriate normative velocity scale for each age group in baseball. Additionally, gathering TV and BEV data could be useful in terms of selecting players to make the team each season, tracking player development, or even determine who the next best recruit may be.

Conclusion

This study implemented a 6-week RT program that focused on the development of the core musculature to directly improve baseball performance. Within the parameters of this study, a core RT program led to an increase in BEV among HS baseball players. A secondary objective of this study was to identify sport-specific training methods to peak baseball performance and we have unlocked significance in core RT specifically related to BEV. Implementing additional rotational exercises that utilize free weights, resistance bands, or medicine balls may lead to additional gains in torso rotational strength and potentially greater improvements in BEV.

References

- Akuthota, V., Ferreiro, A., Moore, T., & Fredericson, M. (2008). Core stability exercise principles. *Current Sports Medicine Reports*, 7(1), 39-44.
- AlTarawneh, G., & Thorne, S. (2017). A pilot study exploring spreadsheet risk in scientific research. *arXiv preprint arXiv:1703.09785*. arxiv.org, Ithaca, NY.
- Baseball. (2016, May 13). *New World Encyclopedia*. Retrieved June 28, 2019 from// www.newworldencyclopedia.org/p/index.php?title=Baseball&oldid=995930.
- Casella, P. (2015, April & may). Statcast primer: Baseball will never be the same. Retrieved December 12, 2018, from <https://www.mlb.com/news/statcast-primer-baseball-will-never-be-the-same/c-119234412>
- DeRenne, C., Buxton, B.P., Hetzler, R., & Ho, KW. (1994). Effects of under-and overweighted implement training on pitching velocity. *Journal of Strength & Conditioning Research*, 8(4), 247-250.
- DeRenne, C., Buxton, B.P., Hetzler, R.K., & Ho, K.W. (1995). Effects of weighted bat implement training on bat swing velocity. *Journal of Strength & Conditioning Research*, 9(4), 247-250.
- Fleck, S.J., & Kraemer, W.J. (2014). *Designing Resistance Training Programs* (4th ed.). Champaign, IL: Human Kinetics.
- Harasin, D., Dizdar, D., & Marković, G. (2006). High reliability of tests of maximum throwing performance. *Journal of Human Movement Studies*, 51(1), 63-76.
- Haugen, T., Haugvad, L., & Røstad, V. (2016). Effects of core-stability training on performance and injuries in competitive athletes. *Sports Science*, 20, 1-7.
- Hibbs, A.E., Thompson, K.G., French, D., Wrigley, A., & Spears, I. (2008). Optimizing

- performance by improving core stability and core strength. *Sports Medicine*, 38(12), 995-1008.
- Hirashima, M., Kadota, H., Sakurai, S., Kudo, K., & Ohtsuki, T. (2002). Sequential muscle activity and its functional role in the upper extremity and trunk during overarm throwing. *Journal of Sports Sciences*, 20(4), 301-310.
- Hedrick, A. (2004). Learning from each other: Training the trunk. *Strength & Conditioning Journal*, 26(6), 70.
- Heyward, V.H. (2010). *Advanced Fitness Assessment and Exercise Prescription* (6th ed.). Champaign, IL: Human Kinetics.
- Hughes, S.S., Lyons, B.C., & Mayo, J.J. (2004). Effect of grip strength and grip strengthening exercises on instantaneous bat velocity of collegiate baseball players. *Journal of Strength & Conditioning Research*, 18(2), 298-301.
- Kohmura, Y., Aoki, K., Yoshigi, H., Sakuraba, K., & Yanagiya, T. (2008). Development of a baseball-specific battery of tests and testing protocol for college baseball players. *Journal of Strength & Conditioning Research*, 22(4), 1051-1058.
- Kenney, W.L., Wilmore, J., & Costill, D. (2015). *Physiology of Sport and Exercise* (5th ed.). Champaign, IL: Human Kinetics.
- Kibler, W.B., Press, J., & Sciascia, A. (2006). The role of core stability in athletic function. *Sports Medicine*, 36(3), 189-198.
- Manchado, C., García-Ruiz, J., Cortell-Tormo, J.M., & Tortosa-Martínez, J. (2017). Effect of core training on male handball players' throwing velocity. *Journal of Human Kinetics*, 56(1), 177-185.
- McGill, S. (2010). Core training: Evidence translating to better performance and injury prevention. *Strength & Conditioning Journal*, 32(3), 33-46.
- McGill, S., & Karpowicz, A. (2009). Exercises for spine stabilization: Motion/motor patterns, stability progressions, and clinical technique. *Archives of Physical Medicine & Rehabilitation*, 90(1), 118-126.
- Posnanski, J. (2017, May 20). Fun with statcast™ (exit velo). Joe Blogs. Retrieved July 10, 2019 from <https://medium.com/joeblogs/fun-with-statcast-exit-velo-20e4ec314744>
- Shaffer, B., Jobe, F.W., Pink, M., & Perry, J. (1993). Baseball batting: An electromyographic study. *Clinical Orthopaedics & Related Research*, (292), 285-293.
- Stalker Radar. Designs high quality electronics and is the nation's largest manufacturer of speed radar. (n.d.). Retrieved December 12, 2017, from <http://www.stalkerradar.com/sportsradar/about.html>
- Statcast | Glossary. (2016, January 20). Retrieved December 12, 2017, from <http://m.mlb.com/glossary/statcast>
- Szymanski, D.J., Szymanski, J.M., Bradford, T.J., Schade, R.L., & Pascoe, D.D. (2007a). Effect of twelve weeks of medicine ball training on high school baseball players. *Journal of Strength & Conditioning Research*, 21(3), 894.
- Szymanski, D.J., McIntyre, J.S., Szymanski, J.M., Bradford, T.J., Schade, R.L., Madsen, N.H., & Pascoe, D.D. (2007b). Effect of torso rotational strength on angular hip, angular shoulder, and linear bat velocities of high school baseball players. *Journal of Strength & Conditioning Research*, 21(4), 1117-1125.
- Szymanski, D.J., DeRenne, C., & Spaniol, F.J. (2009). Contributing factors for increased bat swing velocity. *Journal of Strength & Conditioning Research*, 23(4), 1338-1352.
- Van Den Tillaar, R. (2004). Effect of different training programs on the velocity of overarm throwing: a brief review. *Journal of Strength & Conditioning Research*, 18(2), 388-396.
- Watkins, R.G., Dennis, S., Dillin, W.H., Schnebel, B., Schneiderman, G., Jobe, F., & Pink, M. (1989). Dynamic EMG analysis of torque transfer in professional baseball

pitchers. *Spine*, 14(4), 404-408.

Welch, C.M., Banks, S.A., Cook, F.F., & Draovitch, P. (1995). Hitting a baseball: A biomechanical description. *Journal of Orthopaedic & Sports Physical Therapy*, 22(5), 193-201.

Willardson, J.M. (2007). Core stability training: Applications to sports conditioning programs. *Journal of Strength & Conditioning Research*, 21(3), 979-985.

Willingness to Pay and Accept for Hosting Olympic Games in Germany

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This empirical study investigates whether and how much individuals are willing to pay for hosting Olympic Games in Germany. Moreover, it is examined for the first time what individuals are willing to accept to host Olympic Games in their own country if they do not like that. Furthermore, this study identifies determinants that influence the willingness to pay (WTP) including the willingness to accept (WTA) for hosting Olympic Games in Germany. Extrapolations of the individual WTP and WTA show that, in the net aggregate, the German population is willing to pay €3.57 billion for hosting the Olympic Games in Germany.

Keywords: *contingent valuation method, Olympic Games, willingness to accept, willingness to pay*

Introduction

Hosting mega sport events like the Olympic Games primarily serves the goals to expedite regional development in one big push and/or to present the country to the rest of the world in a new light regarding openness, freedom and modernity. Typically, the achievement of these goals is associated with high costs but little success. An excellent example for this is the 2014 Winter Olympic Games in Sotschi. With approximately \$55 billion these were the most expensive Olympic Games ever in terms of cost per event. However, the benefit from the Olympic Games is limited. Extensive construction led to hotel overcapacities. Investors defaulted on state-backed loans. Additionally, there is no coherent plan for the after use of venues and some of the largest infrastructure projects. Moreover, the sport event did not improve the image of Russia in the world (Müller 2014). The example of Sotschi shows that hosting Olympic Games does not inevitably lead to positive effects. Consequently, cities or countries should consider carefully whether candidacy to host Olympic Games in the own city or country is advantageous. For example, Germany was interested in hosting the 2022 Winter Olympic Games in Munich and in hosting the 2024 Summer Olympic Games in Hamburg. Two local referenda, where immediately affected communities had the possibility to take part in the decision, vehemently spoke out against the plans.

This study examines the question how much German individuals are willing to pay or willing to accept to host the Olympic Games in their country. Considering willingness to accept in this context is new to the literature. Thus, our study is the first to simultaneously take into account both the willingness to pay (WTP) and the willingness to accept (WTA) to host the Olympic Games in Germany. Note that

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the WTA has to be interpreted as a negative WTP, how much compensation Germans who are against hosting the Olympic Games in Germany need to accept hosting them there (see the chapters on methodology and data below). Furthermore, this article focuses on the identification of determinants that influence the WTP and WTA. For example, it is plausible to assume that individuals with a larger interest in the Olympic Games or in sport in general may have a higher (lower) WTP (WTA) than those who are less interested. Less interested individuals might rather reveal a negative WTP (to interpret as the WTA) to host the Olympic Games in their country. In a second step, we extrapolate the individual WTP to get the aggregated WTP of the German population.

The paper is organised as follows: The next chapter reviews existing literature referring to our object of investigation. The following two chapters present theoretical and methodological basics. The fifth chapter describes the data set. The next chapter shows the empirical results starting with the descriptive statistics followed by the regression analysis to identify important factors influencing the WTP, and an extrapolation of the individual WTP. The last chapter concludes the paper and outlines directions for further research and limitations of the paper.

Literature Review

This chapter provides an overview of existing literature with respect to hosting Olympic Games in the own country. To the best of our knowledge, there are six studies that measure the WTP for hosting the Summer Olympic Games. Two out of the six studies focus on the 2012 Summer Olympic Games in London. Atkinson et al. (2008) asked residents from London, Manchester and Glasgow about their individual WTP for hosting the Summer Olympic Games in London. The analysis shows that on average residents from London are willing to pay £21.95 (€24.46¹). Residents from Manchester (£12.40, €13.82) and Glasgow (£10.87, €12.11) are also willing to pay, yet less money on average. The results of this study show that residents from the city, in which the Olympic Games might take place, as well as residents from surrounding towns are willing to pay. Walton et al. (2008) confirm these results. They show that residents who are not living in London have a positive and not inconsiderable WTP for hosting the Summer Olympic Games in London. More precisely, residents from Bath are on average willing to pay £70.11 (€78.14). An extrapolation over the median of £42.20 (€47.03) shows that the residents of Bath are willing to pay £5.83 million (€6.50 million) for hosting this event in London.

Wicker et al. (2017) employed a payment card format, which contains monthly tax amounts to determine the individual WTP for Summer Olympic Games in Germany over a five-year period. The study shows that respondents are on average willing to pay €51. Thereby, the WTP varied widely across regions, ranging from €31 in Hanover to €100 in the Cologne area. An aggregation of the WTP leads to a value of €46 billion. Wicker and Coates (2018) asked weeks before the official

¹British pound equals €1.1145 by now. Retrieved from: http://www.finanzen.net/waehrungsrechner/britische-pfund_euro. [Accessed 13 June 2020.]

referendum in Hamburg (and Kiel) in November 2015 about hosting the Summer Olympic Games 2024 there. In the referendum 51.6 percent voted against bidding for hosting the games. In the survey with 368 included and weighted respondents only 41.3 percent were in favour and 30.2 percent had a positive WTP. The average amount of the WTP was not reported.

Heisey (2009) analyses the individual and aggregated WTP for hosting the 2016 Summer Olympic Games for three competition sites (Chicago, San Francisco, Berlin). Chicago has the highest individual (\$54.89, €48.76²) and aggregated (\$439 million, €390 million) WTP. San Francisco has a smaller individual (\$35.73, €31.74) and aggregated (\$154 million, €137 million) WTP. The residents of the metropolitan area of Berlin are willing to pay on average €16.35 only (€82 million in the aggregate) for hosting the 2016 Summer Olympic Games. Finally, Coates and Szymanski (2014) examine the WTP of US citizens for hosting the 2024 Summer Olympic Games in the USA. In accordance with the results, US citizens are on average willing to pay \$138.27 (€122.84). Projected to the total population above 18 years of age this corresponds to \$33.6 billion (€29.9 billion).

The literature review shows that there is a quite noteworthy WTP for hosting Olympic Games in the own country and city. Interestingly, no study analyses a negative WTP, a WTA, for hosting Olympic Games in the own country or city. To close this research gap, the present study considers this aspect in the empirical analyses.

Theoretical Considerations

Hosting Olympic Games in the own city or country can be classified as a public good. A public good is characterised by no rivalry in consumption as well as non-excludability in consumption (Mozsár 2003). No rivalry in consumption means that different individuals can consume the good at the same time without affecting the individual utility of consuming this good. Non-excludability in consumption means that it is not possible to prevent non-paying individuals from consuming the good (in this case hosting the Games instead of watching them directly in the stadiums). Hosting Olympic Games in the own country primarily generates benefits for residents of this country without affecting the consumption of other residents of this country (no rivalry) while there is rivalry with other countries that cannot host the same event at the same time. Furthermore, residents cannot be excluded by others from 'consuming' the event and its effects (non-excludability). In this case, excludability would only be possible with regard to the audience seats. Problems resulting from public goods are mainly provoked by the characteristic of non-excludability. Caused by the non-excludability, each individual has the chance to consume the good without paying for it (free rider problem) such that potential producers are not able to realise sufficient revenues to cover the cost of production. Consequently, private providers do not offer such goods.

²US-\$1 equals €0.8884 by now. Retrieved from: http://www.finanzen.net/waehrungsrechner/us-dollar_euro. [Accessed 13 June 2020.]

In addition to the individual WTP and WTA for hosting Olympic Games in Germany, the present study tries to identify determinants that influence the WTP and WTA. For this purpose, we identify three factor groups, namely consumption-related factors, intangible factors, and socio-economic factors.

Following Stigler and Becker (1977), individuals are able to generate their own consumption capital and to increase it by repeated consumption of similar goods. Individuals consuming a special good invest in their consumption capital at the same time (Stigler and Becker 1977). Regarding our object of investigation, this means that the interest in sport and specifically in Olympic Games as well as the personal sporting activity lead to a direct benefit of consumption as well as to stocking-up the personal consumption capital. For instance, sports-minded individuals and those who are interested in Olympic Games are more familiar with the effects of hosting sports events in their own country. This knowledge is an essential point to increase one's personal benefit by consuming sports (Schellhaab and Enderle 1999). Moreover, one's personal sporting activity leads also to a higher WTP. That is because more athletic people can better appreciate the value and benefit of sports events due to their own sporting activity. In addition, they can have a higher WTP because it is more valuable for them to host sports events in their own country in a sport they pursue themselves. For this reason, individuals with a higher sporting activity level should have a higher WTP. Preuß and Werkmann (2011) and Walton et al. (2008) show that a general interest in sport as well as sportive activity are positively associated with the WTP. Therefore, consumption-related determinants that influence the WTP are an interest in sports and the personal sporting activity.

The second group of determinants are intangible factors. From a theoretical point of view, these factors can be attributed to the concept of symbolic capital (Bourdieu 1984, Bourdieu 1989). According to Bourdieu (1984), symbolic capital denotes resources generated by honour, prestige, and recognition. This concept can explain the value of hosting Olympic Games in Germany and the intangible benefits created. Similar to the consumption capital theory, the increased utility of symbolic capital leads to an increased WTP. Regarding the subject of research, hosting Olympic Games in Germany can produce public goods with symbolic character such as pride, prestige or recognition. Pride is determined by the degree of identification with the home country and the national team, in this case the athletes of the German team. It is to be expected that both variables influence the WTP for hosting Olympic Games in Germany in a positive way. Furthermore, prestige is measured by assessing the national importance of a good performance by the national Olympic team, recognition by the personal importance of a good performance. Both variables should increase the WTP because individuals who find it important for themselves and for the national reputation that the German team performs well may be willing to pay more for hosting Olympic Games in the own country. For the present research, it is assumed that intangible factors have a positive influence on the value of hosting Olympic Games in Germany.

The last group of determinants comprises socio-demographic factors like monthly human capital in form of graduation level, net income, age, gender and birthplace. It is assumed that the WTP and WTA differ between individuals with

different socioeconomic backgrounds. Thus, human capital and income can have a positive impact on the WTP (Atkinson et al. 2008, Coates and Szymanski 2014, Heisey 2009, Preuß and Werkmann 2011, Walton et al. 2008). For example, individuals with higher human capital, measured by a higher education level, may have better skills to assess (positive) effects for tourism or the economy at large resulting from Olympic Games in their own country. Moreover, individuals with a higher income have higher monetary resources at their disposal. The relation between the individual WTP and the age could be strongly connected to the relations of education and income. At a young age, individuals have less income and a lower educational level. As a result, the WTP might be lower for younger individuals. As the individuals mature, the degree of education and the disposable income increase. Thus, individuals should have a higher WTP with increasing age. Typically, pensions are lower compared to previous salaries. Thus, it is conceivable that the WTP of individuals decreases when they retire. Walton et al. (2008) depict a negative effect of age on the WTP while other studies show an insignificant effect of age (Atkinson et al. 2008, Coates and Szymanski 2014, Preuß and Werkmann 2011). With regard to gender, previous studies show that males report a greater WTP than females (Coates and Szymanski 2014, Walton et al. 2008). This interdependency is intuitive because, typically, men are more interested in sport than women. Thus, they might have a greater WTP for hosting Olympic Games in their own city or country to experience this event live and in person. Further, it can be assumed that the birthplace has a positive impact on the WTP for hosting Olympic Games in the own country because it should provide a greater benefit, which results in a higher WTP.

Methodology

To measure the monetary value of a public good like national defence, environmental protection or in this case hosting Olympic Games, the individual preferences have to be monetarised. The concept of the WTP is an economic concept to express the preferences of the individuals in monetary terms. Likewise, the concept of the WTA (negative WTP) is an economic concept that displays the minimum amount of money that an individual is willing to accept to put up with something negative. Both concepts allow to monetarise public goods and display the utility of the consumers. The amount of the WTP depends on the utility of consuming the public good and increases with it. Based on different preferences, the utility and thus the WTP differs among individuals.

The Contingent Valuation Method (CVM) is an established method to monetarise preferences of consumers regarding certain public goods. By surveys, the CVM identifies the WTP of economic entities for the provision or the withdrawal of a public good. For this purpose, hypothetical scenarios are created where public goods are directly assessable. In these scenarios respondents have to state an amount of money they are willing to pay or accept for the public good considering their individual preferences. Hence, this allows for determining the individual consumer surplus (Coates and Humphreys 2003, Heyne and Süssmuth

2008, Mitchell and Carson 1989). In the past, the CVM was primarily used in the field of environmental and nature protection (Carson 2011, Davis 1963, Diamond and Hausman 1994, Heyne and Süßmuth 2008, Thayer 1981). Over time, this method has been established in political analyses (Chambers et al. 1998, Grootuis et al. 1998). Johnson and Whitehead (2000) used this method for the first time in the field of sports economics in order to value sport teams economically. For a recent survey of the many uses of the CVM in sports economics in the meantime see Orłowski and Wicker (2019). The present study applies the CVM to determine the WTP for hosting Olympic Games in Germany. The exact scenario created to measure the WTP is presented in the next chapter. We used the statistical programme Stata.

Data

To measure the WTP for hosting Olympic Games in Germany, the data were collected by using an online questionnaire. The online survey had been available from November 27, 2013 until February 6, 2014. One day later, on February 7, the XXII. Winter Olympic Games in Sotschi started, and ended on February 23. The online-link to access the online questionnaire was published on several social media networks (Facebook, Twitter, and XING) as well as on web pages of the University of Münster. In the following, the structure, as well as the single variables collected, are described.

At the beginning, the questionnaire informed the participants about the topic of the survey. Furthermore, participants were notified that the participation is anonymous, that every data is treated confidentially, and that the information they provide is to be used for scientific purposes only. The questionnaire comprised several questions that can be divided in sport-specific questions and Olympia-specific questions as well as socio-economic questions. Table 1 provides an overview of the variables collected.

Table 1. Overview of Variables

Variables	Description
WTP_O_GER	WTP for hosting Olympic Games in Germany in €
WTA_O_GER	WTA for hosting Olympic Games in Germany in €
WTP/A_O_GER	WTP and WTA (negative WTP) for hosting Olympic Games in Germany in €
INT_SPORT	Interest in sports in general (from 0 = no interest at all to 4 = very strong)
SPORT_P	Regular sport participation (at least once per week; 0 = no; 1 = yes)
ID_GER	Identification with Germany (from 0 = not at all to 4 = very strong)
ID_TEAM	Identification with German Olympic team (from 0 = not at all to 4 = very strong)
PERS_IMP	Personal importance that the Olympic team does well (from 0 = not at all to 4 = very important)
NAT_IMP	Importance to country that the Olympic team does well (from 0 = not at all to 4 = very important)
OPTION_O_inG	Are you in general in favour or against that the Olympic Games are hosted in Germany (0 = against; 1 = indifferent; 2 = in favour)
AGE	Age (in years)
GENDER	Gender of the respondent (0 = female; 1 = male)
GRAD	Educational level (from 0 = no education to 6 = university degree)
INC 1	Personal monthly net income up to €1,000
INC 2	Personal monthly net income from €1,001 to €2,000
INC 3	Personal monthly net income from €2,001 to €3,000
INC 4	Personal monthly net income from €3,001 to €4,000
INC 5	Personal monthly net income more than €4,000
BORN_GER	Born in Germany (0 = no; 1 = yes)

Regarding hosting Olympic Games in Germany in general, the participants were asked whether they are in general in favour or against such an event (OPINION_O_inG). In particular, in case that participants were in favour of hosting Olympic Games in Germany they were asked:

"Hypothetically, suppose it would be possible, what is the maximum amount you would be willing to pay for hosting the Olympic Games in Germany?"

If respondents were against Olympic Games in Germany, the constructed scenario was slightly adjusted. The specific question was:

"Hypothetically, suppose it would be possible, how much money (compensation) would it take for you to accept that the Olympic Games are hosted in Germany?"

Moreover, respondents also got questions about their interest in sports in general (INT_SPORT). Furthermore, the participants were asked whether they practice any sport regularly, for example at least once a week (SPORT_P). The questionnaire also contained questions about the respondents' level of identification with Germany (ID_GER) and with the national Olympic team (ID_TEAM). In

addition, respondents were asked to give information about the importance for them personally (PERS_IMP) and nationally (NAT_IMP), for the reputation of Germany, that the German Olympic team performs well.

At the end of the survey, respondents were confronted with a set of socio-economic questions about age (AGE), gender (GENDER), graduation level (GRAD), monthly net income (INC), and whether they were born in Germany (BORN_GER).

Before starting with the data evaluation, data and specifically the WTP variables were checked with respect to validity and plausibility. €1,000 were considered suitable as a plausible limit for both WTP variables. Questionnaires with greater absolute values were not included in the analyses.

Empirical Results

This chapter contains the descriptive statistics to determine a possible (negative) WTP and the empirical results to identify determinants that influence the WTP for hosting Olympic Games in Germany. Moreover, an extrapolation of the individual WTP leads to the aggregate WTP of the German population.

Table 2 shows the descriptive statistics. Accordingly, 53 percent of the participants are willing to pay for hosting Olympic Games in Germany whereas only 11 percent request a payment to accept their hosting in Germany. Regarding absolute WTP and WTA, participants are on average willing to pay €77.58 for hosting Olympic Games in Germany (WTP_O_GER). As compensation for hosting Olympic Games in Germany they demand on average €36.71 (WTA_O_GER).

Regarding further variables, the descriptive statistics show that 78 percent of the participants practice sport regularly. On average, the respondents are moderately to strongly interested in sports in general.

Furthermore, Table 2 shows that the degree of identification with Germany is greater than with the German Olympic team. Nevertheless, both identification features are not very pronounced. In particular, the respondents stated that they neither find it important on the personal level nor on the national level that the German Olympic team performs well at Olympic Games.

Table 2. Descriptive Statistics

Metric/ordinal variables	Obs.	Mean	S.D.	Min.	Max.
WTP_O_GER	188	77.58	229.97	0	1,000
WTA_O_GER	188	36.71	168.84	0	1,000
WTP/A_O_GER	188	40.87	295.16	-1,000	1,000
INT_SPORT	351	2.57	1.04	0	4
ID_GER	350	2.53	0.96	0	4
ID_TEAM	396	1.54	1.12	0	4
PERS_IMP	387	1.58	1.22	0	4
NAT_IMP	387	1.63	1.02	0	4
AGE	349	26.77	9.39	16	71
INC	265	2.81	2.14	1	9
GRAD	343	5.17	1.13	1	6
Dummy variables		% of respondents			
WTP_O_GER_D	188	52.66			
WTA_O_GER_D	188	10.64			
OPTION_O_inG (against)	57	15.04			
OPTION_O_inG (indiff.)	152	40.11			
OPTION_O_inG (in favour)	170	44.85			
SPORT_P	366	77.68			
GENDER (1=male)	349	52.15			
BORN_GER	349	95.42			

Regarding the opinion variable, 15 percent of the respondents stated that they are against hosting Olympic Games in Germany. Forty percent are indifferent, and 45 percent of the participants are in favour of hosting Olympic Games in Germany.

Concerning socio-economic factors, most respondents have a higher education entrance qualification (Abitur: German equivalent of ‘A Levels’), and a personal monthly net income between €501 and €1,500. Respondents are on average 26.77 years old with age ranging from 16 to 71 years. According to the official statistics (Statistische Ämter des Bundes und der Länder 2016), only 30 percent of German people are 30 years old or younger. The descriptive statistics also shows that 52 percent of the respondents are males. Thus, 48 percent of the participants are females. In comparison to the gender relation in Germany at large, males are overrepresented in the present dataset. To match the present data with the real gender and age relations in the German population, weights for gender and age are used for further analyses. The weights are calculated based on information by Statistische Ämter des Bundes und der Länder (2016). Finally, descriptive statistics display that 95 percent of the respondents were born in Germany.

In the following, determinants that influence the WTP and WTA for hosting Olympic Games in Germany are presented. The regression analysis is based on a weighted Ordinary-Least-Square (OLS)³ regression. The dependent variable is the WTP including the WTA as negative WTP (WTP/A_O_GER).

³A binary-logistic regression leads to similar results. This regression is available upon request.

Table 3. Regression Results of Weighted OLS Regression

Dependent Variable	WTP/A_O_GER
INT_SPORT	21.71 (0.49)
SPORT_P	139.91 (0.78)
ID_TEAM	-89.05 ⁺ (-1.69)
NAT_IMP	183.36*** (4.37)
AGE	86.41** (2.87)
AGE ²	-0.96** (-2.84)
GENDER	149.71 ⁺ (1.67)
GRAD	30.31 (0.98)
INC_1 (€1-€1,000)	409.17* (2.54)
INC_2 (€1,001-€2,000)	327.61* (2.03)
INC_3 (€2,001-€3,000)	167.41 ⁺ (1.63)
INC_4 (€3,001-€4,000)	6.84 (0.05)
INC_5 (more than 4,001)	REF
BORN_GER	106.19 (0.93)
CONSTANT	-5,519.66** (-3.05)
F	2.66
Significance	0.00
R ²	0.61

Note: N=129, displayed are the unstandardised coefficients, t-values in parentheses. +p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001, weighted sample.

Regression results in Table 3 show that the interest in sports in general and practicing sport on a regular basis have no significant impact on the WTP (always including WTA). Interestingly, the identification with the German Olympic team has a significantly negative impact on the WTP. Thus, the WTP decreases by €89.05 for individuals who identify with the team by one more unit. In contrast to this, individuals who find it nationally important that the German Olympic team performs well have a significantly greater WTP. More concretely, the WTP increases by €183.36 for individuals who find it more important by one unit that the German Olympic team performs well.

Regarding socio-economic factors, age has a significantly positive impact on the WTP whereas age squared has a significantly negative impact. Therefore, the impact of age on WTP follows an inverted U-shape with a maximum at 45 years.

Consequently, both younger and older respondents are less willing to pay for hosting Olympic Games in Germany.

As expected, men have a significantly greater WTP than women. Specifically, men are on average willing to pay €149.71 more than women. The graduation level has no significant impact on the WTP. Thus, there are no significant differences between respondents with no university degree and those who have a graduate degree or who are going for it. Concerning the personal monthly net income, regression results show that the income classes one, two, and three have a significantly positive impact. Respondents with a personal monthly net income between €1 and €1,000 are willing to pay €409.17 more than individuals with a personal monthly net income above €4,001. In comparison to those participants with a monthly net income of more than €4,001, the WTP of participants with a monthly net income between €1,001 and €2,000 increases by €327.61. Individuals in the personal monthly net income class of €2,001 and €3,000 are willing to pay €167.41 more than individuals of the reference category. Individuals in the income class between €3,001 and €4,000 have no significantly different WTP than individuals who earn more than €4,001 per month. Lastly, the variable of the birth place has no significant impact on the WTP.

The extrapolation of the weighted data of the individual WTP and WTA for hosting Olympic Games in Germany is shown in Table 4.

Table 4. *Extrapolation of the WTP and WTA Differentiated by Gender*

	Women	Men	Σ
WTP	€4.35 billion	€2.33 billion	€6.68 billion
WTA	€1.77 billion	€1.34 billion	€3.11 billion
WTP-WTA	€2.58 billion	€0.99 billion	€3.57 billion

The results show that German women are willing to pay €4.35 billion in aggregate whereas German men are willing to pay €2.33 billion. While males have a higher WTP controlling for all other variables in the OLS regression, this is not the case in the extrapolated aggregate, meaning that women have other characteristics that boost their WTP. In sum, the German population is willing to pay €6.68 billion. An extrapolation of the WTA for hosting Olympic Games in Germany shows that women demand €1.77 billion while men demand €1.34 billion (in sum €3.11 billion) to accept that the Olympic Games are hosted in Germany. Subtracting WTA from WTP indicates that Germans are willing to pay €3.57 billion for hosting Olympic Games in Germany, much smaller than the estimated €7.4 billion cost of hosting the 2024 Summer Olympic Games in Hamburg.

Conclusion

This study tried to answer the question how many German individuals are willing to pay or willing to accept to host the Olympic Games in Germany. Considering WTA in this context is new to the literature. The approach allows for

determining both hypothetical payments to have the Olympic Games hosted in Germany and hypothetical compensations needed to accept that the Olympic Games are hosted in Germany. The used data set, generated with an online questionnaire, shows that 53 percent of the respondents have a positive WTP whereas 11 percent of the participants request compensation to accept that Olympic Games are hosted in Germany. On average, participants stated that they are willing to pay €77.58 for hosting Olympic Games in Germany. In contrast to this, participants who are against Olympic Games in their own country stated that they demand on average €36.71 as a compensation for hosting Olympic Games in Germany. The extrapolation of the individual WTP and WTA leads to an aggregated WTP of €6.68 billion, and to an aggregated WTA of €3.11 billion. Put together, this leads to a positive net balance of €3.57 billion. This figure can be interpreted as the maximum amount Germans are willing to pay for Olympic Games in their country (with caution given the limits of the used data). Certainly, the whole costs for hosting Olympic Games should not be imposed on the residents of the hosting city or county alone. This would cause residents to vote against hosting Olympic Games in the own city or county as has been the case in cities like Hamburg (Wicker and Coates 2018) or Munich.

Regarding the determinants that influence the WTP, regression results show that in particular the socio-demographic factors influence the WTP in a significant way. As expected, the gender variable has a significantly positive impact. This means that males stated a greater WTP for hosting Olympic Games in Germany. This is hardly surprising as men are typically more interested in sport than women. The keener interest translates into greater WTP for hosting Olympic Games in the own country that also makes it easier to see this event live and in person. Similar results can be found in Coates and Szymanski (2014), Walton et al. (2008), and Wicker et al. (2017). Regarding the age, WTP follows an inverted U-shape with a maximum at 45 years. Thus, both younger and older people are less willing to pay for hosting Olympic Games in Germany. One possible explanation might be that younger people may not be able to assess the value of hosting Olympic Games for lack of experience. This means that they cannot evaluate whether hosting Olympic Games cause positive or negative effects for the home country. Due to this fact, they are less inclined to pay for hosting Olympic Games. As one result of bad publicity regarding hosting mega sport events – for example reports on Sotschi before and after the Winter Olympic Games – the WTP for hosting Olympic Games in the own country might decrease. Middle-aged people appear to be rather optimistic with respect to the opportunities resulting from hosting Olympic Games in their own country, while older people are less interested (Walton et al. 2008). Considering the income variables, the regression results show that the three lower income classes have a significantly positive impact on the WTP (contrary to Atkinson et al. 2008, Coates and Szymanski 2014, Heisey 2009, Preuß & Werkmann 2011, Walton et al. 2008). This means that individuals with a personal monthly net income between €1 and €3,000 have a greater WTP than individuals with a personal monthly net income of more than €4,000. Regarding the absolute value, respondents with a personal monthly net income between €1 and €1,000 have the greatest WTP. One conclusion may be that with an increase of the

personal monthly net income other interests predominate the interest in hosting Olympic Games in the own country. The graduation level and the birthplace both have a positive sign regarding the WTP. However, they are not statistically significant and thus need no further explanation.

In need of explanation is the significantly negative impact of the identification with the German Olympic team. The negative effect of the identification variable suggests that the identification with the German Olympic team is a substitute for the WTP. This suggests that as individuals already identify with the German Olympic team they do not feel obliged to pay for having the team compete in Olympic Games in the own country. The level of national importance influences the WTP in a significantly positive way. This means that individuals who find it on a national level important that the German Olympic team performs well have a greater WTP for hosting Olympic Games in Germany. In other words, the WTP increases with national pride. Therefore, individuals with greater national pride have keener interest in hosting Olympic Games in their own country to present the country and its strengths in sports to the world.

In terms of methodology, it would be interesting to examine in more detail which respondents may have misunderstood the WTP as a kind of bribery instead of as an equivalent for the subjective utility. Therefore, it is not clear whether the CVM overestimates or underestimates the real value of sport events. The overestimation arises from statements of high amounts because they are free of real costs. The underestimation arises because some individuals state no WTP even though they value this event. In any case, to complement the question concerning the WTP with the question of a potential WTA is very important for determining the real value because the positive WTP alone is clearly an overestimation. Furthermore, it would be interesting to study differences between the WTP for hosting Olympic Games in the own country and in the own city. The outcomes of the referenda in Hamburg and Munich are relevant for future votes for hosting Olympic Games in other cities. Finally, it could be worthwhile to replicate this kind of study for other countries (and with representative samples). The country with the highest WTP (less WTA) would be a good candidate for hosting the Olympic Games.

References

- Atkinson G, Mourato S, Szymanski S, Ozdemiroglu E (2008) Are we willing to pay enough to 'back the bird'? Valuing the intangible impacts of London's bid to host the 2012 Summer Olympic Games. *Urban Studies* 45(2): 419–444.
- Bourdieu P (1984) *Distinction: a social critique of judgment of taste*. Cambridge, MA: Harvard University Press.
- Bourdieu P (1989) Social space and symbolic power. *Sociological Theory* 7(1): 14–25.
- Carson RT (2011) *Contingent valuation: a comprehensive history and bibliography*. Cheltenham: Edward Elgar Publishing Limited.
- Chambers CM, Chambers PE, Whitehead JC (1998) Contingent valuation of quasi-public goods: a validity and reliability assessment. *Public Finance Review* 26(2): 137–154.

- Coates D, Humphreys BR (2003) Professional sport facilities: franchise and urban economic development. *Public Finance and Management* 3(3): 335–357.
- Coates D, Szymanski S (2014) *Willingness to pay to host the summer Olympic Games*. Working Paper. USA: University of Maryland Baltimore County.
- Davis RK (1963) *The value of outdoor recreation: an economic study of the Maine Woods*. Doctoral Dissertation. Cambridge, USA: Harvard University.
- Diamond PA, Hausman JA (1994) Contingent valuation: is some number better than no number? *Journal of Economic Perspective* 8(4): 45–64.
- Groothuis PA, Van Houtven G, Whitehead JC (1998) Using contingent valuation to measure the compensation required to gain community acceptance of a LULU: the case of a hazardous waste disposal facility. *Public Finance Review* 26(2): 231–249.
- Heisey K (2009) *Estimating the intangible benefits of hosting the 2016 Olympic and Paralympic Games for potential bid cities: Berlin, Chicago, and San Francisco*. Doctoral Dissertation. Cologne, Germany: German Sport University.
- Heyne M, Süßmuth B (2008) Wie viel ist den Deutschen die Ausrichtung der FIFA WM 2006 wert und warum? [The willingness-to-pay to host the 2006 FIFA World Cup in Germany.] In M Klein, M Kurscheidt (eds), *Neue Perspektiven ökonomischer Sportforschung*. Schorndorf: Hofmann.
- Johnson BK, Whitehead JC (2000) Value of public goods from sports stadiums: the CVM approach. *Contemporary Economic Policy* 18(1): 48–58.
- Mitchell RC, Carson RT (1989) *Using surveys to value public goods: the contingent valuation method*. Washington: Resources for the Future.
- Mozsár F (2003) On the notion of public goods. In I Lengyel (ed), *Knowledge transfer, small and medium-sized enterprises, and regional development in Hungary*. Szeged: JATE Press.
- Müller M (2014) After Sochi 2014: costs and impacts of Russia's Olympic Games. *Eurasian Geography and Economics* 55(6): 628–655.
- Orlowski J, Wicker P (2019) Monetary valuation of non-market goods and services: a review of conceptual approaches and empirical applications in sports. *European Sport Management Quarterly* 19(4): 456–480.
- Preuß H, Werkmann K (2011) Erlebniswert Olympische Winterspiele in München 2018 [Experiential value of the Winter Olympic Games in Munich 2018.] *Sport und Gesellschaft* 8(2): 97–123.
- Schellhaaß HM, Enderle G (1999) *Wirtschaftliche Organisation von Sportligen in der Bundesrepublik Deutschland*. [Economic organisation of sports leagues in the Federal Republic of Germany]. Cologne: Buch und Strauß.
- Statistische Ämter des Bundes und der Länder (2016). *Bevölkerungsstand: Bevölkerung nach Geschlecht und Altersgruppen: Stichtag 31.12.2013*. [Population level: human population differentiated by age and gender: record date December 31, 2013]. Retrieved from: <https://bit.ly/3jirrC8>. [Accessed 24 March 2016.]
- Stigler GJ, Becker GS (1977) De gustibus non est disputandum. [There is no disputing about tastes.] *American Economic Review* 67(2): 76–90.
- Thayer MA (1981) Contingent valuation techniques for assessing environmental impacts: further evidence. *Journal of Environmental Economics and Management* 8(1): 27–44.
- Walton H, Longo A, Dawson P (2008) A contingent valuation of the 2012 London Olympic Games. *Journal of Sports Economics* 9(3): 304–317.
- Wicker P, Whitehead JC, Mason DS, Johnson BK (2017) Public support for hosting the Olympic Summer Games in Germany: the CVM approach. *Urban Studies* 54(15): 3597–3614.

Wicker P, Coates D (2018) Flame goes out: determinants of individual support at the 2024 Hamburg Games referendum. *Contemporary Economic Policy* 36(2): 302–317.

