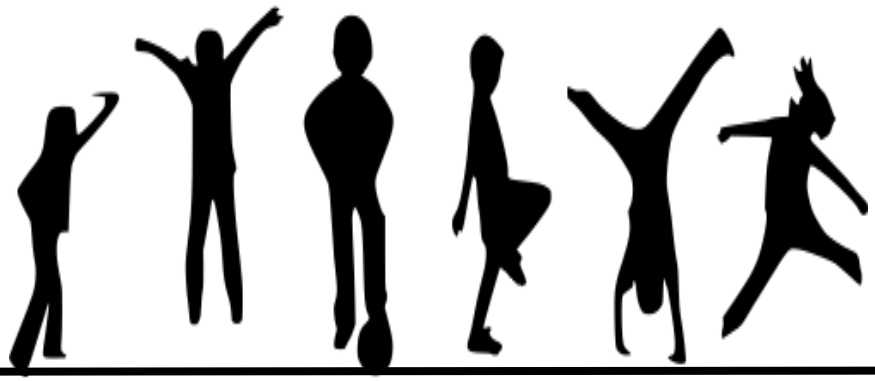
Athens Journal of Sports

Quarterly Academic Periodical, Volume 13, Issue 1
Published by the Athens Institute
URL: https://www.athensjournals.gr/ajspo Email: journals@atiner.gr
e-ISSN: 2241-7915 DOI: 10.30958/ajspo



Athens Journal of Sports

Quarterly Academic Periodical, Volume 13, Issue 1, March 2026
Published by the Athens Institute
URL: https://www.athensjournals.gr/ajspo Email: journals@atiner.gr
e-ISSN: 2241-7915 DOI: 10.30958/ajspo

Front Pages

INGRID BRENNER, SAI GAYATHRI CHAKRALA & HOLLY BATE
Cardiovascular Effects of Passive Exercise:A Comparative Study

GEORGIOS ANDRONIKOS, TONY WESTBURY, ATHANASIOS SOUGLIS & RUSSELL MARTINDALE
A Qualitative Investigation of Successful Junior-to-Senior Transitions in Elite Athletes

KONRAD REUß, YANNICK WEILER & CHRISTOPHER HUTH
Challenging the Olympic Model? Expected Consumer Interest in the Enhanced Games

TOM BÖTTGER & LARS VISCHER
Home Advantage in Different German Football League

Athens Journal of Sports

Published by the Athens Institute

Editors

- **Dr. Gregory T. Papanikos,** President of Athens Institute. (Economics)
- **Dr. Margo Apostolos,** Academic Member, Athens Institute & Professor, University of Southern California -USC Kaufman School of Dance-USC Glorya Kaufman Dance Medicine Center- & Co-Director- Cedars-Sinai, USA. (Arts, Technology and Sports)
- **Dr. Maria Kosma,** Head, Sports Unit, Athens Institute & Associate Professor, Louisiana State University, USA. (Physical Education & Sport Science)
- **Dr. Seppo Suominen,** Academic Member, Athens Institute & Senior Lecturer, University of Applied Sciences, Finland. (Sports Economics)

https://www.athensjournals.gr/ajspo/eb

Administration of the Journal

1. Vice President of Publications: Dr Zoe Boutsioli
2. General Managing Editor of all Athens Institute's Publications: Ms. Afrodete Papanikou
3. ICT Managing Editor of all Athens Institute's: Mr. Kostas Spyropoulos
4. Managing Editor of this Journal: Ms. Eirini Lentzou

Athens Institute is an Athens-based World Association of Academics and Researchers based in Athens. Athens Institute is an independent and non-profit Association with a Mission to become a forum where Academics and Researchers from all over the world can meet in Athens, exchange ideas on their research and discuss future developments in their disciplines, as well as engage with professionals from other fields. Athens was chosen because of its long history of academic gatherings, which go back thousands of years to Plato's Academy and Aristotle's Lyceum. Both these historic places are within walking distance from Athens Institute's downtown offices. Since antiquity, Athens was an open city. In the words of Pericles, Athens"…is open to the world, we never expel a foreigner from learning or seeing". ("Pericles' Funeral Oration", in Thucydides, The History of the Peloponnesian War). It is Athens Institute's mission to revive the glory of Ancient Athens by inviting the World Academic Community to the city, to learn from each other in an environment of freedom and respect for other people's opinions and beliefs. After all, the free expression of one's opinion formed the basis for the development of democracy, and Athens was its cradle. As it turned out, the Golden Age of Athens was in fact, the Golden Age of the Western Civilization. Education and (Re)searching for the 'truth' are the pillars of any free (democratic) society. This is the reason why Education and Research are the two core words in Athens Institute's name.

The *Athens Journal of Sports* (AJSPO) is an Open Access quarterly double-blind peer reviewed journal and considers papers from all areas of sports and related sciences. Many of the papers published in this journal have been presented at the various conferences sponsored by the Sport, Exercise, & Kinesiology Unit of the Athens Institute & the Panhellenic Association of Sports Economists and Managers (PASEM). All papers are subject to Athens Institute's Publication Ethical Policy and Statement.

Athens Journal of Sports
ISSN NUMBER: 2241-7915 - DOI: 10.30958/ajspo
Volume 13, Issue 1, March 2026
Download the entire issue (PDF)

Front Pages i-viii

Cardiovascular Effects of Passive Exercise: A Comparative Study 9
Ingrid Brenner, Sai Gayathri Chakrala & Holly Bates

A Qualitative Investigation of Successful Junior-to-Senior Transitions in Elite Athletes 27
Georgios Andronikos, Tony Westbury, Athanasios Souglis & Russell Martindale

Challenging the Olympic Model? Expected Consumer Interest in the Enhanced Games 49
Konrad Reuß, Yannick Weiler & Christopher Huth

Home Advantage in Different German Football League 61
Tom Böttger & Lars Vischer

Athens Journal of Sports
Editorial and Reviewers' Board

Editors

- **Dr. Gregory T. Papanikos,** President of Athens Institute. (Economics)
- **Dr. Margo Apostolos,** Academic Member, Athens Institute & Professor, University of Southern California -USC Kaufman School of Dance-USC Glorya Kaufman Dance Medicine Center- & Co-Director- Cedars-Sinai, USA. (Arts, Technology and Sports)
- **Dr. Maria Kosma,** Head, Sports Unit, Athens Institute & Associate Professor, Louisiana State University, USA. (Physical Education & Sport Science)
- **Dr. Seppo Suominen,** Academic Member, Athens Institute & Senior Lecturer, University of Applied Sciences, Finland. (Sports Economics)

Editorial Board

- **Dr. Panagiota (Nota) Klentrou,** Academic Member, Athens Institute & Professor and Associate Dean Research and Graduate Studies, Brock University, Canada.
- **Dr. Roberta Newman,** Academic Member, Athens Institute & Master Teacher, Liberal Studies Program, New York University, USA.
- **Dr. Samuel Honório,** Polytechnic Institute of Castelo Branco, SHERU (Sport, Health and Exercise Research Unit), Castelo Branco, Portugal.
- **Dr. Vassilios Ziakas,** Academic Member, Athens Institute & Associate Professor, University of St Mark & St John, UK.
- **Dr. Barry Costas,** Senior Lecturer, University of Hertfordshire, UK.
- **Dr. Ruben Goebel,** Academic Member, Athens Institute & Director of the Sport Science Program, Qatar University, Qatar.
- **Dr. Nadim Nassif,** Academic Member, Athens Institute & Associate Professor, Department of Psychology, Education and Physical Education, Notre Dame University - Louaize, Lebanon.

- **Vice President of Publications:** Dr Zoe Boutsioli
- **General Managing Editor of all Athens Institute's Publications:** Ms. Afrodete Papanikou
- **ICT Managing Editor of all Athens Institute's Publications:** Mr. Kostas Spyropoulos
- **Managing Editor of this Journal:** Ms. Eirini Lentzou

Reviewers' Board
Click Here

President's Message

All Athens Institute's publications including its e-journals are open access without any costs (submission, processing, publishing, open access paid by authors, open access paid by readers etc.) and is independent of presentations at any of the many small events (conferences, symposiums, forums, colloquiums, courses, roundtable discussions) organized by Athens Institute throughout the year and entail significant costs of participating. The intellectual property rights of the submitting papers remain with the author. Before you submit, please make sure your paper meets the basic academic standards, which includes proper English. Some articles will be selected from the numerous papers that have been presented at the various annual international academic conferences organized by the different divisions and units of the Athens Institute for Education and Research. The plethora of papers presented every year will enable the editorial board of each journal to select the best, and in so doing produce a top-quality academic journal. In addition to papers presented, Athens Institute will encourage the independent submission of papers to be evaluated for publication.

The current issue is the first of the thirteenth volume of the *Athens Journal of Sports (AJSPO),* published by the Sport, Exercise, & Kinesiology Unit of the Athens Institute under the aegis of the Panhellenic Association of Sports Economists and Managers (PASEM).

Gregory T. Papanikos
President
Athens Institute

26th Annual International Conference on Sports: Economic, Management, Marketing & Social Aspects 11-15 May 2026, Athens, Greece

The Sports Unit of ATINER organizes its **26th Annual International Conference on Sports: Economic, Management, Marketing & Social Aspects, 11-16 May 2026, Athens, Greece** sponsored by the Athens Journal of Sports. The aim of the conference is to bring together academics and researchers of all areas of sports. Please submit a proposal using the form available (https://www.atiner.gr/2025/FORM-SPO.doc).

Academic Members Responsible for the Conference

Dr. Gregory T. Papanikos | Dr. Maria Konstantaki | Dr. Chris Sakellariou | Dr. Sharon Claire Bolton | Dr. Valia Kasimati | Dr. Cleopatra Veloutsou | Dr. Christos Anagnostopoulos

Important Dates

- Abstract Submission: **24 March 2026**
- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **13 April 2026**

Social and Educational Program

The Social Program Emphasizes the Educational Aspect of the Academic Meetings of Athens Institute.

- Greek Night Entertainment (This is the official dinner of the conference)
- Athens Sightseeing: Old and New-An Educational Urban Walk
- Social Dinner
- Mycenae Visit
- Exploration of the Aegean Islands
- Delphi Visit

Conference Fees

Conference fees vary from 400€ to 2000€
Details can be found at: https://www.atiner.gr/fees

22nd Annual International Conference on Sport & Exercise Science 27-31 July 2026, Athens, Greece

The Sports Unit of ATINER will hold its **22nd Annual International Conference on Sport & Exercise Science, 27-31 July, Athens, Greece** sponsored by the Athens Journal of Sports. You may participate as stream leader, presenter of one paper, chair a session or observer. Please submit an abstract (email only) to: atiner@atiner.gr, using the abstract submission form (https://www.atiner.gr/2026/FORM-FIT.doc).

Important Dates

- Abstract Submission: **7 April 2026**
- Acceptance of Abstract: 4 Weeks after Submission
- Submission of Paper: **23 June 2026**

Academic Member Responsible for the Conference

- Dr. Maria Konstantaki, Academic Member, Athens Institute & Senior Lecturer, Buckinghamshire New University, UK.

Social and Educational Program

The Social Program Emphasizes the Educational Aspect of the Academic Meetings of Athens Institute.

- Greek Night Entertainment (This is the official dinner of the conference)
- Athens Sightseeing: Old and New-An Educational Urban Walk
- Social Dinner
- Mycenae Visit
- Exploration of the Aegean Islands
- Delphi Visit
- Ancient Corinth and Cape Sounion

More information can be found here: https://www.atiner.gr/social-program

Conference Fees

Conference fees vary from 400€ to 2000€
Details can be found at: https://www.atiner.gr/fees

Athens Journal of Sports - Volume 13, Issue 1, March 2026 – Pages 9-26

Cardiovascular Effects of Passive Exercise: A Comparative Study

By Ingrid Brenner, Sai Gayathri Chakrala± & Holly Bates○*

Despite its clinical use for rehabilitation, little is known about the cardiovascular effects of passive exercise. This study examined the cardiovascular response of passive compared to active exercise. Twelve healthy individuals (7 M and 5 F, aged 21 ± 1 yrs) participated in the study. Participants were randomly assigned to perform 30 min of passive or active exercise, each separated by a one-week interval. Each session involved three, 10-minute bouts of pedalling performed either passively on a Theracycle or actively on a Monark cycle ergometer. Heart rate (HR), heart rate variability (HRV), blood pressure (BP), rate pressure product (RPP), and ratings of perceived exertion (RPE) were evaluated throughout each exercise session. HR and RPP were significantly increased from baseline with passive exercise, at all pedaling frequencies. At the highest pedaling frequency, diastolic blood pressure and RPE were significantly higher in passive exercise, compared to baseline. However, these measures were significantly lower than that observed with active exercise. Sympathetic nervous system (SNS) activation and parasympathetic nervous system (PNS) withdrawal was greater with active exercise. The results of this study indicate that passive exercise places minimal stress on the cardiovascular system and may be useful to promote mobility in people with chronic diseases.

Keywords: *Cardiovascular response, passive exercise, active exercise*

Introduction

Passive (or forced) exercise involves movement of a body part without voluntary contraction of skeletal muscle and can be accomplished with help from an individual (e.g., a physical therapist, kinesiologist, or a caregiver) or by using a mechanized device (i.e., continuous motion machine, motion splints or motorized exercise equipment) to move a patient's joints throughout their range of motion (Shirzad et al. 2022). These devices are commonly used to treat patients with a variety of neurological conditions (for example, Parkinson's disease, stroke, spinal cord injury, multiple sclerosis and post-traumatic brain injury) or for patients following orthopedic surgery. This form of movement is usually applied as an early form of physical therapy for patient mobilization (Llano-Diez et al. 2012).

Several studies have demonstrated that passive exercise training can induce numerous physiological benefits depending upon the clinical population examined. Patients with Parkinson's disease experience a reduction in tremors immediately post-exercise as well as an improvement in overall physical fitness following training (Sackner 2012). Stroke and spinal cord-injury patients experience a reduction in

*Associate Professor, Trent University, Canada.
±Student, Trent University, Canada.
○Associate Professor, Trent University, Canada.

edema, a decrease in spasticity, improved balance, increased cognition, enhanced muscle strength and an increased range of motion (ROM) (Brenner 2018). In patients with multiple sclerosis, continuous passive motion exercise (CPM) has been shown to increase mobility, gait speed, stride length and balance (Heesen et al. 2006).

As described above, most studies examining the effects of passive exercise training focus on neuromuscular effects. Perhaps, since the goal of passive therapy does not normally target the cardiovascular system, minimal information is available on the cardiovascular responses to an acute bout of passive exercise. By recruiting young, healthy participants, this preliminary investigation has been designed to determine the feasibility of the use of passive exercise as a mode of training for both healthy and clinical populations. The focus of this study is to examine the cardiovascular responses of passive exercise performed on a Theracycle (a passive exercise ergometer) in comparison to a Monark cycle ergometer (an active exercise ergometer) performed at the same pedalling frequency.

Literature Review

A review of the literature was done to examine the history of passive exercise as a treatment modality as well as the effects of one bout of passive exercise on the cardiovascular responses in healthy and clinical populations. Minimal information was available on the effects of one bout of passive exercise on the cardiovascular system and no information was available on the effects of passive exercise compared to active exercise on heart rate variability. To date, most of the research has focused on the effects of regular passive exercise training on neuromuscular function (i.e., motor function and performance) in stroke patients and/or patients with Parkinson's disease. Other studies have examined the effects of continuous passive motion following knee replacement surgery. These areas are outside the scope of this study and are not included in the literature review which follows.

The History of Passive Exercise

Historically, passive exercise treatment was introduced to enhance circulation. Herrmann and Reid (1934) describe a method known as passive vascular exercise or "pavaex" treatment that was used to treat patients with peripheral vascular disease. Use of this device involved placing the effected leg into a treatment boot made of Pyrex glass. With the patient in the supine position, the foot and leg were elevated slightly above the heart. Positive and negative pressure were rhythmically applied to the lower leg which in-turn influenced circulation. Post-pavaex treatment, patients displayed greater blood flow to the lower limb, a decrease in pain and a reduction in the incidence and extent of gangrene.

Roberts et al. (1971) investigated the effect of rhythmic passive foot flexion in patients undergoing surgery for varicose veins using a motorized foot mover. Patients performed passive flexion movements (24 to 50 flexions per minute) through a 20-to-50-degree range of motion (ROM) (depending upon flexibility) for 30 minutes prior to their surgery. These patients experienced an increase in femoral vein blood flow, faster

recovery times, and a reduction in the occurrence of postoperative deep vein thrombosis (DVT).

While these earlier studies focused primarily upon the effects of passive exercise on the vascular system, later work extended these findings to the cardiovascular system in healthy and clinical populations. However, inconsistencies are reported regarding the effects of passive exercise on the HR response. Some studies indicate no change in HR whereas others reported a slight decrease following passive exercise.

Healthy Participants

Nagaya et al. (2015) recruited 17, healthy elderly females (aged 69-83 years) to examine an intervention to counteract orthostatic hypertension. Participants performed foot-flexion exercise (60 flexes per minute) for two, 1-minute bouts in the supine position. One bout was performed passively, and 1-bout was performed actively. Participant allocation to each bout was randomized. As little as 1-min of active foot flexion led to an increase in heart rate (HR) and mean arterial pressure (MAP). However, heart rate and blood pressure did not change with passive exercise, although both active and passive exercise increased cerebral oxygenation (as measured by near-infrared spectroscopy [NIRS]). Active exercise was thought to increase blood velocity in the femoral and popliteal veins by activating the skeletal muscle pump, increasing venous return and cardiac output. This in turn led to an increase in cerebral perfusion. Passive exercise was thought to produce a similar type of mechanical stimulation on the vasculature which also led to increased cerebral perfusion.

Nóbrega et al. (1994) compared active and passive exercise in 10 (7 male and 3 female) healthy volunteers (aged, 24-36 yrs) using a tandem bike with the second rider performing the active movements. Their results support the findings that HR and blood pressure (BP) are influenced differently in active and passive exercise. Study participants performed unloaded (no load placed on the bike) active cycling for 5 minutes at 40 rpm, rested for 5 minutes, then cycled for 5 minutes at 60 rpm, with passive revolutions performed by a second rider. Both active and passive pedalling on the tandem bike invoked similar leg movements. Nóbrega et al., (1994) reported that HR increased during active exercise but did not change during passive exercise. The increase in HR that occurred during active exercise was thought to be caused by stimulation of cardiac control centre by the motor cortex and subsequently activation of the sino-atrial node of the heart, increasing HR. Further to this, peripheral vascular resistance and mean arterial pressure decreased during active exercise. In contrast, mean arterial pressure increased in passive exercise due to stimulation of muscle mechanoreceptors.

Clinical Populations

Studies involving clinical populations have also demonstrated similar effects of passive and active exercise on the cardiovascular system. Ballaz et al. (2007) examined the effects of 10 minutes of passive cycling at 40 revolution per minute (RPM) in 15 paraplegic patients. Twelve males and three females (aged 39 - 55 years) with spinal cord injuries (SCI) in the thoracic region (T3 through T12) volunteered to

participate in the study. One single bout of passive leg cycling increased the velocity of leg vascular blood flow, however, heart rate did not change.

Burns et al. (2018) recruited nine paraplegic (T3-T11) patients (aged 40 – 52 years) to participate in five, 1-minute bouts of knee flexion and extension exercise. Participants performed 50 extensions/flexions per minute on a single leg using the Biodex System 4 Pro dynamometer and maintained an 80° range of motion. These exercises were performed in the up-right position, and a 1-minute recovery period took place between each bout. The authors found that although neither HR nor MAP was altered by the passive exercise bouts, skin and femoral blood flow increased. These results have implications for the prevention of decubitus pressure ulcers, deep-vein thrombosis, cardiovascular disease and poor wound healing from occurring in the lower extremities of paraplegics through improving tissue perfusion with regular passive exercise bouts.

Lastly, Camargo Pires-Neto et al. (2013) examined the effects of 20 minutes of passive rotational leg motion performed at 30 rpm (using a Flexo-motor device) by intensive care unit (ICU) patients lying in bed. Participants included eighteen (8 male, 10 female), newly admitted patients (within 72 hours), aged 55 ± 17 years who were on ventilators. During the exercise session, these patients were under deep sedation and 68% required nor-epinephrine to sustain their blood pressure. No significant hemodynamic, metabolic, nor respiratory changes were observed during exercise. However, there was a significant 3% reduction in HR following exercise compared to pre-exercise values which the authors deemed clinically irrelevant. Although, the reduction in heart rate (HR) following exercise in these mechanically ventilated, critically ill patients possibly suggest an interaction with nor-epinephrine. This study also demonstrated that acute bouts of passive exercise could be safely performed by ventilated ICU patients, with the goal of patient mobilization, early discharge and a reduction in readmission. Since these patients were highly sedated, central command by the motor cortex was negated explaining the minimal effect on heart rate. Moreover, the limited range of motion utilized did not stretch the leg muscles nor induce a passive muscle pump sufficient to increase venous return or stimulate muscle mechano-reflexes further explaining the minimal cardiovascular effects observed.

In summary, minimal information is available on the cardiovascular effects of one bout of passive exercise, compared to active exercise, performed at similar pedalling frequencies. Moreover, there has not been any studies that have compared heart rate variability (HRV) in response to both types of exercise. Therefore, this study examined the cardiovascular responses (including HRV) of passive and active exercise performed at similar pedalling frequencies on two different cycle ergometers (the Theracycle and the Monark ergometer). Our research question was: what is the cardiovascular response in young, healthy individuals to passive and active exercise performed at the same pedaling frequency? Our hypothesis was that the cardiovascular response to passive and active exercise would vary; HR, BP and SNS tone (as reflected through HRV measures) would increase with active exercise and not change with passive exercise.

Materials and Methods

Participants

Following local research ethic board (REB) approval (REB file #: 28277), twelve University students (7 male and 5 female) were recruited to participate in the study through announcements and word of mouth. Participants were required to be healthy, between the ages of 18 and 30 years and English speaking to be eligible for the study. The study took place through the months of March and April of 2023.

Testing

A flow-chart of the testing procedures used in this study is displayed below (Figure 1). Participants visited the exercise laboratory on three occasions (each separated by a one-week interval). Each visit was approximately 1 hour in duration and occurred at the same time and day of the week to account for circadian variation. At the first visit, participants signed consent forms and completed the "Get Active Questionnaire" to assess their ability to perform exercise safely. Anthropometric measurements such as height (cm) and weight (kg) (Health-o-Meter Professional Scale - Model: 402KL) were made and body mass index (BMI) (kg/m^2) was subsequently determined (weight (kg) / (height (m))^2.

Maximal aerobic capacity was assessed using the submaximal Åstrand-Rhyming cycle ergometer test (Acevedo & Starks, 2011). For this test, HR was measured throughout all stages of exercise using a POLAR V800 GPS sports watch (Model: 90060773). Participants initially warmed-up by cycling on a Monark cycle ergometer for 3-minutes at 50 revolutions per minute (rpm) and 0 resistance. They then continued pedalling at 50 rpm for 6 minutes with the resistance set at an intensity to sufficiently to elicit an average target HR between 125 and 170 beats per minute (bpm). Based upon the average HR attained during the last two minutes of exercise, the participants' maximum aerobic capacity ($\dot{V}O_2$ max) was predicted from sex-specific tables.

Figure 1. *Flow Chart of testing Procedures*

The following two visits consisted of either a passive exercise procedure using the Theracycle (Theacycle 100 - RSS Industries, Franklin, MA) or an active exercise procedure using the Monark Exercise Bike (Ergomedic 828E, Sweden) (Figure 2).

Figure 2. *Exercise Equipment used for the Study*

a) Position on the Theracycle. b) Position on the Monark cycle ergometer.

Participants were randomly assigned to perform either the passive or active exercise for the first visit and performed the other procedure in the second visit. HR was measured continuously using the POLAR V800 GPS sports watch (Model: 90060773) at rest and throughout each exercise bout. BP was measured every 5 minutes using a BPTru monitor (Model: BPM-200 - BPTru Medical Devices, BC, Canada). Borg's, 6-20 rating of perceived exertion (RPE) scale was used to determine RPE every 5 minutes. For each procedure, measurements were first taken for 10 minutes at rest, with HR recorded continuously and BP measured every 5 minutes in a supine position on an examination bed. The participant then moved to the Theracycle or the Monark cycle ergometer. For the Theracycle, the participant used the machine for 10 minutes per pedalling frequency (low - level 4, medium - level 8, high - level 12) for 30 minutes total. For the Monark bike, the participant cycled for 10 minutes at each pedalling frequency (low, medium and high) for 30 minutes total while matching the revolutions per minute (rpm) that was (or would be) performed on the Theracycle to the Monark cycle ergometer (level 4 = 23 rpm, level 8 = 47 rpm, level 12 = 67 rpm). The participant returned to the supine position for 10 minutes for recovery measurements on an examination bed. Following the collection of all measurements, rate pressure product (RPP) was calculated according to the formula HR (bpm) × systolic blood pressure (mmHg) to assess the workload of each exercise bout on the heart. Heart rate variability (HRV) data was analyzed based upon the HR recordings obtained during the last 7 minutes of each stage (i.e., once steady state had been achieved).

Data Analysis

Polar Flowsync was used to download the POLAR watch data (R-R intervals) and the downloaded data was put into the Kubios HRV Scientific software. The Kubios HRV software measured differences in the R-R intervals to provide a detailed overview of HR and variability at each of the exercise stages using the Fast Fourier transformation (FFT) spectral analysis (Tarvainen et al. 2013). Data was extracted from each Kubios HRV spectral analysis output for the values of low-frequency

power (LF), high-frequency power (HF) and total power in milliseconds squared (ms^2), along with the LF/HF ratio (sympathetic nervous system (SNS) tone indicator) (Bernardi et al. 2011). The parasympathetic nervous system (PNS) indicator tone indictor was determined from the HF and total power indicator (HF/total). The SNS and PNS tone were determined to assess the autonomic effects of active and passive exercise.

Statistical analysis was performed using Microsoft Excel for Mac, version 16.101.3. All statistical analyses used the measurements taken at the ten-minute mark for each stage and variable, except for HRV data which was analyzed over the last 7 minutes of each data collection point (rest, low, medium and high frequency and recovery). Differences in descriptive characteristics between males and females were assessed using an independent sample t-tests with a significance level of $p < 0.05$. A repeated measure, two-factor analysis of variance (ANOVA) was performed for the rest, exercise and recovery data obtained with a significance level set at $p < 0.05$. Two between–group measures (passive versus active exercise) and a within group measure (exercise frequency stage) were compared (Haverkamp & Beauducel, 2019). Two-tailed paired t-tests were used to determine differences between the two exercise modes at each exercise stage and for within-group measures. The values for PNS tone (HF/total power) were were log-transformed to normalize the data for statistical analysis. All data is presented as means and standard deviation (SD).

Results

Descriptive Characteristics

The descriptive characteristics of the 12 participants are displayed in Table 1. There were no significant differences between the sexes for age, BMI or aerobic capacity ($\dot{V}O_2$ max). The male participants were significantly taller and heavier than the female participants.

Table 1. *Descriptive Characteristics (mean ± SD) of the Participants*

Variable	Male (n=7)	Female (n=5)	Total (n=12)
Age (years)	20.7 ± 0.8	20.8 ± 0.8	20.8 ± 0.8
Height (cm)	177.1 ± 6.1 *	162.5 ± 6.1	171.0 ± 9.5
Weight (kg)	89.0 ± 24.6 *	63.7 ± 14.6	78.4 ± 24.0
Body mass index (kg/m^2)	28.3 ± 7.5	24.1 ± 5.4	26.6 ± 6.8
$\dot{V}O_2$ max (mL/kg/min)	28.3 ± 9.1	28.4 ± 4.7	28.3 ± 7.3

Note: * = significant difference between males and females ($p < 0.05$).

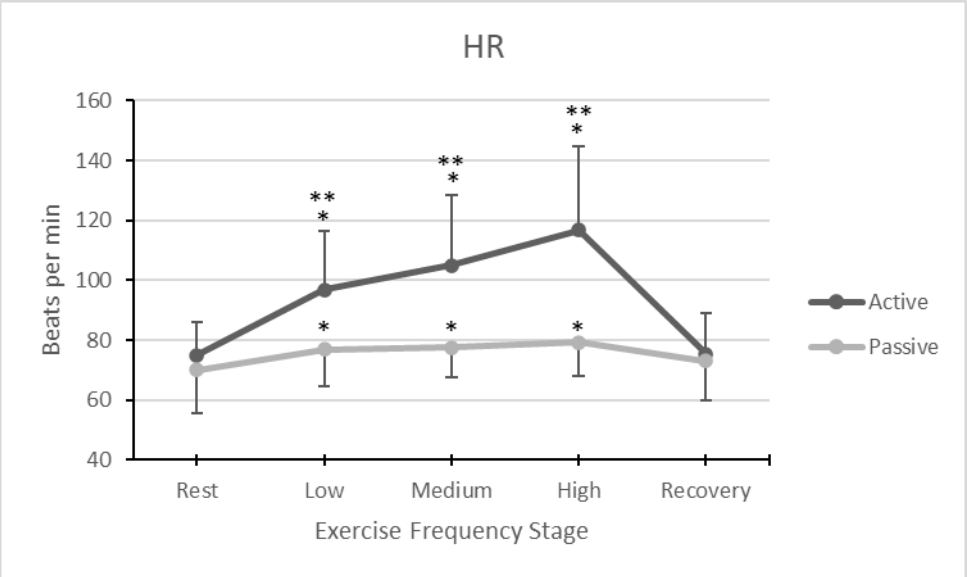
Cardiovascular Responses

A two-way analysis of variance for repeated measures revealed no significant differences in the cardiovascular responses of males versus females in response to each exercise mode. Thus, data from both sexes were combined and are presented as follows.

Heart Rate

Heart rate (HR) significantly increased from rest in response to exercise during the low, medium and high pedalling frequency exercise stages for both active and passive exercise and returned to pre-exercise baseline values at recovery (Figure 3). HR was significantly higher for active compared to passive exercise at all three of the exercise stages.

Figure 3. *Heart Rate Response*



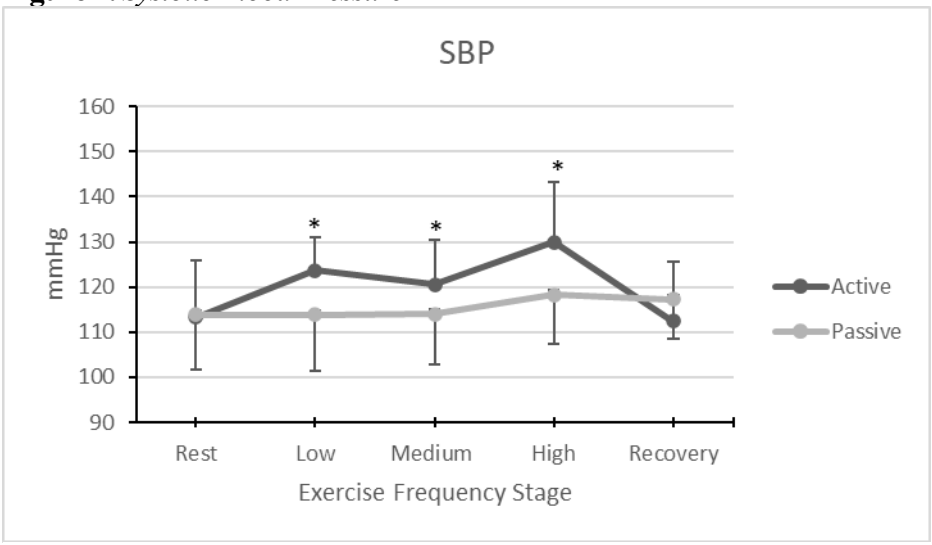
Note: Mean (± SD) heart rate responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded at the end of each 10 min exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$). ** = significant difference between exercise modes at each exercise stage ($p < 0.05$).

Blood Pressure

Systolic Blood Pressure (SBP)

SBP significantly increased from resting measures during the low, medium, and high pedalling frequency exercise stages of active exercise and returned to pre-exercise baseline values at recovery (Figure 4).

Figure 4. *Systolic Blood Pressure*

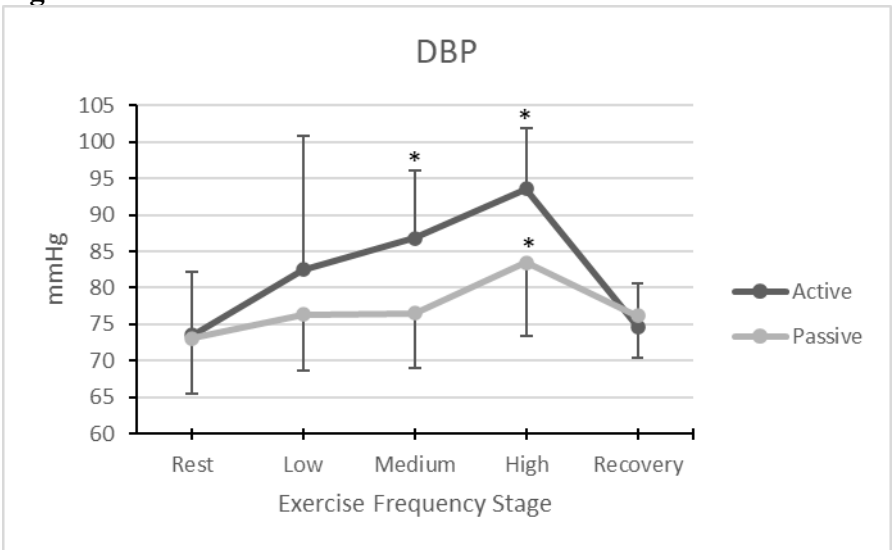


Note: Mean (± SD) systolic blood pressure responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded at the end of each 10 min exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$).

Diastolic Blood Pressure (DBP)

DBP significantly increased from resting measures during the medium and high pedalling frequency exercise stages of active exercise and returned to pre-exercise baseline values at recovery (Figure 5). During passive exercise, DBP significantly increased from rest in response to the high frequency pedalling stage and returned to pre-exercise baseline values at recovery.

Figure 5. *Diastolic Blood Pressure*

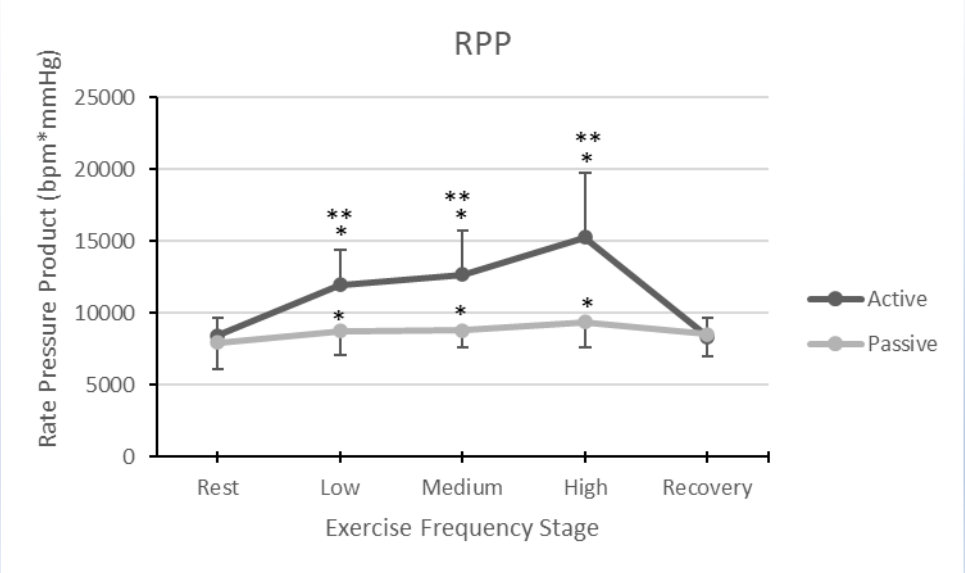


Note: Mean (± SD) diastolic blood pressure responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded at the end of each 10 min exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$).

Rate Pressure Product (RPP)

During both active and passive exercise, RPP significantly increased from resting measures during the low, medium and high pedalling frequency exercise stages and returned to pre-exercise baseline levels at recovery (Figure 6). RPP was significantly higher for active compared to passive exercise at all three pedalling frequency exercise stages.

Figure 6. *Rate Pressure Product*



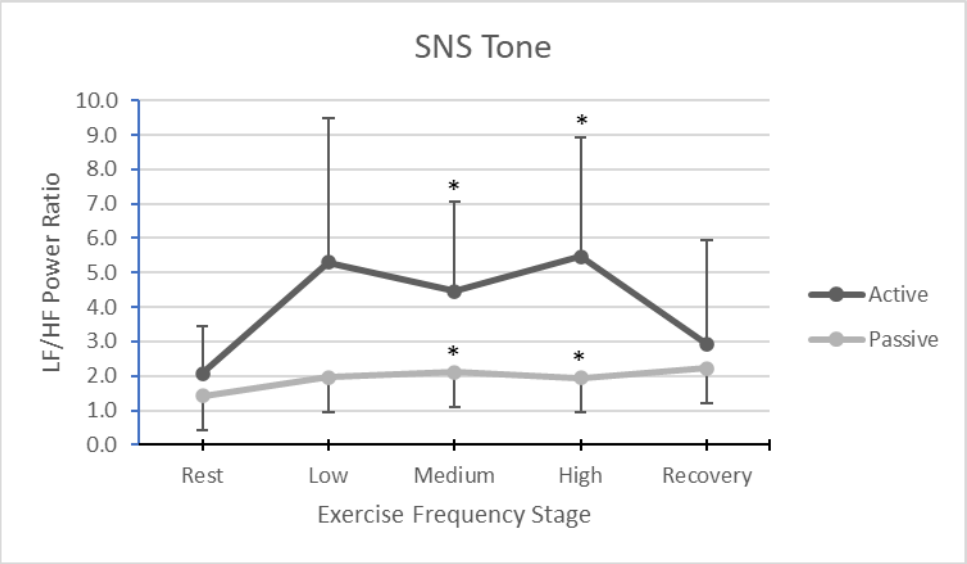
*=Note: Mean (± SD) rate-pressure pressure responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded at the end of each 10 min exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$). ** = significant difference between exercise modes at each exercise stage ($p < 0.05$).

Autonomic Effects

Sympathetic Nervous System (SNS) Tone

During both active and passive exercise, SNS tone significantly increased from resting measures during the medium and high pedalling frequency stages and returned to pre-exercise baseline values at recovery (Figure 7).

Figure 7. *Sympathetic Nervous System Activity*

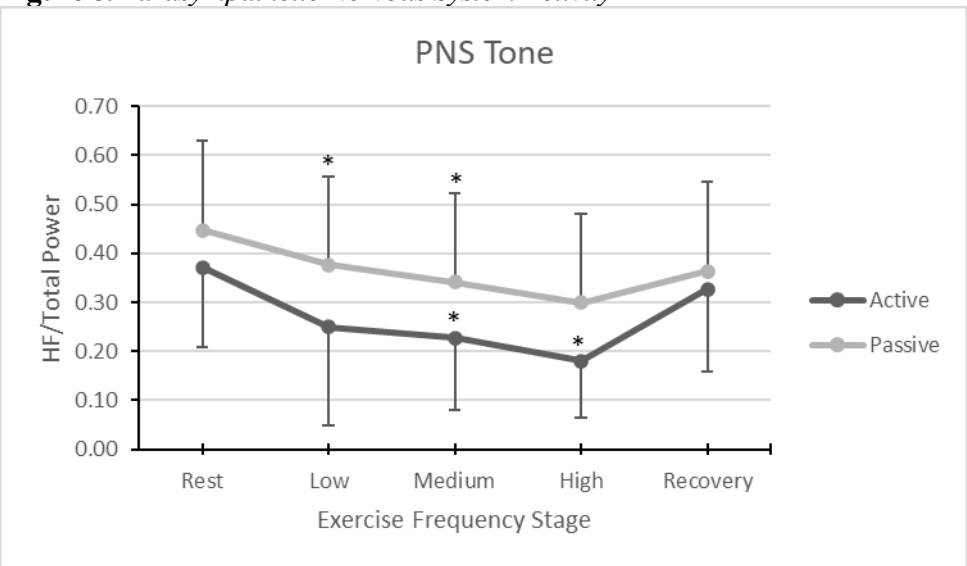


Note: Mean (± SD) sympathetic nervous system responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded and analyzed for the last 7 min of each exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$).

Parasympathetic Nervous System (PNS) Tone

During active exercise, PNS tone significantly decreased from resting measures during the medium and high pedalling frequency exercise stages and returned to pre-exercise baseline measures at recovery (Figure 8). In passive exercise, PNS tone significantly decreased from rest during the low and medium pedalling frequency exercise stages and returned to pre-exercise baseline measures at recovery.

Figure 8. *Parasympathetic Nervous System Activity*

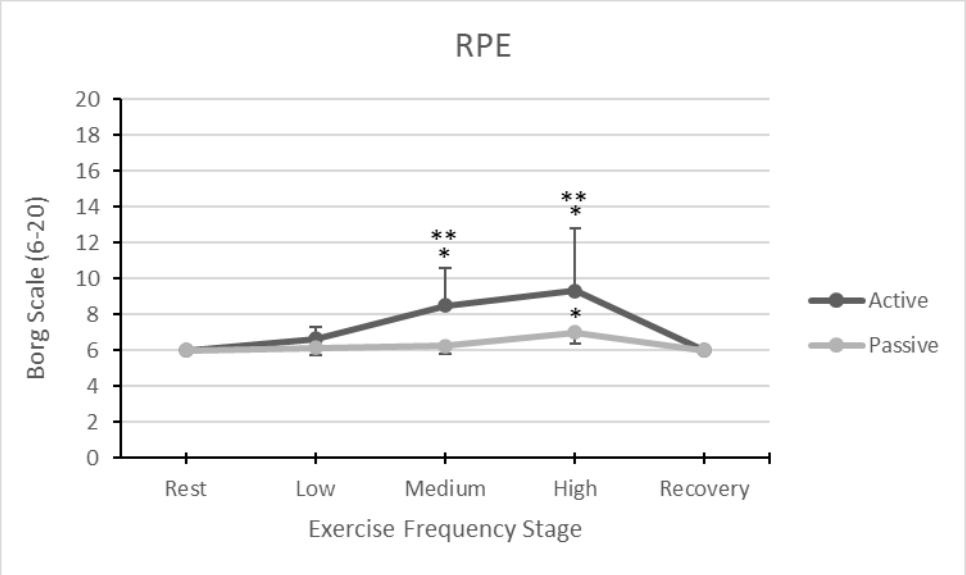


Note: Mean (± SD) parasympathetic nervous system responses during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded and analyzed for the last 7 min at each exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$).

Ratings of Perceived Exertion (RPE)

During active exercise, RPE significantly increased from resting measures during the low, medium and high pedalling frequency exercise stages and returned to pre-exercise baseline values at recovery (Figure 9). In passive exercise, RPE significantly increased from rest in response to the high frequency pedalling and returned to baseline values at recovery. RPE was significantly higher for active compared to passive exercise during the medium and high pedalling frequencies.

Figure 9. *Ratings of perceived Exertion*



Note: Mean (± SD) ratings of perceived exertion during active and passive exercise at 3 pedalling frequencies and recovery. Data were recorded at the end of each 10 min exercise stage. * = significant difference for specific exercise stage compared to rest ($p < 0.05$). ** = significant difference between exercise modes at each exercise stage ($p < 0.05$).

Discussion

This study examined the cardiovascular responses to passive and active exercise performed at similar pedalling frequencies. The results of this study supported our hypothesis that cardiovascular responses to exercise would vary depending on whether the exercise is performed passively or actively. A significant main effect of exercise modality and the different pedalling frequencies was observed for the cardiovascular measures as well as for RPE. As predicted, HR, RPP, and RPE were significantly greater for active exercise compared to passive exercise performed at similar pedalling frequencies. SBP and DBP increased in response to active exercise but was generally unaffected by passive exercise. Significant changes in SNS and PNS tone also occurred whereby the SNS tone increased and PNS tone decreased to a greater extent in active exercise compared to passive exercise. However, our findings that HR and RPP was significantly greater compared to pre-exercise baseline values

for passive cycling was unexpected. Based upon our literature review, we had expected these values to not change.

This is one of the first studies to compare the cardiovascular responses and autonomic balance (as assessed through HRV analysis) to both passive and active exercise performed at identical pedalling frequencies using two different exercise modalities (a Theracycle versus a Monark cycle ergometer, respectively). To date, there has been only one other study whose investigators have examined the cardiovascular responses to similar pedalling frequencies (Nóbrega et al., 1994). Nóbrega et al. (1994) examined the effects of participants performing exercises on an adaptive tandem bicycle. One person actively pedalled, whereas the other person had their legs moved passively at the same time. Participants performing the passive exercise reported that they did not conscientiously contract their exercising muscles. Oxygen uptake, cardiac output and HR significantly increased from resting baseline measures during active exercise performed at both 40 and 60 rpm. Peripheral vascular resistance significantly decreased with each exercise stage during active exercise. However, HR did not change but mean arterial pressure as well as stroke volume significantly increased during passive exercise. The results obtained for HR differed from those reported in our study and may be explained by the possible postural differences associated with the different exercise modalities used in our study. Nóbrega et al. (1994) had their participants in identical postural positions (using a tandem bike) when comparing the responses of passive to active exercise. Thus, one would assume that there were no additional muscle groups used for the passive exercise. In our study, the participants were positioned slightly different during the two modes of exercise, with a slight semi-recumbent posture and greater hip flexion occurring during the passive exercise performed on the Theracycle. The increase in HR and RPP from resting measures during the low, medium and high pedalling frequency exercise stages for both active and passive exercise may be attributed to central command driven by the motor cortex and changes in autonomic balance.

The cardiovascular changes that occurred in response to passive exercise in our study was also contrary to that reported in the literature for both healthy and clinical populations (Ballaz et al., 2007; Burns et al., 2018; Nagaya et al., 2015; Nóbrega et al., 1994). This may have been due to postural difference as explained above or by our participants actively contracting their muscles while exercising. Even though, in our study, the participants were asked to not exert pressure with their legs when they were pedalling, our results suggest that they were. Moreover, we observed PNS (vagal) withdrawal to occur in our study. PNS withdrawal normally occurs at the start of exercise through feedback provided to the central nervous system, from the metabolic and mechanoreceptors in the exercising muscles (Miyamoto et al., 2006). SNS activation, which tends to occur at approximately 50% of maximal aerobic capacity (Goldsmith et al., 2000) would have contributed to the greater rise in HR that was observed during active exercise. This is important to note, as passive exercise utilized in our study did not engage the SNS to the same degree as active exercise. Hence, patients who clinically are encouraged to minimize the amount of stress imposed on the body can still perform passive exercise without inducing substantial cardiovascular responses.

The effects of active and passive exercise on the autonomic nervous system were measured through HRV analysis. SNS and PNS tone responded differently to each exercise modality and the various pedalling frequency stages, but with no interactions. Malhotra et al., (2023) studied HR variability in healthy untrained adults who performed an acute bout of mild-intensity exercise on a cycle ergometer and saw that SNS tone increased as PNS tone decreased at the beginning of exercise and throughout cycling. During recovery, PNS tone increased. Similarly, this study reported an increased SNS tone from resting measures only for the medium and high pedalling frequency exercise stages of active and passive exercise. The PNS tone also significantly decreased from resting measures during the medium and high frequency exercise stages for participants performing active exercise and during the low and medium pedalling frequency stages for the passive exercise while increasing again during the recovery stages for both exercise modalities.

The prediction that blood pressure would be different in response to the different types of exercise performed at the same pedalling frequency was partially supported. SBP and DBP were significantly affected by the exercise modality and the different exercise stages performed but with no significant interactions between the effects of active and passive exercise and the three exercise stages. Wielemborek-Musial et al. (2016) examined the normal BP responses to submaximal, multistage exercise tests using a cycle ergometer in healthy adults. Participants displayed significantly increased SBP with an increase in exercise workload and intensity. Like these results, the results of our study demonstrated a significant increase in SBP from rest during the low, medium and high pedalling frequency stages for active exercise only. It is interesting to note that the SBP response mirrored the pattern of SNS activation, and an increase in SNS tone may have contributed to the increased SBP observed.

In addition, DBP significantly increased from rest during the medium and high pedalling frequency stages for active exercise and only during the high pedalling frequency stage for passive exercise. These results are aligned with the work of Wielemborek-Musial et al. (2016), who also reported that DBP increased significantly from resting measures during exercise. However, DPB is a relatively stable value that normally remains unchanged during an acute bout of exercise. The higher DBP observed in this study for the various exercise stages may be attributed to a decrease in vasodilation of the resistance vessels of the actively exercising muscles (Brett et al. 2000). However, the DBP results for active and passive exercise should be carefully evaluated, primarily due to the small sample size of this study.

RPP is an indicator of myocardial exertion used to approximate increases in the heart's metabolic requirements (workload) that can be caused by exercise (Adams et al. 2010). The RPP for participants in this study was significantly affected by the exercise modality and the various exercise stages, with a significant interaction between the effects of active and passive exercise and the three exercise stages. Kim et al. (2013) examined the effects of RPP on a graded cycle ergometer exercise test in healthy men and saw that RPP increased from resting measures during exercise, with greater RPP values correlating with increased exercise intensities. Similarly, RPP increased from rest during the low, medium and high pedalling frequency stages during active exercise and passive exercise. Although, RPP was greater during active than passive exercise for all three pedalling frequency stages. The differences in RPP

observed for the active compared to the passive exercise, and for the different exercise stages can be attributed primarily to the increases in HR and SBP.

Borg's RPE is a subjective measurement that estimates exercise intensity based upon the exercise load applied during exercise and is associated with a homeostatic imbalance of the body (Day et al. 2004, Mann et al. 2017). The RPE of participants in this study was significantly affected by the exercise modality and the different exercise stages performed, with an interactive effect between the effects of active and passive exercise and the three exercise stages. These results align with the work done by Nóbrega et al. (1994), as the RPE of their participants was significantly higher for active exercise compared to passive exercise. Mann et al. (2017) suggested that psychological factors may also affect the RPE of an individual at any given point during exercise. RPE also has a known correlation between HR and blood lactate levels, as exercise induced changes in HR, depletion of energy stores and reliance on anaerobic metabolism has been suggested to make an individual perceive greater exertion. Thus, participants in this study may have displayed significant changes in RPE with both active and passive exercise at the different pedalling frequency stages due to the combined psychological and physiological effects.

Limitations

Due to the small sample size and the participation of young, apparently healthy individuals, this study can be considered a preliminary investigation on the cardiovascular responses to passive exercise on a Theracycle. With only twelve participants (five female and seven males) the applicability of the study findings is limited. Moreover, without consideration of menstrual phase of the female participants, the interpretation of the results could be problematic. Since the data was collected over a two-week period, the data collected could have been influenced by the phase of the menstrual cycle the female participants were in. Also, the participants in this study were all healthy and did not have any health complications.

Furthermore, the results obtained for the passive exercise are applicable for use of the Theracycle only. The Theracycle (Theracycle, 100) used in this study was pre-programmed with specific levels that had pre-selected speeds (rpm). The Monark cycle ergometer was standardized by instructing participants to maintain a similar rpm speed (at a minimal load) corresponding to each selected pedalling frequency. This study only explored the cardiovascular responses to one bout of active versus passive exercise performed at different pedalling frequencies.

Future Studies

Future studies should be designed to recruit more participants. It would be advisable to also have a greater range in participant ages. Female participants should be tested in the same phase of their menstrual cycle. Examining and comparing the responses of regularly active individuals, sedentary participants and individuals with neurological impairments to passive exercise would increase the applicability of the results. Additional studies should also be designed to use the same cycle ergometer by making modifications to the cycle ergometer (or to use a tandem bike) to allow for

both active exercise and passive exercise to be performed in the same body position at the same pedalling frequency. Collecting oxygen consumption measures during exercise would allow us to determine exercise intensity more accurately. Training studies designed to compare the effects of passive exercise training on the cardiovascular system are also needed. Overall, these modifications to the design of the study would increase the reliability of the results.

Conclusions

In conclusion, the results of this study supported our hypothesis that the cardiovascular responses to exercise vary depending on whether the exercise was performed actively or passively. The significantly different HR, RPP, and RPE responses observed between passive and active exercise at similar pedalling frequencies in a young and generally healthy population suggest that passive exercise may be a suitable form of activity/exercise for individuals beginning an exercise program or for those who have health limitations as it places minimal stress upon the CV system. These findings can inform exercise guidelines for individuals with chronic disease for use of passive exercise modalities and to promote the use of passive exercise as a mode of training for both sedentary healthy and clinical populations.

Acknowledgements

The authors acknowledge the generous contribution of the Kinesiology Dept. at Trent University for allowing use of their Monark cycle ergometer for exercise testing for this study.

References

Acevedo EO, Starks MA (2011) *Exercise testing and prescriotion lab manual* (Second ed.). Human Kinetics.

Adams J, Hubbard M, McCullough-Shock T, Simms K, Cheng D, Hartman J, Strauss D, Anderson V, Lawrence A, Malorzo E (2010) Myocardial work during endurance training and resistance training: a daily comparison, from workout session 1 through completion of cardiac rehabilitation. *Proc (Bayl Univ Med Cent)*, *23*(2), 126-129. https://doi.org/10.1080/08998280.2010.11928599

Ballaz L, Fusco N, Cretual A, Langella B, Brissot R (2007) Acute peripheral blood flow response induced by passive leg cycle exercise in people with spinal cord injury. *Arch Phys Med Rehabil*, *88*(4), 471-476. https://doi.org/10.1016/j.apmr.2007.01.011

Bernardi L, Spallone V, Stevens M, Hilsted J, Frontoni S, Pop-Busui R, Ziegler D, Kempler P, Freeman R, Low P, Tesfaye S, Valensi P, Toronto Consensus Panel on Diabetic (2011) Methods of investigation for cardiac autonomic dysfunction in human research studies. *Diabetes Metab Res Rev*, *27*(7), 654-664. https://doi.org/10.1002/dmrr.1224

Brenner I (2018) Effect of passive exercise training in hemiplegic stroke patient: Mini-review. *Sports Med Rehabil J.*, *3*(3), 1036.

Brett SE, Ritter JM, Chowienczyk PJ (2000) Diastolic blood pressure changes during exercise positively correlate with serum cholesterol and insulin resistance. *Circulation*, *101*(6), 611-615. https://doi.org/10.1161/01.cir.101.6.611

Burns KJ, Pollock BS, Stavres J, Kilbane M, Brochetti A, McDaniel J (2018) Passive limb movement intervals results in repeated hyperemic responses in those with paraplegia. *Spinal Cord*, *56*(10), 940-948.

Camargo Pires-Neto R, Fogaça Kawaguchi YM, Sayuri Hirota A, Fu C, Tanaka C, Caruso P, Park M, Ribeiro Carvalho CR (2013) Very early passive cycling exercise in mechanically ventilated critically ill patients: physiological and safety aspects-a case series. *PloS One*, *8*(9).

Day ML, McGuigan MR, Brice G, Foster C (2004) Monitoring exercise intensity during resistance training using the session RPE scale. *J Strength Cond Res*, *18*(2), 353-358. https://doi.org/10.1519/R-13113.1

Goldsmith RL, Bloomfield DM, Rosenwinkel ET (2000) Exercise and autonomic function. *Coronary Artery Disease*, *11*(2), 129-135. https://doi.org/10.1097/00019501-20000300 0-00007

Haverkamp N, Beauducel A (2019) Differences of Type I error rates for ANOVA and multilevel-linear-models using SAS and SPSS for repeated measures designs. *Meta-Psychology*, *3*, 1-15.

Heesen C, Romberg A, Gold S, Schulz KH (2006) Physical exercise in multiple sclerosis: supportive care or a putative disease-modifying treatment. *Expert Rev Neurother*, *6*(3), 347-355. https://doi.org/10.1586/14737175.6.3.347

Herrmann LG, Reid MR (1934) The conservative treatment of arteriosclerotic peripheral vascular diseases: Passive vascular exercises (pavaex therapy). *Ann Surg*, *100*(4), 750-760. https://doi.org/10.1097/00000658-193410000-00016

Kim YJ, Chun H, Kim CH (2013) Exaggerated response of systolic blood pressure to cycle ergometer. *Ann Rehabil Med*, *37*(3), 364-372. https://doi.org/10.5535/arm.2013.37.3. 364

Llano-Diez M, Renaud G, Andersson M, Marrero HG, Cacciani N, Engquist H, Corpeno R, Artemenko K, Bergquist J, Larsson L (2012) Mechanisms underlying ICU muscle wasting and effects of passive mechanical loading. *Crit Care*, *16*(5), R209. https://doi.org/10.118 6/cc11841

Malhotra V, Thakare AE, Hulke SM, Javed D, Dixit AK, Wakode SL, Cidral F (2023) Heart rate variability among healthy untrained adults during mild intensity stationary cycling exercise. *Advanced Biomedical Research*, *12*, 55.

Mann TN, Lamberts RP, Nummela A., Lambert MI (2017) Relationship between perceived exertion during exercise and subsequent recovery measurements. *Biology of Sport*, *34*(1), 3 - 09.

Miyamoto T, Oshima Y, Ikuta K, Kinoshita H (2006) The heart rate increase at the onset of high-work intensity exercise is accelerated by central blood volume loading. *European Journal of Applied Physiology*, *96*(1), 86-96.

Nagaya S, Hayashi H, Fujimoto E, Maruoka N, Kobayashi H (2015) Passive ankle movement increases cerebral blood oxygenation in the elderly: an experimental study. *BMC Nurs*, *14*, 14. https://doi.org/10.1186/s12912-015-0066-x

Nóbrega AC, Williamson JW, Friedman DB, Araujo CG., Mitchell JH (1994) Cardiovascular responses to active and passive cycling movements. *Med Sci Sports Exerc*, *26*(6), 709-714. https://doi.org/10.1249/00005768-199406000-00009

Roberts VC, Sabri S, Pietroni MC, Gurewich V, Cotton LT (1971) Passive flexion and femoral vein flow: a study using a motorized foot mover. *Br Med J*, *3*(5766), 78-81. https://doi.org/10.1136/bmj.3.5766.78

Sackner MA (2012) Whole body periodic acceleration: "Passive exercise" for Parkinson's disease. *Journal of Parkinsonism & Restless Legs Syndrome*, *2*(1), 1-5.

Shirzad M, Tari B, Dalton C, Van Riesen J, Marsala MJ, Heath M (2022) Passive exercise increases cerebral blood flow velocity and supports a postexercise executive function benefit. *Psychophysiology*, *59*(12), e14132. https://doi.org/10.1111/psyp.14132

Tarvainen MP, Niskanen JP, Lipponen JA, Ranta-aho PO, Karjalainen PA (2013) Kubios HRV – Heart rate variability analysis software. *Computer Methods and Programs in Biomedicine*, *113*(1), 210-220.

Wielemborek-Musial K, Szmigielska K, Leszczynska J, Jegier A (2016) Blood pressure response to submaximal exercise test in adults. *Biomed Res Int*, *2016*, 5607507. https://doi.org/10.1155/2016/5607507

Athens Journal of Sports - Volume 13, Issue 1, March 2026 – Pages 27-48

A Qualitative Investigation of Successful Junior-to-Senior Transitions in Elite Athletes

By Georgios Andronikos, Tony Westbury±, Athanasios Souglis◦ & Russell Martindale•*

Transitions are widely acknowledged as pivotal points in the development of athletes during their athletic career. The aim of this study was to explore the athletes' transition experiences towards elite level, identifying the challenges they faced, and examining the key determinants that enabled their successful adjustment. Semi-structured interviews were conducted with six elite male athletes representing a range of sports and talent development environments across Greece and the UK. Athletes described the importance of deliberate play activities and diverse early engagement, commitment, and high aspirations, while also highlighting organizational factors such as quality of coaching and access to facilities. Key challenges included injuries, balancing sport with studies, and coping with increased pressure, with successful adjustment underpinned by resilience, perseverance, and strong support networks. Intentional use of structured challenges by coaches was reported as a critical developmental mechanism, enabling athletes to develop coping skills and be better prepared for elite sport. The findings highlight common determinants of effective transitions across sporting contexts, suggesting that talent development programs should prioritize psychological preparation, structured support, and proactive exposure to developmental challenges.

Keywords: *talent development, transitions, elite sport, senior level, success*

Introduction

Transitions are critical periods in an athletic career and are often characterised by both opportunities and challenges that influence the long-term development, performance, and overall well-being of athletes (Henriksen et al. 2024, Stambulova et al. 2020). Transitions can be divided into normative (predictable), non-normative (unpredictable), and quasi-normative (predictable for certain groups), each presenting distinctive challenges and requiring individualized support (Stambulova 2016). Transitions may take place in different contexts such as junior-to-senior (JST), amateur to professional, moving between different teams or even cultures. Inevitably, such periods (particularly during the JST) involve demands and challenges in various areas; not only athletic level but also psychosocial, academic/vocational, and personal level (Wylleman et al. 2013). Challenges during these periods may include increased physical and psychological demands, social adjustments, risk of deselection, or injury,

*Lecturer, School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK.
±Associate Professor, School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK
◦Assistant Professor, School of Physical Education and Sport Science, National and Kapodistrian University of Athens, Greece.
•Professor, School of Applied Sciences, Edinburgh Napier University, Edinburgh, UK.

all of which can affect motivation, performance, and well-being (Morris et al. 2017, Wylleman et al. 2013). Dealing successfully with the challenges of the transitions is essential to progress to higher levels of competition at senior level. The mechanisms underpinning effective adjustment are complex and multifaceted, incorporating personal, psychosocial, and environmental factors that require further investigation in sports.

Findings have highlighted the crucial role of psychological characteristics in relation to long-term success in sports. For instance, psychological characteristics of developing excellence (PCDEs) have been identified in the literature as predictors of successful adaptation in high-performance contexts (MacNamara et al. 2010). Specifically in recent studies, attributes such as resilience, self-confidence, focus, and adaptability were shown to facilitate the progression of athletes during transition periods. Those attributes are key in the transition process as they allow athletes to cope with the increasing demands (Wixey & Kingston 2023). Interestingly, those characteristics are not necessarily considered as innate but are viewed as qualities that can be nurtured to support the development and progression of athletes (Collins et al. 2016). In addition, mental health and well-being have gained increasing attention, and theoretical frameworks have been created to support athletes' psychological health during the transition to elite level (Pilkington et al. 2024). This approach shows a wider shift in sport towards a more holistic understanding of development and performance, where psychological safety and well-being are equally important as tangible achievements in the athletic journey towards success.

Beyond individual characteristics, the environment in which athletes operate and develop plays an integral role in influencing the outcomes of a transition. Findings have highlighted that support networks and significant others are of paramount importance in facilitating the effective progression of athletes during transitions (Andronikos et al. 2024). These may include family members, coaches, teammates/ peers, and support staff, who can offer invaluable support while dealing with the demands of a transition (Brockett et al. 2024). In line with the idea that success incorporates achievements and mental well-being, these support networks can provide both tangible support and emotional support, cultivating a holistic athlete development approach during transitions. Tangible support includes training opportunities, structured guidance, career advice, financial assistance, or logistical help, such as travel or accommodation for competitions. Emotional support includes encouragement, reassurance, social inclusion, a sense of belonging, and moral support during setbacks. The quality and the perceived availability of this support network can influence whether athletes interpret challenges as growth opportunities or as threats to their progression leading to stress, anxiety, or even dropout (Rees et al. 2016).

Due to the complexity of the transition process, further research in this area is necessary to allow us to understand the appropriate resources and support required for career transitions. Recent findings have shown that amongst the strongest predictors of adjustment during the JST were personal resources, environmental support, and type of sport (Andronikos et al. 2021). Thus, exploring the transition and development experiences of successful athletes allows us to identify individual and environmental characteristics that facilitated their successful JST. Examining both individual and team sport athletes that were nurtured in different talent development environments within different countries gives us an opportunity to distinguish common, generic

features related to effective development. When examining experiences, it is essential to use a methodology that will enable the researcher to capture the perspective of the person who experienced it (Vaismoradi et al. 2013). Therefore, it is not surprising that a qualitative approach is usually preferred regarding when analysing within-career transitions.

Despite the growing body of literature on athlete development, limited research has explored elite athletes' subjective experiences of transitions, particularly the interrelation between developmental experiences, psychological characteristics, and support systems. This study aims to address this gap by describing the transition experiences of elite-level athletes from their own perspectives, identifying the challenges they faced, and examining the key determinants that enabled successful progression towards senior elite level. Insights from these experiences can inform the design of talent development programs that foster long-term athlete development and well-being.

Methodology

Participants

To understand the elements that facilitate a successful JST it was necessary to ensure that all participants had successfully transitioned into senior level elite sport; demonstrated by competing at the top level of their sport for their country. This criterion ensured participants had not only transitioned successfully but also sustained a career at elite senior level. There have been a great number of definitions of 'elite' athlete in sport (psychology) research and therefore a systematic review created a classification system (Swann et al. 2015). In line with this, all participants were classified as 'successful elite' or better according to the framework suggested by Swann et al. (2015). In total six participants (three British and three Greek) were purposefully selected as information-rich cases who had successfully transitioned to elite senior level. This number was considered adequate for the depth of analysis required and consistent with qualitative research recommendations emphasizing data saturation rather than large samples (Smith 2018). The group included four footballers, one judoka, and one track-and-field sprinter. All had competed at the highest national and international levels, as detailed in Table 1.

Table 1 *Participants*

Participant	Age	Nationality	Gender	Sport	Achievements
1	32	Greek	Male	Football	Greek Cup winner, Greek super league winner, Participation in Europa league and Champions league, 150+ appearances in top division
2	24	Greek	Male	Football	Representation of the U21 national team, 50+ appearances in the top division.
3	23	British	Male	Judo	Silver medalist in world cup event, representation at the U21 national team.
4	24	British	Male	Track and field	Bronze medalist in World cup event, participation in commonwealth games
5	21	British	Male	Football	Representation at U15, U17, U19, U21 national teams, 50+ appearances in the Premiership.
6	26	Greek	Male	Football	Representation of the U21 national team, Greek cup winner, participation in Europa league, 100+ appearances in the first division

Procedure

The researcher applied for and received ethical approval for the study from the Research Ethics and Governance Committee. All the participants were informed that it was not compulsory to take part in the study, and they would be able to withdraw from the study at any moment. All data were anonymized, confidential, and stored in a password-protected computer accessible only to the lead researcher. The interview guide was sent in advance to allow reflection, which has been shown to elicit richer responses (Burke & Miller 20011, Martindale et al. 2007). The interviews lasted approximately one hour and were recorded and transcribed verbatim. Pilot interviews were conducted with two professional track and field athletes. Feedback from the pilot interviews informed refinements to the interview guide, including reordering questions to improve flow and revising unclear wording. A qualitative approach gives the participants the opportunity to share information and experiences regarding the phenomenon being studied and probes allow researchers to further examine areas related to the research objectives (Berg 2004, Guest et al. 2013). Use of neutral and impartial position when probing participant responses, combined with the build of rapport (Patton 2002) were used to guide the interviewer away from biasing the responses of the participants (Backstrom & Hursch-Ceasar 1981).

Interview Guide

To maximize the chances of gaining a complete picture of the nature of the JST, a semi-structured interview was developed, consisting of nine open-ended questions (Patton 2002). This approach was chosen to allow flexibility when exploring areas that may emerge during discussions with the participants (Rynne et al. 2010, Nash et al. 2011). Details of the interview guide are presented in Table 2. In addition to the interview questions, follow-up probes were used for clarification and further discussion to obtain consistency in the depth of responses across participants (Patton 2002).

Table 2. *Main Questions used in the Semi-structured Interviews with the successful Athletes*

1. Can you describe your current situation in sport?
2. Could you describe your career within sport until now?
3. Which were the pivotal points and main challenges throughout your career?
4. When did you consider yourself to be 'elite'? What facilitated that change? How does this change over time?
5. Is the process towards 'elite level' the same for everyone?
6. From your personal experience can you give us examples of talented athletes that did not reach their best potential? Why did this happen?
7. What characterizes someone who has the potential to become elite? How does this change over time?
8. Which are the goals for your future steps in your career?
9. What elements do you think can facilitate development and/or remove barriers?

Data Analysis

Interviews were analyzed thematically following Braun and Clarke's (2006) six-step framework. The researchers familiarized themselves with the transcripts, generated initial codes, and searched for themes. Themes were refined, named, and supported with participant quotes in the results section. Analysis continued until no new themes emerged. To enhance rigor, reliability checks were conducted in collaboration with a senior researcher (Patton 2002). Bi-weekly debriefing sessions were held to review codes and themes, minimizing bias and ensuring interpretations were grounded in the data (Shenton 2004). The primary researcher led the analysis, with the senior researcher acting as a critical peer reviewer until agreement was reached.

Results

This section presents data according to the main themes identified by the analysis of the interviews: 1) development process, 2) challenges, 3) characteristics of successful talent development environments, and 4) individual determinants of success.

Table 3. *Characteristics of the Development Process, Challenges and Key Determinants for a Successful Transition to Elite Level*

Main Theme	Subthemes
Development Process	Early steps Development years Mastery stage
Challenges	Injuries External pressure Balancing academic/vocational career with sport Performance related challenges Distractions
Characteristics of Successful Talent Development Environments	Support Network Holistic approach Intentional structured challenge
Individual Determinants of Success	Performance related characteristics Psychological characteristics

Development Process

Early Steps

The athletes initially got involved in sport to have fun, enjoy themselves and socialize with their peers. They were all involved in deliberate-play activities such as 'backyard' football and tried several different sports early in their development. This initial involvement acted as a trigger for them to understand their potential, try harder to improve, and seek opportunities for more organized activities.

> I started playing football when I was a kid, the same as everyone else in the alleys and when I realized that this is what I wanted to do I asked my parents to join an academy.
>
> Participant 2

> I started just to have fun and do something enjoyable in my free time as a kid and then when I saw that I had the potential to compete at a higher level I started thinking about football more seriously...
>
> Participant 1

Participants also described that the coaches need to promote enjoyment and fun during the early steps of development since this can increase the motivation of athletes. Consequently, young athletes are more likely to stay involved in sport and engage more seriously by trying harder to get better.

> The coach needs to make it fun for them at that young age. They need to be enjoying it and then with that enjoyment as they grow older, they will start to try that bit harder.
>
> Participant 4

Some of the athletes participated in a variety of sports before deciding in which sport they wanted to focus. Other reasons besides actual performances at that time led

athletes to choose their sport. Based on the descriptions of the participants, they had a free choice (without external pressure) to choose the sport they wanted to focus on.

> …when I was 7-8 years old, I was doing 5-6 different sports. When I got older because of school I had to stop some of them and finally I was between tennis and football. I liked playing a team sport because I was socializing with more people, so I chose football.
>
> Participant 6

Development Years

At this stage of their development, athletes described that they made a conscious decision to excel. Participants described having high aspirations during the development age (>12 years old). Constantly progressing regardless of failures or disappointments was identified as key by these successful athletes. Participant 2 shared that '…when you love what you do you don't have a limit…'

> …it doesn't matter how many times I fail as long as I know that I am still improving, I am still working towards this end goal.
>
> Participant 3

Interestingly, participants reported that being committed, staying focused on your target, adopting a healthy lifestyle and being consistent in training, nutrition and recovery is more likely to determine the success of an athlete than technical or physical ability.

> You might not be so consistent in terms of your timetables, your nutrition, your obligations, your training and all these factors play a significant role…
>
> Participant 1

According to the athletes, a combination of a healthy lifestyle, commitment/ consistency, high aspirations and the mentality of continuous improvement represent the conscious decision to excel during the development stage. Nevertheless, athletes highlighted that the development pathway is idiosyncratic. For some people, it is smoother while others have to overcome multiple obstacles.

> Everyone has different barriers. Mine have been pretty smooth other than a couple of injuries. Other people have probably had maybe transport issues, maybe their only coach has been in one area and they can't get there, so I can see that preventing people from developing. I would say it is different for every single person. It is not a smooth run for everybody.
>
> Participant 4

Mastery Stage

Athletes described that the transition to mastery stage may incorporate a combination of sport-specific normative transitions such as amateur to professional level, JST and pre-elite to elite level. Athletes reported that working in a professional environment, even if it was at junior level, was very helpful for their future development. Others started participating at senior level when they were relatively young which gave them the opportunity to gain experience, understand the expectations at senior level and get prepared to cope with the upcoming increasing demands of elite senior level in sport.

> …to a team that worked in a professional way even if I was playing for the youth team because I learned football in a different way compared to how you learn it in an amateur team.
>
> Participant 6

> At the age of 15 I started competing in adult level in a local team and after playing for two years at the age of 17 I started competing in semi-professional level. I played for two years in the 4th division, after this, I played for one year at a team in the third division and I was constantly improving so I moved towards elite level. Then I played for two years in the second division and now I am at a very popular club in Greek Superleague.
>
> Participant 2

It was reported that an achievement during that stage can increase the motivation of athletes and inspire them to try harder to be successful. Winning a U21 championship was the trigger for one of the participants to realize his true potential, commit and work hard to become an elite senior athlete.

> …when I was 19 years old, I won the U21 British championships, and that was kind of a springboard into my judo career, because I realized that I could achieve something and from then I started to take judo a lot more seriously…
>
> Participant 3

Steady progress and playing time at senior level were the key elements that facilitated a successful transition towards elite senior level according to the majority of the participants. Data showed that progressing to elite senior level at a fast pace may be detrimental to the future career of youth athletes. Athletes described that gradual, steady progress should be prioritized because rapid advancement may have the opposite effect to the one intended.

> They need to practice every day and work hard every day and with slow but steady steps to reach their best potential.
>
> Participant 2

> The transition from junior to senior level needs to be made at a normal pace, step by step - not go from the first step to the tenth because usually, you fall.
>
> Participant 6

Furthermore, playing time at senior level was also recognized as a prerequisite for a successful transition to senior level. Participants explained that in order to prove their playing ability and gain playing experience playing time is needed. Only training with the senior team or playing a few games per year is not enough for the athletes to get prepared for the demands they have to face as senior athletes.

> Playing one game per year and playing 30 is a big difference. That year gave me the opportunity to play consistently, and I showed that I can play at this level.
>
> Participant 6

Challenges

Injuries

Participants reported that injuries can affect them both physically and psychologically which eventually may even lead to drop out. Thus, they proposed that rehabilitation period is crucial, and that medical staff, support from family, and coaches are essential. However, they suggested that unfortunately in some cases, injuries can be the main reason that athletes do not reach their best potential or simply drop out.

> There are a few athletes that I know have dropped out simply because of injury. They have been getting the same injury over and over again and then they don't do the right rehab all the time, they never really recover from it.
>
> Participant 4

> Some of the athletes may have injuries which can affect their psychology in a negative way and make them drop out.
>
> Participant 2

On the other hand, an injury can be beneficial according to athletes who described becoming wiser and managing to reach the same or even higher level of performance after an injury. Essentially, athletes recognized this difficult period in their career as a learning process. As such, it is how someone responds to challenge that appears to be the key.

> I had an injury and for sure it made me wiser and it was a difficult period of my career. You need to stay calm in many situations such as an injury and work to recover in order to reach the level you were before.
>
> Participant 6

External Pressure

The existence of potential external pressure from fans or the media was highlighted by the participants. Athletes agreed this pressure is something that they need to learn to manage, as it can have a negative impact on their performance.

> …to play in front of the fans and see what it is like. When you play with the youth teams you are not experiencing anything like that.
>
> Participant 5

> We are a country [Greece] that has 15 newspapers, 500 websites and 10 radio stations with sport content. So every day there is some tension around football…
>
> Participant 1

Balancing Academic/Vocational Career with Sport

Four of the six participants found it challenging to combine work/studies with sport. Athletes highlighted prioritization as key to balancing sport with work or study. Prioritization of different tasks according to the needs of each period is essential for athletes to achieve their goals in sport, studies and work. Athletes believe that available support within the school and from the team/coach was very helpful because it can increase their chances of meeting their goals and staying committed to their sport.

> I would go to school on a Wednesday and because I was only doing two subjects I was catching up on both during the week and the teachers helped me a lot and got me through it. Then I passed both my exams, but it was quite hard to play football and do the Highers as well.
>
> Participant 5

Athletes reported that prioritizing was the key factor that enabled them to successfully combine a career in sport while working or studying. Setting specific goals depending on the needs and the expectations of either academic/vocational or sport career enabled them to combine both. This strategy resulted in favoring either sport or studies/work at certain periods of the year. For this to happen, support and understanding from the coaches/team were essential. Athletes needed their coaches' support for their life choices, because they are not only athletes but also people with their own wishes and targets outside sport.

> …so as a junior, when I was younger, it was balancing my school, my social life, and my training and now I am a university part-time, so I have to balance my university work alongside training full time and earning money to pay my rent. So, at different times of the year, different things take priority.
>
> Participant 3

> Everybody will favour one or the other. At some time like this time last year, I probably favoured my training a lot more because I had things to aim for. I wanted to achieve things that year whereas now it is the other side. I have got an honours degree to try to complete so it is the complete opposite, but my coach is completely 110% behind me.
>
> Participant 4

Performance Related Challenges

According to participants' opinions, the biggest performance-related challenge was to stay at elite level. Some of the participants (1 and 6) had to make hard decisions for their careers to eventually return to elite level after having a performance decrease or being dropped by their teams. Athletes competed with lower-level teams or even lower division teams to get playing time, build up their confidence and finally return to elite level.

> Then I took the decision to leave, and I went to a weaker team to have some playing time and gain confidence which is what happened in the next two years.
>
> Participant 1

> The biggest challenge was to stand up again after spending a year in obscurity [lower division teams] and PP [Super league team] was a step for me to come back to elite level.
>
> Participant 6

Distractions

Potential distractions such as nights out, hanging out with friends or playing video games were also discussed by the participants. Being committed and focused to their goals seems to be the key to avoiding those potential distractions. However, at certain times those distractions can relieve pressure which highlights the need to consider individual circumstances before identifying good and bad practice.

> Whilst some of my friends would spend night after night just kicking a football around with a friend or going out drinking or with their play stations, I had a focus, and I had like the direction in where I wanted to go in my life.
>
> Participant 3

> Stay focused on what you are doing and don't get distracted from nights out, coffees, journalists, women. Everything in balance.
>
> Participant 1

Characteristics of successful Talent Development Environments

Support Network

Athletes identified that a support network from people from the close environment is the basis for effective development since athletes need to rely on certain people that they trust, and they need this extra 'push' when things are not going well. It was suggested that without this social support the pathway to elite level can be more difficult for athletes. According to the participants' view, significant others can support emotionally during tough times, but they can also bolster their confidence while dealing with stressful situations.

> you really just have to rely on the people around you. When I was back at home, I had the full support of my friends and my family, and they were really supportive. Now I am up in EE by myself, but I have a girlfriend, so she is my support network and I have a good few friends who help me and a coach who I trust.'
>
> Participant 3

> I would say a lot of the time, my family came into it. Because they are very, very supportive. I would say them being on my back all the time, sort of, is a blessing in disguise…that level of support which when you are having tough times, when you are facing barriers, that it allows you to have someone to be by your side and give you that support to keep going and keep driving through it.
>
> Participant 4

Experts (e.g., coaches, physiotherapists, psychologists) are essential pieces of a successful environment at elite level and athletes acknowledged this. Receiving the support from people who are experts in their field can help athletes pay attention to detail and enhance their performance. Providing athletes with guidance regarding

possible solutions to a problem or providing them with the necessary resources to cope with stressful situations is of paramount importance according to the participants.

> The coaches influenced my development in a good way; if you have a good coach, you acquire a good mentality as well. My coach was my second father for me personally.
>
> Participant 2

> I believe a sport psychologist is essential in a team especially after the age of 15 because athletes may need to speak with a sport psychologist and express some issues that may bother them which can help them perform well.
>
> Participant 6

It was reported that role models and more specifically elite level teammates can also provide support and help athletes become better especially in terms of building their character based on professional elite level standards. By acting as a good example, they can inspire youth athletes and enable them to understand what it takes to be elite.

> It helped me very much the fact that I was training with the senior team of OO [Super league team] for a year and a half because my teammates were elite level players who had played in Champions league. This helped me build my character.
>
> Participant 6

Holistic Approach

The value of maintaining a skill focus development instead of being results-oriented was highlighted by the participants. Winning at young ages does not necessarily mean that an athlete is skillful or has the potential to be successful. Success could be a result of a physical advantage at that time. Therefore, improving technique and skills aiming to be successful in the long-term is suggested to be advantageous for youth athletes.

> I would say people not being medal orientated at a younger age, the best way to get to elite level is to not be focused on results. Not be result orientated. I feel if you are results orientated too early you will only focus on how to win at that time.
>
> Participant 3

Constantly progressing is the philosophy that will increase the possibilities for a youth athlete to make a successful career at elite senior level. In addition, having clear and achievable goals is useful for athletes because it keeps them committed at all times.

> He [the coach] always told me that it didn't matter, we were always developing for the future, and it is ok, as long as each time I competed I could show that I had improved a little bit, and what we were working on I was putting into practice, he was OK. So he said the results will come and as long as I keep putting in the hard work and keep trying to improve, eventually the results will come.
>
> Participant 3

Athletes stated that an environment that promotes healthy competition is of paramount importance because it challenges athletes to get better. This can be a mechanism to get the most out of the athletes in every training session.

> Every day is a competition we are in. I have a good friend in my training partner, and we are both in the same weight category, but everything is a competition. If we lift weights in the gym, who can lift the heaviest weights that day, if we have conditioning, who can do it for the fastest or for the longest? If we have a judo fight it is obviously who can throw each other the most, every single day. Even in training is competition which means that we constantly push ourselves to get better and better as well as having to support each other as well.
>
> Participant 3

Education was also described as essential for the development of elite-level athletes. More specifically athletes highlighted that family should instill the right principles from an early age and promote healthy competition. Significant others should be educated regarding the needs, expectations and long-term goals of the athletes to empower the support network instead of creating obstacles due to lack of knowledge.

> To begin with my family for sure, this is where it all begins. They gave me the right principles and they taught me to compete in a healthy way.
>
> Participant 2

> I think education of people supporting the athlete is very important. If you educate the parents or the support system, especially when you are younger it will allow you to maximise the child's potential.
>
> Participant 3

Furthermore, a caring environment based on the values of trust and honesty to make athletes feel satisfied should be in place because, according to the participants, their wellbeing is linked with their performance.

> When athletes want to be a professional in any sport the environment needs to make them happy, make them feel close with everyone and be happy to work hard.
>
> Participant 2

Participants described that during their careers, challenges helped them to improve weaknesses. More specifically, learning to deal with disappointment and defeat is an important lesson for young athletes. Losing time after time can make an athlete understand this the hard way. However, if the coach is next to the athlete to support and instill values such as hard work, perseverance instead of letting the athletes get upset for losing this challenge can be beneficial. This scenario could be a structured challenge (competing against stronger opponents) to achieve the desired outcome which in that case would be to learn to deal with defeat/disappointment. Additionally, having teammates with the same mindset can be helpful since they push each for the greater good always within the limits of healthy competition.

> I have seen many talented persons come and go because they don't have the psychological drive or toughness to reach the top. I believe that it is something that you instil in someone from a young age. So, it is kind of like tough love. I believe it is mostly through tough love and having a good group of people around you who are also, like-minded. If everybody is trying their hardest it means you push each other.'
>
> Participant 3

On the other hand, when things are going too easy for young athletes, they lack the ability to deal with disappointment, and they are more likely to drop out when the demands are higher and the challenges numerous. Therefore, even losing can be a learning process and a very important one. Dealing with disappointment/defeat was described as a key characteristic for effective development especially when athletes face multiple challenges.

> …people who get it easy, struggle when things get difficult. There are a few people who I know that instead of pushing through they just quit. They were so used to winning. I think that is a major factor.
>
> Participant 3

Another structured challenge reported by a participant was related to being given a senior debut at a young age. This strategy can provide a clear picture of the expectations at the elite senior level and empower the desire of athletes to improve and reach elite senior level.

> It was a very big step for the manager to give me a shot in the first team that young. It kind of helped me and showed me what is there to have if I really want it that badly, if I put in the work…
>
> Participant 5

Individual Determinants of Success

Performance Related Characteristics

Athletes highlighted the importance of appropriate recovery, and they linked poor recovery with injuries and poor fitness. Interestingly, participants shared that athletes should be responsible for their recovery and take care of their bodies to be in the best possible condition for training and competitions.

> I feel that that is probably one of the reasons why injuries occur. I see it in so many different athletes where they don't recover as they should and they don't use the correct methods
>
> Participant 4

> I had teammates who were coming at training 5 minutes before it started and were leaving always first thinking about the coffee afterwards without caring about recovery and how they could enhance their fitness. We are talking about professional level. Athletes should give much attention to their recovery and their preparation.'
>
> Participant 1

As participant 3 specifically described, physical attributes and sport abilities can facilitate the pathway towards elite level. Nonetheless, it was suggested that this would not be possible without having the drive and the mental toughness required to reach elite level.

> You do need some kind of sporting natural ability and physical attributes because everybody who reaches the top, whether they are great or not, has some deep sporting ability. However, I have seen many a talented person come and go because they don't have the psychological drive or toughness to reach the top.
>
> Participant 3

Psychological Characteristics

All the athletes highlighted that the most important elements that will enable an athlete to reach the elite senior level are psychological characteristics such as hard work ethic; perseverance; self-reflection; coping with disappointment; self-confidence; and coachability. All the participants agreed that these elements are the ones that make the difference for someone who wants to become elite. According to the athletes, having a hard work ethic means always giving your best efforts and having the drive to excel. Athletes also described that attending training with consistency while constantly trying to get better is a cornerstone of the hard work ethic.

> Consistency, desire and a strong personality. If someone combines these characteristics the success is guaranteed if there are no injuries.
>
> Participant 1

> But on top of everything else, there is just the will to work hard and push yourself. There is nobody at the very top of any sport who hasn't pushed themselves to the point of being sick, or crying, you have to be able to push yourself
>
> Participant 3

In addition, being committed to a specific target and having the perseverance to do their best no matter what obstacles they may face were highlighted by the participants. Whether it is an injury or failure or not being picked for the team, athletes need to stay committed and be totally determined to overcome the difficulties that have arisen.

> You need to be resilient and never give up; you need to keep trying no matter what difficulty you may face. This is a determinant for an athlete to continue within the sport and reach their best potential. I realized that I can be a professional footballer because I was working daily and never gave up.
>
> Participant 2

Participants described that sometimes they need to self-reflect and be aware of their strengths and weaknesses to enhance their performance. Reflection combined with the ability to use a problem-solving approach when facing difficulties is a toolbox for athletes to eventually overcome those difficulties. Those two characteristics can facilitate the personal development of athletes and enable them to reach their personal goals.

> …You may have some moments that you think about your mistakes and what you need to improve. You need to think to find a way to react and eventually improve through hard work.'
>
> Participant 2

Furthermore, athletes distinguished the ability to cope with pressure and disappointment. If an athlete learns how to deal with pressure, difficulties and disappointments it is likely that they will become resilient throughout the process. This characteristic should be instilled in young athletes since it is an element that will enable them to progress further in their careers. The difficult moments will be much more than the happy moments in sport; therefore, athletes need to be able to cope with failures and disappointments to finally reach elite level.

> You need to be mentally tough. The failures are more than the successes. The disappointments are more than the happy moments, but the joys are so strong that this is what you remember in the end.
>
> Participant 6

> So that is one major challenge, is dealing with disappointment over and over again but having the self-belief to know that you will eventually achieve what you need.
>
> Participant 3

As described by participant 3 above, the athletes always believed in their abilities and felt confident that they would manage to be successful. The participants reflected on the importance of that self-confidence, and they described that believing in your skills can facilitate better performance. Realizing the potential is more likely if they have confidence, which will create more chance of progressing to a better-quality team/environment.

> If you believe in yourself and you think you can do everything possible it makes everything so much easier. You can perform better. You definitely need talent but if you believe in yourself it makes your talent show.
>
> Participant 5

Having a positive attitude was another factor that was suggested by the athletes who took part in this study. Good values and generally maintaining a positive attitude towards teammates, coaches, and opponents are vital at elite level sport.

> As long as you have the ability and you have the right attitude and character, then you should make it. But it does all come down to the character and your attitude.
>
> Participant 5

Discussion

The purpose of this study was to explore athletes' transitional experiences to elite senior level in sport, specifically identifying the challenges encountered and the factors that facilitated their successful adjustment. The analysis revealed four overarching

themes: a developmental process characterized by early engagement, commitment, and gradual progression; a range of personal and environmental challenges including injury, pressure, and balance between sport and life; the importance of supportive and holistic talent development environments; and individual determinants such as motivation, perseverance, and self-reflection that enabled athletes to thrive. These findings highlight the complex, non-linear, and individualized nature of transitions to elite sport.

The key stages of development that emerged through the analysis correspond to those described previously in the literature (Côté et al. 2007). During their early engagement in sport, athletes were involved in deliberate play activities which have been shown to promote enjoyment and intrinsic motivation both of which facilitate further engagement in sport and future commitment to talent development (Côté & Hancock 2016). More recent evidence has also highlighted that playful and diverse early experiences are a critical foundation for later elite performance (Côté & Erickson 2015, Sieghartsleitner et al. 2018). Additionally, time and space given for the development was identified, which is in line with findings suggesting that some characteristics of talent may need several years to emerge (Andronikos et al. 2019). This highlights the need for long-term development approaches rather than results-driven approaches.

Athletes of the current study reported that they were very committed and had high aspirations to reach elite level in sport. Research has shown that commitment to the pursuit of excellence and motivation are characteristics that successful athletes share (Burns et al. 2022). Those characteristics have been shown to facilitate sport transitions (MacNamara et al. 2010) and the transition to university (MacNamara & Collins 2010). While commitment and motivation were essential, participants also noted that organizational factors such as access to facilities and high-quality coaching can be very influential in the overall quality of athlete development and as a result the outcome of their transitions. This finding could be linked to the concept of the "birthplace effect," which suggests that availability and quality of resources and opportunities can shape the developmental experiences and pathways of young athletes (Côté et al. 2006). Therefore, our findings suggest that successful progression results from the interaction between athletes' personal commitment and the quality of opportunities provided by their environment.

Athletes identified that JST occurs around the time of the transition from development to mastery stage, in a period that other transitions are expected to occur in vocational, psychosocial, and psychological level. This finding aligns with holistic models of athlete development (Stambulova et al. 2020), reinforcing that transitions are multidimensional, involving athletic, psychosocial, and vocational domains. Interestingly, participants identified parallel transitions (e.g., from amateur to professional, or pre-elite to elite), underlining the non-linear and individualized nature of development (Thomas 2024). Our understanding is that there is no fixed pattern in which those transitions will occur. Recent research reinforces this dynamic and complex nature, suggesting that the sequence and timing of the transitions may vary depending on the sport and context (Henriksen & Stambulova 2017, Stambulova et al. 2020).

Several challenges, including injuries, pressure, and balancing school and sport were identified in the current study. In line with this, participants described psychological characteristics such as high self-confidence, work ethic, and perseverance as key resources in coping with challenges, which aligns with previous research (Dohme

et al. 2019, Toering & Jordet 2015). Additionally, athletes highlighted the importance of support networks and environments that promote the wellbeing of athletes. Growing evidence supports this finding, noting that high-quality talent development environments create support networks that contribute to better performance and mental health (Ivarsson et al. 2015, Lane 2024). Notably, the present findings suggest that support systems are most effective when they are individualized and embedded across multiple layers of an athlete's environment (e.g., family, coach, peers).

Furthermore, athletes suggested that in certain cases intentional structured challenge implemented by their coaches enabled them to overcome an obstacle, get better or learn how to deal with disappointments. In line with this, Savage et al., (2017) proposed that structured challenges should be incorporated in talent programs (e.g., intentionally promoting athletes to a level or squad that will be difficult for them to handle at a technical and tactical level). Collins and MacNamara (2012) suggested that the deliberate use of structured challenge can facilitate athlete development. The experiences of athletes in this study reinforce this concept, demonstrating that structured challenge can serve as a developmental tool when supported appropriately. Interestingly, recent studies have shown that the learning athletes 'bring into' the challenge is more important rather than the experience itself. Such experiences act as opportunities to prove, test, and refine existing skills (Collins et al. 2016, Savage et al. 2017). It is therefore essential to proactively and intentionally develop supporting mechanisms to prepare youth athletes for inevitable upcoming challenges (Savage et al. 2017). As such, the effectiveness of structured challenges depends on the athletes' pre-existing coping resources, highlighting the importance of 'up-front' skills prior to exposure (Collins et al. 2019). This proactive approach ensures that challenges act as growth catalysts rather than potential stressors.

Conclusions

This study provides valuable insights into mechanisms and processes that support successful transitions to elite senior level, emphasizing how personal qualities and environmental factors interact to facilitate progression and adjustment. In particular, the study highlights the influential role of development experiences, supportive talent development environments, and key psychological characteristics in shaping athletes' responses to challenge. These insights align with previous research on athletic transitions and suggest that effective programs should not only provide resources but also deliberately integrate challenge and psychological skill development to enhance athletes' readiness for transitions. From a practical perspective, such an approach underlines the importance of balancing performance with well-being and personal growth, creating a supportive environment for holistic athlete development.

Although the study involved a relatively small sample of six participants, they were carefully selected to capture the transition experiences of successful athletes across sports and talent development environments. The key determinants that can influence the outcome of the transition appear to be consistent across different countries and sports. Despite the valuable insights of the current study, it needs to be acknowledged that the focus was solely on male participants. Future research should

therefore examine whether similar patterns and mechanisms are evident in female athletes, as gender related differences in developmental pathways and support systems may influence the transition process. Future research should also examine how these factors interact across different contexts and competitive levels as experiences may vary even within the same environment. In addition, further research is required to enable us to understand different types of transitions occurring in sport (e.g., children-to-youth-sport transition). Adopting a longitudinal approach, comparing athletes who successfully cope with a transition with those who do not, could extend our understanding in sport transitions.

References

Andronikos G, Westbury T, Martindale RJ (2019) Unsuccessful transitions: Understanding dropout from the athletes' perspective. *Athens Journal of Sports,* 6(4), 195–214. https://doi.org/10.30958/ajspo.6-4-1

Andronikos G, Westbury T, Brazo-Sayavera J, Olivares PR, Martindale RJJ (2021) Factors contributing to the quality of the junior-to-senior transition in Greek athletes. *International Journal of Sport and Exercise Psychology,* 23(5), 1–17. https://doi.org/10.1080/1612197X.2021.1912281

Andronikos G, Westbury T, Souglis A, Travlos A, Martindale RJ (2024) Examining a successful high-performance triathlon environment from the coaching team perspective. *International Sport Coaching Journal,* 1(aop), 1–12. https://doi.org/10.1123/iscj.2024-0005

Backstrom CH, Hursh-César G (1981) *Survey Research* (2nd ed.). Wiley, New York.

Berg BL (2004) *Qualitative Research Methods for the Social Sciences* (5th ed.). Pearson, Boston.

Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brockett CL, Stansen C, Bourke M, Pascoe M, Clements M, Parker AG (2024) Factors that influence mental health and well-being of high-performance athletes who have transitioned out of national- or international-level sport: A mixed methods approach. *BMJ Open Sport & Exercise Medicine,* 10(2), e001675. https://doi.org/10.1136/bmjsem-2023-001675

Burke LA, Miller MK (2001) Phone interviewing as a means of data collection: Lessons learned and practical recommendations. *Forum: Qualitative Social Research,* 2(2), Article 7. https://doi.org/10.17169/fqs-2.2.959

Burns L, Weissensteiner JR, Cohen M (2022) Psychological characteristics of developing excellence in elite athletes: A systematic review. *International Review of Sport and Exercise Psychology,* 15(1), 247–268. https://doi.org/10.1080/1750984X.2021.1947052

Collins D, MacNamara Á (2012) The rocky road to the top: Why talent needs trauma. *Sports Medicine,* 42(11), 907–914. https://doi.org/10.1007/BF03262302

Collins D, MacNamara Á, Cruickshank A (2019) Research and practice in talent identification and development: Some thoughts on the state of play. *Journal of Applied Sport Psychology,* 31(3), 340–351. https://doi.org/10.1080/10413200.2018.1475430

Collins D, MacNamara Á, McCarthy N (2016) Super champions, champions, and almosts: Important differences and commonalities on the rocky road. *Frontiers in Psychology,* 6, 2009. https://doi.org/10.3389/fpsyg.2015.02009

Côté J, Erickson K (2015) Diversification and deliberate play during the sampling years. In Baker J, Farrow D (eds) *Routledge Handbook of Sport Expertise,* 305–316. Routledge, London.

Côté J, Hancock DJ (2016) Evidence-based policies for youth sport programmes. *International Journal of Sport Policy and Politics,* 8(1), 51–65. https://doi.org/10.1080/19406940.2015.1060705

Côté J, Baker J, Abernethy B (2007) Practice and play in the development of sport expertise. In Tenenbaum G, Eklund RC (eds) *Handbook of Sport Psychology* (3rd ed.), 184–202. Wiley, Hoboken, NJ.

Côté J, Macdonald DJ, Baker J, Abernethy B (2006) When "where" is more important than "when": Birthplace and birthdate effects on the achievement of sporting expertise. *Journal of Sports Sciences,* 24(10), 1065–1073. https://doi.org/10.1080/02640410500432490

Dohme LC, Piggott D, Backhouse S, Morgan G (2019) Psychological skills and characteristics facilitative of youth athletes' development: A systematic review. *The Sport Psychologist,* 33(4), 261–275. https://doi.org/10.1123/tsp.2018-0058

Guest G, Namey EE, Mitchell ML (2013) *Collecting Qualitative Data: A Field Manual for Applied Research.* SAGE Publications, Thousand Oaks, CA.

Henriksen K, Stambulova N (2017) Creating optimal environments for talent development: A holistic ecological approach. In Baker J, Cobley S, Schorer J, Wattie N (eds) *Routledge Handbook of Talent Identification and Development in Sport,* 271–284. Routledge, London.

Henriksen K, Stambulova N, Storm LK, Schinke R (2024) Towards an ecology of athletes' career transitions: Conceptualization and working models. *International Journal of Sport and Exercise Psychology,* 22(7), 1684–1697. https://doi.org/10.1080/1612197X.2022.2139640

Ivarsson A, Stenling A, Fallby J, Johnson U, Borg E, Johansson G (2015) The predictive ability of the talent development environment on youth elite football players' well-being: A person-centered approach. *Psychology of Sport and Exercise,* 16, 15–23. https://doi.org/10.1016/j.psychsport.2014.09.006

Lane S (2024) It's the people that make the difference: Understanding the significance of psychosocial support for professional athletes. *Mental Health & Prevention,* 36, 200364. https://doi.org/10.1016/j.mhp.2024.200364

MacNamara Á, Collins D (2010) The role of psychological characteristics in managing the transition to university. *Psychology of Sport and Exercise,* 11(5), 353–362. https://doi.org/10.1016/j.psychsport.2010.04.003

MacNamara Á, Button A, Collins D (2010) The role of psychological characteristics in facilitating the pathway to elite performance. *The Sport Psychologist,* 24(1), 52–73. https://doi.org/10.1123/tsp.24.1.52

Martindale RJJ, Collins D, Daubney J (2007) Talent development: A guide for practice and research within sport. *Quest,* 59(4), 353–375. https://doi.org/10.1080/00336297.2007.10483552

Morris R, Tod D, Eubank M (2017) From youth team to first team: An investigation into the transition experiences of young professional athletes in soccer. *International Journal of Sport and Exercise Psychology,* 15(5), 523–539. https://doi.org/10.1080/1612197X.2016.1152992

Nash C, Sproule J, Horton P (2011) Excellence in coaching: The art and skill of elite practitioners. *Research Quarterly for Exercise and Sport,* 82(2), 229–238. https://doi.org/10.1080/02701367.2011.10599748

Patton MQ (2002) *Qualitative Research & Evaluation Methods* (3rd ed.). SAGE Publications, Thousand Oaks, CA.

Pilkington V, Rice S, Olive L, Walton C, Purcell R (2024) Athlete mental health and wellbeing during the transition into elite sport: Strategies to prepare the system. *Sports Medicine – Open,* 10(1), 24. https://doi.org/10.1186/s40798-024-00765-0

Rees T, Hardy L, Güllich A, Abernethy B, Côté J, Woodman T, Montgomery H, Laing S, Warr C (2016) The Great British Medalists Project: A review of current knowledge on

the development of the world's best sporting talent. *Sports Medicine,* 46(8), 1041–1058. https://doi.org/10.1007/s40279-015-0372-8

Rynne SB, Mallett CJ, Tinning R (2010) Workplace learning of high-performance sports coaches. *Sport, Education and Society,* 15(3), 315–330. https://doi.org/10.1080/13573322.2010.493312

Savage J, Collins D, Cruickshank A (2017) Exploring traumas in the development of talent: What are they, what do they do, and what do they require? *Journal of Applied Sport Psychology,* 29(1), 101–117. https://doi.org/10.1080/10413200.2016.1194911

Shenton AK (2004) Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information,* 22(2), 63–75. https://doi.org/10.3233/EFI-2004-22201

Sieghartsleitner R, Zuber C, Zibung M, Conzelmann A (2018) The early specialised bird catches the worm! A specialised sampling model in the development of football talents. *Frontiers in Psychology,* 9, 188. https://doi.org/10.3389/fpsyg.2018.00188

Smith B (2018) Generalizability in qualitative research: Misunderstandings, opportunities and recommendations for the sport and exercise sciences. *Qualitative Research in Sport, Exercise and Health,* 10(1), 137–149. https://doi.org/10.1080/2159676X.2017.1393221

Stambulova N (2016) Athletes' transitions in sport and life: Positioning new research trends within the existing system of athlete career knowledge. In *Routledge International Handbook of Sport Psychology,* 519–535. Routledge, London.

Stambulova NB, Ryba TV, Henriksen K (2021) Career development and transitions of athletes: The International Society of Sport Psychology position stand revisited. *International Journal of Sport and Exercise Psychology,* 19(4), 524–550. https://doi.org/10.1080/1612197X.2020.1737836

Stambulova N, Henriksen K (2025) Career transitions in sport: Bridging holistic developmental and ecological approaches. *Psychology of Sport and Exercise,* 102900. https://doi.org/10.1016/j.psychsport.2025.102900

Swann C, Moran A, Piggott D (2015) Defining elite athletes: Issues in the study of expert performance in sport psychology. *Psychology of Sport and Exercise,* 16(1), 3–14. https://doi.org/10.1016/j.psychsport.2014.07.004

Thomas PG, Lucas P, Walters S, Oldham ARH (2024) Emerging athletes' career transitions in professional sport: An existential multi-case perspective. *Frontiers in Sports and Active Living,* 6, 1401848. https://doi.org/10.3389/fspor.2024.1401848

Toering T, Jordet G (2015) Self-control in professional soccer players. *Journal of Applied Sport Psychology,* 27(3), 335–350. https://doi.org/10.1080/10413200.2014.996302

Vaismoradi M, Turunen H, Bondas T (2013) Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences,* 15(3), 398–405. https://doi.org/10.1111/nhs.12048

Wixey D, Kingston K (2023) Identifying the psychological characteristics desired of elite youth athletes: Toward an interdisciplinary approach to talent development. *Journal of Sport Behavior,* 46(1), 93–109.

Wylleman P, Reints A, De Knop P (2013) A developmental and holistic perspective on athletic career development. In Sotiaradou P, De Bosscher V (eds) *Managing High Performance Sport,* 159–182. Routledge, London.

Athens Journal of Sports - Volume 13, Issue 1, March 2026 – Pages 49-60

Challenging the Olympic Model? Expected Consumer Interest in the Enhanced Games

By Konrad Reuß, Yannick Weiler± & Christopher Huth○*

Background: *The Enhanced Games challenge the traditional Olympic model by openly embracing technological and pharmacological performance enhancement. This study examines whether spectator interest in this novel event format differs from interest in the Olympic Games, with a particular focus on the role of perceived fairness.* ***Methods:*** *An online survey of German-speaking respondents (n=229) assessed awareness, general interest, viewing intentions, and motivational factors related to both the Olympic Games and the Enhanced Games.* ***Results:*** *The findings show that the Olympic Games continue to generate higher levels of awareness, preference, and viewing intention than the Enhanced Games. While peak athletic performance motivates interest in both formats, fairness emerges as a key normative factor shaping spectator attitudes. The perceived importance of fair competition is negatively associated with interest in the Enhanced Games.* ***Conclusions:*** *Overall, the results suggest that the Enhanced Games are not yet perceived as a viable alternative to the Olympic Games. The study highlights ongoing tensions between the fascination with enhanced performance and established fairness norms in elite sport.*

Keywords: *Olympic Games, The Enhanced Games, Spectator Interest, Fairness*

Introduction

Fairness is a fundamental prerequisite for credible sporting competitions (Costa et al. 2025). Fairness in sport, however, is not a monolithic concept. Several dimensions that structure spectators' evaluations of competitions can be distinguished. Procedural fairness refers to the perception that rules are applied consistently and transparently to all participants. Distributive fairness concerns the equality of starting conditions and opportunities, ensuring that success results from comparable prerequisites rather than structural advantages (Colquitt 2001). Beyond these aspects, fairness also encompasses moral legitimacy, meaning the broader societal acceptance of the normative principles underlying a competition. In this sense, fairness operates as both a rule-based criterion and a value-laden expectation embedded in cultural and ethical frameworks (Loland 2024). In the present study, fairness was operationalized primarily as distributive and procedural equality, focusing on perceptions of equal competitive conditions. The broader dimension of moral legitimacy, while conceptually relevant, was indirectly captured

*Research Assistant, University of the Bundeswehr München, Institute of Sports Science, Chair of Sports- and Health Management, Germany.
±Student Assistant, University of the Bundeswehr München, Institute of Sports Science, Chair of Sports- and Health Management, Germany.
○Professor, University of the Bundeswehr München, Institute of Sports Science, Chair of Sports- and Health Management, Germany.

through attitudinal responses toward performance enhancement and rule regulation. In competition sports, fairness can be understood as sportive actions performed according to specific rules whilst being guided by the principle of justice (Pawlenka 2005). Spectators expect sporting competitions to be based on fair and equal conditions and that success results from rule-compliant, honest performance, not from improper means or the principle of winning at all costs (Durá et al. 2020). Doping scandals, corruption, or controversial referee decisions can undermine spectators' trust in the fairness of competitions and significantly damage it, thereby negatively affecting associations and sports (Otto et al. 2021). The Enhanced Games (TEG) thus see themselves as a transparent, scientifically monitored alternative to traditional elite sports. TEG presents itself as a futuristic project that aims to replace the allegedly outdated ideals and traditions of the Olympics with a techno-scientifically driven mega-event (Ekdahl & Krieger 2024). In the ancient and early modern Olympic Games, performance-enhancing drugs were used; however, in the 1960s, the International Olympic Committee tackled this issue by providing the first definition of doping in 1964 and establishing the Medical Commission in 1967 (Botre 2008). At the current modern Olympic Games, competitions serve to compare natural abilities within a historically developed value system (Koenigstorfer & Preuss 2018). TEG is based on the idea that human performance can be enhanced through technology, pharmaceuticals, and conventional methods and optimization (Ekdahl & Krieger 2024, Turnock 2024). Therefore, the two events differ in the values they represent and seem to be at odds (Møller 2025), and can be seen as contrapositives (Richardson 2024). The Olympic Games are a global communal experience (Short, 2008), pointing towards the ancient harmony of mind and body. TEG primarily aims to fascinate through extreme performance framed as the full potential of human ability, whilst also promoting fairness and opportunities to protect individuals' rights to become extraordinary (Møller, 2025).

The fascination with top athletic performances is an essential part of spectator interest. People feel admiration when athletes exceed their physical and mental limits or set new records. Spectators experience moments when human performance is almost ideally realized, moments when something succeeds exactly as it should, and the athletic ideal is achieved. These moments also generate emotions that remain in the collective memory of the sporting world (Smith 2020). Major international sporting events are defining stages for national identification. The collective emotionality that arises there allows spectators to develop a strong sense of connection to their own country. The decisive factors here are their level of emotional involvement in the sporting events and the intensity of their personal interest in the sport (Mutz & Gerke 2018). The successes of their own nation awaken a strong sense of pride in many people and foster shared experiences that contribute to an understanding of collective unity (Hallmann et al. 2013). Today, major sporting events are much more than just competitions; they function as globally staged experiences in which media, commerce, and politics are closely intertwined. Through spectacular staging and mass media coverage, they generate cultural significance, create economic opportunities, and influence urban and social developments (Horne 2015). The media's framing of athletes and events is influenced by various factors, including

the media's own interests, the nature of the event, and the audience's expectations (Lewis & Weaver 2015). In recent years, the Olympic Games have sought to attract a younger audience (Falcao et al. 2021, Wheaton & Thorpe 2018), but now seem to have to compete with this new event format for spectators' attention (Møller 2025). From a sociological perspective, the Olympic Games and TEG constitute competing legitimacy regimes, with the former grounded in fairness norms and traditional sporting values, and the latter oriented toward techno-scientific rationality and performance optimization. This fundamental tension structures how spectators evaluate and accept both event formats. This study aims to assess whether young adult spectators' interest in the Olympic Games, a well-established event, differs from that in the new TEG format by answering the following research question:

> To what extent does viewer interest in TEG differ from viewer interest in the Olympic Games, and which factors influence audience acceptance of both events?

The paper is structured as follows: After this Introduction, which outlined the paper's focus on spectators' interest in the Olympic Games versus TEG, the Materials and Methods section describes the empirical research design, including the survey methodology, participant recruitment, and data collection. The Results present key findings on consumer interest, and the discussion analyzes these findings in relation to previous research, highlighting the implications. Finally, the Conclusion summarizes key insights, provides recommendations for stakeholders, and suggests areas for future research to monitor the long-term impact of formats such as TEG.

Materials and Methods

The study employs a direct primary empirical research design that focuses on consumers' perspectives on the Olympic Games and TEG. The questionnaire was available in the German language, tested for clarity of wording and logical structure beforehand, and revised accordingly. The participant's recruitment was conducted using the snowball sampling method, and no eligibility criteria were applied. The survey period was from October 23rd to November 23rd, 2025, and was accessible via the SoSci Survey online platform. Where possible and appropriate, a five-point Likert scale with (1) disagreement/ unlikely and (5) agreement/ likely was used to answer the questions. These scales have been widely used since they best reflect the participants' perspectives (Li et al. 2008, Revilla et al. 2014). The questionnaire was structured as follows (Table 1). The first section included socio-demographic variables such as age, gender, and income, as well as personal engagement in sports, both active and passive. The following section focused on participants' interest in the Olympic Games/TEG by asking questions such as "How interested are you in the Summer Olympics/TEG in general?" or "How likely are you to watch the next Summer Olympics/TEG?" The following questions covered the aspects that would most motivate respondents to follow the Olympic Games or TEG. For both events, the questions were asked separately. Furthermore, participants had to answer questions that aimed to assess the importance of fairness. "When watching sports, how important would the

following aspect be to you: Fair competition under conditions that are as equal as possible"? or "What is your opinion on the statement: Creating a level playing field without any prohibitions"? If necessary, brief explanations were provided before the questions were asked to ensure that all participants had a similar understanding of the topic. Ethical objection was operationalized by dichotomizing the five-point Likert item measuring agreement with the statement "Creating a level playing field without any prohibitions." Participants expressing negative attitudes (values 1–2) were categorized as having high ethical objection, whereas those expressing positive attitudes (values 4–5) were categorized as having low ethical objection.

Table 1. *Structure of the Questionnaire and Brief Description of Items*

Item	Description	Level of Scale
Demographics	Age, gender, level of education and income	Nominal and interval
Personal immersion	General interest sports events	Ordinal
Olympic Games vs The Enhanced Games	General interest in the events and likelihood of watching subsequent or first holding of either of the events	Ordinal
Motivation for watching	Tradition, peak performances, fairness	Ordinal

The data were initially analyzed descriptively, and Spearman rank correlations were computed to assess associations. Group differences were calculated using a t-test. The size of the effect is determined using the r-value and classified according to Cohen (2013). The data were analyzed using IBM SPSS Statistics Version 29.0.2.

Results

A total of 320 questionnaires were completed. After removing questionnaires due to missing data, 229 could ultimately be used for the evaluation.

Participants

Regarding gender distribution, 61.1% of participants identified as male (n = 140), 37.1% as female (n = 85), and 1.7% as diverse (n = 4). The sample was predominantly young: 67.2% of respondents (n = 154) were between 18 and 29 years of age, reflecting the study's focus on young adult spectators, a group often discussed as increasingly critical toward traditional mega-sport events. Smaller proportions were represented in older age groups. In terms of educational background, the sample showed a relatively high level of formal education. 45.4% of participants (n = 104) reported holding a high school diploma, while 37.5% (n = 86) had completed a university degree. With respect to monthly net income, the largest share of respondents (55.0%, n = 126) reported an income between €2,000 and €2,999, indicating a predominantly middle-income sample. Participants also reported varying levels of engagement with sport. More than half of the respondents (55.5%, n = 127) indicated that they were often or very often physically active, suggesting a comparatively sport-involved sample. In addition,

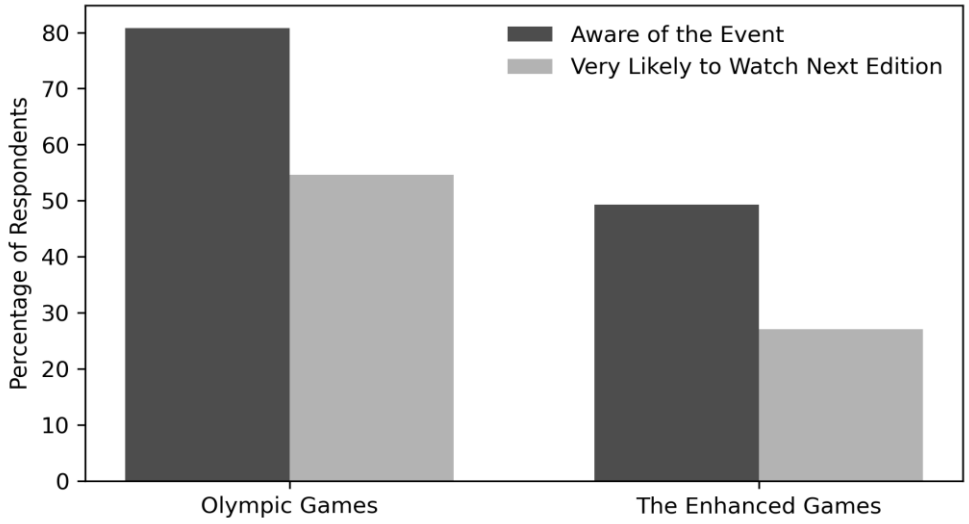
general consumption of major sporting events differed across respondents: while 9.6% (n = 22) reported never following major sporting events and 24.0% (n = 55) doing so only rarely, 31.4% (n = 72) indicated occasional engagement, and 13.5% (n = 31) reported frequent and 21.4% (n=49) report very frequent consumption of major sporting events. Overall, the sample represents a young, relatively well-educated, and moderately to highly sport-affine group of respondents, providing a suitable basis for exploring perceptions of traditional and alternative elite sport event formats such as the Olympic Games and TEG.

Spectators' Interest in the Olympic Games and TEG

Regarding the Olympic Games, 80.8% (n=185) reported having already been watching them. In general, 25.7% (n=59) have little to no interest, 24.0% (n=55) are neutral, and 40.6% (n=93) have a great deal of interest. In terms of the upcoming Olympic Summer Games, 32.2% (n=74) (very) unlikely, and 54.6% (n=125) consider it (very) likely that they would follow the subsequent holding.

Regarding TEG, the picture is balanced in terms of awareness: 49.3% (n=113) were already familiar with them. A difference between the genders can be observed. 56.4% (n=79) of male participants have heard of the event, compared with 38.8% (n=33) of female participants. In terms of general interest, 52.8% (n=121) have little to no interest, and 29.9% (n=68) are (very) interested. Following the first holding of TEG is for 55.9% (n=128) (very) unlikely, and for 27.1% (n=62) (very) likely. For the Olympic Games, there exists a difference in the amount of sport the participants engage in. For TEG, this effect was not visible. Figure 1 illustrates substantially higher awareness and viewing intention for the Olympic Games than for TEG, indicating the continued dominance of the traditional event format in spectator perception.

Figure 1. *Awareness of the Olympic Games and the Enhanced Games and Respondents' Likelihood of watching the Next (or first) Edition (in %)*



Viewer interest in the Olympic Games (M = 3.27, SD = 1.19) was notably higher than interest in TEG (M = 2.57, SD = 1.26). Similarly, the likelihood of following the Olympic Games (M = 3.33, SD = 1.40) exceeded that of TEG (M = 2.46, SD = 1.28).

Reasons for watching and Event Preference

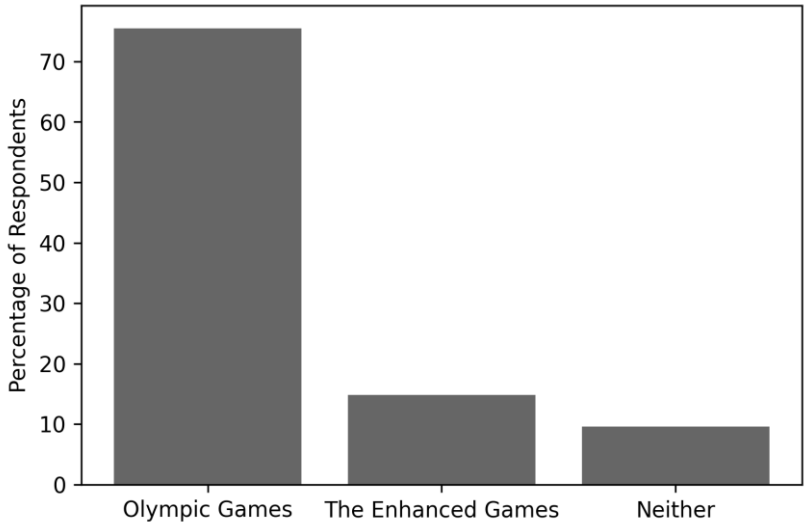
For both events, peak performances were cited as the main reason to watch. 65.9% (n=151) chose this aspect regarding the Olympic Games, and 52.8% (n=121) for TEG. For the Olympic Games, national identification (59.0%, n=135), entertainment (39.7%, n=91), and the importance of individual athletes (36.2%, n=83) were subsequent reasons. For TEG symbolism (49.8%, n=114) and entertainment (36.2%, n=83) are the most relevant aspects. In general, fairness during events is regarded as (very) important by 83.4% of respondents (n=191). The statement "Creating a level playing field by not imposing any bans" is (firmly) rejected by 47.2% (n=108), whilst 30.6% (n=70) are neutral and 22.3% (n=51) (strongly) approve it. To examine whether viewer interest differs according to ethical attitudes toward performance enhancement, independent-samples *t*-tests were conducted comparing respondents with low versus high ethical objections. As shown in Table 2, no significant differences emerged between the two groups regarding interest in TEG. Participants with low ethical objection (M = 2.55, SD = 1.29) and those with high ethical objection (M = 2.57, SD = 1.21) reported nearly identical levels of interest. Similarly, the likelihood of following TEG did not differ significantly between respondents with low (M = 2.33, SD = 1.29) and high ethical objection (M = 2.62, SD = 1.25), although a non-significant trend toward higher viewing intention among ethically critical respondents was observed. In contrast, substantial group differences were found for the Olympic Games. Participants with high ethical objection expressed significantly greater interest in the Olympic Games (M = 3.82, SD = 0.98) than those with low ethical objection (M = 2.86, SD = 1.16; $p < .001$). A similar pattern emerged for the likelihood of following the Olympic Games, with ethically critical respondents reporting markedly higher viewing intention (M = 4.02, SD = 1.12) compared to respondents with low ethical objection (M = 2.82, SD = 1.37; $p < .001$).

Table 2. *Group Differences in Viewer Interest by Ethical Attitudes toward Performance Enhancement*

Variable	Low Ethical Objection (M, SD)	High Ethical Objection (M, SD)	p
Interest in the Enhanced Games	2.55 (1.29)	2.57 (1.21)	.940
Likelihood of Following the Enhanced Games	2.33 (1.29)	2.62 (1.25)	.096
Interest in the Olympic Games	2.86 (1.16)	3.82 (0.98)	< .001
Likelihood of Following the Olympic Games	2.82 (1.37)	4.02 (1.12)	< .001

When asked which event they would prefer to attend, 75.5% (n=173) would like to attend the Olympic Games, while 14.8% (n=34) prefer TEG, and 9.6% (n=22) do not want to attend either event. The distribution highlights a pronounced preference for the Olympic Games, suggesting that TEG is not yet perceived as an equally attractive alternative in terms of live-event appeal. Figure 2 illustrates this finding. Further, the results show that the probability of watching the Olympic Games is positively associated with the likelihood of watching TEG ($\rho = .231$, $p < .001$).

Figure 2. *Preference for attending one of the Sports Events among Respondents (in %)*



Participants with high sport affinity reported significantly greater interest in TEG (M = 2.85, SD = 1.25) compared to participants with low sport affinity (M = 2.47, SD = 1.27; $p < .05$). Similarly, respondents with high sport affinity indicated a significantly higher likelihood of following TEG (M = 2.79, SD = 1.26) than those with low sport affinity (M = 2.35, SD = 1.29; $p < .05$). In contrast, no significant differences by sport affinity were found for the Olympic Games. Interest in the Olympic Games was comparable between participants with low (M = 3.27, SD = 1.19) and high sport affinity (M = 3.26, SD = 1.18; $p = .970$). Likewise, the likelihood of following the Olympic Games did not differ significantly between respondents with low (M = 3.35, SD = 1.40) and high sport affinity (M = 3.26, SD = 1.39; $p = .672$).

Discussion

This study aimed to assess the potential spectators' interest in TEG compared to the Olympic Games. Since more than two-thirds of this study's participants are between 18 and 29 years old, the results provide valuable insights into the perspectives of this age group, which also appears to have a waning interest in the Olympic Games (Thorpe & Wheaton 2011). According to the results of this study, there seems to be a medium interest in the Olympic Games since only about half of the participants show a (rather) high interest. This result appears to support the reduced interest among younger spectators in the Olympic Games (Wheaton &

Thorpe 2018). For TEG, there seems to be even less interest, as fewer than one-third of participants express (relatively) high interest in following the games. The Olympic Games are a global mega-event that is embedded in modern sports culture, with high media visibility, symbolic and historical roots, and therefore is deeply embedded in processes of media publicity, nation-building, and urban development. Against this backdrop, it is not surprising that, in the present sample, they are significantly ahead of TEG in both actual viewing and future viewing willingness. More than two-thirds of the respondents say they are somewhat or definitely more interested in the Olympic Games. At the same time, only 12.2% are slightly or definitely more interested in TEG. If respondents had to hypothetically choose only one event, the difference is even greater. 75.5% would choose the Olympic Games. The results indicate that TEG, as a deliberate counter-concept to the Olympic movement, is not yet perceived by spectators as a fully-fledged alternative. From a legitimacy perspective, these findings suggest that novelty alone is insufficient to generate sustained spectator support in elite sport. While TEG attracts attention by challenging established conventions, the findings suggest that, in this sample, legitimacy appears to be more strongly associated with historically embedded norms than with innovation alone. The Olympic Games function as a taken-for-granted reference point against which alternative formats are evaluated, providing spectators with a familiar framework of meaning and credibility. In this sense, TEG may be perceived as challenging established normative expectations rather than functioning as an accepted substitute, highlighting the difficulty of translating disruption into legitimacy in the absence of widely shared value foundations. However, TEG was known to only about half of the participants; therefore, if media coverage around TEG increases in the future as the first holding approaches, awareness of the event could rise, which could also lead to greater interest among spectators.

Top athletic performances are identified both theoretically as a key driver of viewer interest (Smith 2020) and are also reflected in this study's results. Two-thirds of respondents cite top performances as the primary motivating factor for following the Olympic Games, and more than half cite this factor for TEG. This shows that fascination with performance transcends formats. At the same time, the differences show that, for a larger proportion of respondents, the Olympic Games represent the preferred setting in which peak athletic performance is perceived as particularly significant. The Olympic Games are perceived as a place where the athletic ideal is realized (Smith 2020). This corresponds to the significance of records and moments of success, as well as the values and meaning represented by Olympism. The high importance of fairness is particularly striking: 83.4% of respondents rate fair competition under conditions that are as equal as possible as (very) important, and there is a negative correlation between the importance of fairness and interest in TEG, suggesting that the more important a fair contest is to respondents, the less interest they have in TEG. Even though the effect sizes were weak, these can still be regarded as meaningful in an exploratory context. Furthermore, those findings are consistent with the media's portrayal of TEG as a format that deviates from the traditional concept of fairness and the ideal of naturalness (Richardson 2024). The comparatively low and undifferentiated levels of interest in TEG may also reflect the still-limited institutional consolidation of the event. At the time of data collection, fundamental

structural aspects remained unclear to many spectators, including the regularity of the event cycle, the scope of participating countries, the range of sports disciplines, the level of athletic participation, and the extent of international broadcasting. Such uncertainties may hinder the formation of stable expectations and normative evaluations. Unlike the Olympic Games, which are embedded in a well-established four-year cycle, global media distribution networks, and long-standing national representation structures, TEG has not yet developed comparable institutional anchors. The absence of significant differences in TEG interest between respondents with low and high ethical objections may reflect normative ambiguity rather than clear acceptance. As a novel format, TEG has not yet established a stable moral framework that consistently activates fairness-based distinctions among spectators. This suggests that attitudes toward enhanced sport may currently be characterized by uncertainty and interpretive openness rather than polarized ethical positioning. Fairness is not just an abstract rule requirement, but a central component of the appeal of major sporting events. The enhanced format thus finds itself in a field of tension. Its programmatic departure from classic fairness norms attracts attention but also seems to limit its ability to connect with the central expectations of many viewers. Major sporting events in the digital age increasingly function as staged experience spaces in which media, commerce, and politics are closely intertwined (Horne & Manzenreiter 2006, Lewis & Weaver 2015). Show elements, media frames, and narrative embeddings contribute significantly to the appeal of mega-events. Therefore, it remains to be seen whether and how consumer interest in TEG will change after the event's first holding. This will then allow assessment of whether sports need to be divided into doping-entertainment and serious sports (Møller 2025).

Taken together, the findings of this study suggest that spectator interest in elite sport is shaped by the interaction of performance, fairness, and legitimacy rather than by any single factor in isolation. While fascination with peak performance remains a fundamental driver of attention, it is the perceived fairness of competition that anchors performance within a broader framework of meaning and credibility. The Olympic Games benefit from this alignment, as athletic excellence is embedded in widely shared norms that confer legitimacy and foster emotional investment. In contrast, TEG challenges these normative foundations by redefining the conditions under which performance is achieved, thereby complicating their legitimacy in the eyes of spectators. As a result, enhanced performance may generate curiosity and debate, but without normative alignment, it struggles to translate into sustained acceptance and support.

Limitations

There are some limitations to consider when interpreting and drawing conclusions from the results of this exploratory study. First, the results are primarily limited to the German-speaking, young, and highly educated context. This could lead to an overrepresentation of respondents who already hold strong normative views about fairness and elite sport, potentially inflating the observed importance of fairness-related considerations. Since sports cultures vary internationally, with different doping-related discourses, other experiences of mega-events, or a stronger focus on

technology and performance, assessments of TEG may differ. Furthermore, the snowball sampling approach resulted in a predominantly young, highly educated, and sport-affine sample, which may have influenced the prominence of fairness considerations in the findings. Individuals with greater engagement in sport or greater exposure to ethical debates may hold more clearly defined normative positions regarding performance enhancement. Therefore, the observed patterns should not be generalized beyond comparable populations without caution. A second point concerns the temporal dimension. Therefore, the results' transferability is limited. The survey was conducted at a time when TEG had been announced but had not yet been experienced. Many assessments, therefore, refer to media reports, self-presentations by the organizers, or intuitive considerations. Participants' responses to TEG only reflect stated, not revealed, preferences. Attitudes may change after TEG has occurred, depending on media coverage, scandals, or athletes' performances. Third, although established Likert-type scales were used, complex constructs such as fairness perceptions, legitimacy, and ethical acceptance were necessarily simplified. The fairness-related items capture general attitudes toward equal competition and rule enforcement but do not fully reflect the multidimensional nature of fairness in sport, which may include distributive justice, procedural fairness, and moral legitimacy. Furthermore, future studies may benefit from regression-based approaches treating fairness as a continuous predictor. Finally, responses related to doping, fairness, and ethical evaluation may have been influenced by social desirability bias. Given the strong normative condemnation of doping in many sports cultures, respondents may have overstated their commitment to fairness norms or understated their curiosity toward enhanced performance formats. This bias could partially explain the strong support for the Olympic Games observed in the data. As the study is based on a single cultural context, the transferability of the findings may be limited. Future studies should take these limitations into account. Beyond these limitations, the results of this study highlighted aspects that sports federations and other organizations should consider to prepare for potential upcoming changes in the world of sporting events.

Conclusion

This study provides valuable insights into the potential spectators' interest in TEG compared to the Olympic Games. In general, fairness seems highly relevant to spectator interest. Interestingly, this is one of the reasons TEG promotes as a core element of the new event format. However, in the end, the spectators' understanding of fairness will determine whether the event becomes an established counterproposal. The tension among the Olympic ideal, media reality, and the enhanced format opens new perspectives. The conflict surrounding TEG illustrates how the markets surrounding sports events, ethics, and public opinion are being rebalanced in global sports. However, TEG currently attracts comparatively limited spectator interest. The findings suggest that this may be related not to a lack of fascination with peak performance, but to tensions with widely shared fairness norms that underpin the perceived legitimacy of the Olympic Games.

References

Botre F (2008) New and old challenges of sports drug testing. *Journal of Mass Spectrometry,* 43, 903-907.

Cohen J (2013) *Statistical Power Analysis for the Behavioral Sciences.* Routledge.

Colquitt JA (2001) On the Dimensionality of Organizational Justice: A Construct Validation of a Measure. *Journal of Applied Psychology,* 86(3), 386-400.

Costa S, Silva AJ, Dias T, Marinho DA, Batalha NM, Roque R, Afonso C, Aminova M, Ferraz R (2025) Integrity and Transparency in Sports: A Survey Review. *The Open Sports Sciences Journal*, 18(1).

Durá J, Molina P, Martínez-Baena A (2020) Systematic review of research on fair play and sporting competition. *Sport, Education and Society*, 26, 1–15.

Ekdahl D, Krieger J (2024) The Enhanced Games: A timely injection for the International Olympic Committee. *Frontiers in Sports and Active Living*, 6, 1490651.

Falcao TB, Sotiriadou P, Uvinha R (2021) Olympic Games and Adventure Sports: The Inclusion of Surfing in the Tokyo 2020 Edition. *The International Journal of the History of Sport,* 40(4), 334-349.

Hallmann K, Breuer C, Kühnreich B (2013) Happiness, pride and elite sporting success: What population segments gain most from national athletic achievements? *Sport Management Review*, 16(2), 226–235.

Horne J (2015) Assessing the sociology of sport: On sports mega-events and capitalist modernity. *International Review for the Sociology of Sport*, 50(4–5), 466–471.

Horne J, Manzenreiter W (2006) An Introduction to the Sociology of Sports Mega-Events1. *The Sociological Review*, 54*(2)*, 1–24.

Koenigstorfer J, Preuss H (2018) Perceived Values in relation to the Olympic Games: Development and use of the Olympic Value Scale. *European Sport Management Quarterly*, 18(5), 607–632.

Lewis N, Weaver A (2015) More Than a Game: Sports Media Framing Effects on Attitudes, Intentions, and Enjoyment. *Communication and Sport*, 3, 219–242.

Li M, Pitts BG, Quarterman J (2008) *Research Methods in Sport Management*. Fitness Information Technology.

Loland S (2024) *Fairness in Sport*. Routledge.

Møller V (2025) Can the enhanced games be defended, and are they a good idea? *Performance Enhancement & Health*, 13(4), 100373.

Mutz M, Gerke M (2018. Major Sporting Events and National Identification: The Moderating Effect of Emotional Involvement and the Role of the Media. *Communication & Sport*, 6(5), 605–626.

Pawlenka C (2005) The Idea of Fairness: A General Ethical Concept or One Particular to Sports Ethics? *Journal of the Philosophy of Sport,* 32(1), 49-64.

Otto F, Pawlowski T, Utz S (2021) Trust in fairness, doping, and the demand for sports: A study on international track and field events. *European Sport Management Quarterly*, 21(5), 731–747.

Revilla MA, Saris WE, Krosnick JA (2014) Choosing the Number of Categories in Agree–Disagree Scales. *Sociological Methods and Research*, 43(1), 73–97.

Richardson A (2024) The Enhanced Games or Enhancing Harm? *Performance Enhancement & Health*, 12(3),

Short JR (2008) Globalization, cities and the Summer Olympics. *City*, 12(3), 321–340.

Smith TA (2020) On a Pedestal—Sport as an Arena for Admiration. *Sport, Ethics and Philosophy*, 14(1), 4–25.

Turnock LA (2024) The Enhanced Games: Prohibition, harm reduction & the future of sport. *Performance Enhancement & Health*, 12(4),

Wheaton B, Thorpe H (2011) 'Generation X Games' Action Sports and the Olympic Movement: Understanding the Cultural Politics of Incorporation. *Sociology,* 45(5), 830–847.

Wheaton B, Thorpe H (2018) Action Sport Media Consumption Trends Across Generations: Exploring the Olympic Audience and the Impact of Action Sports Inclusion. *Communication and Sport,* 7(4), 415–445.

Athens Journal of Sports - Volume 13, Issue 1, March 2026 – Pages 61-80

Home Advantage in Different German Football League

By Tom Böttger[±] & Lars Vischer[*]

This study investigates the presence and variation of home advantage across different hierarchical levels in German men's football. Based on an extensive dataset comprising 357,530 matches from the 2023/2024 season—collected via a Python script—the analysis includes match outcomes, attendance figures, club locations, and prior season standings across 165 divisions in 28 football associations. These leagues span 13 hierarchical levels, from professional to amateur football. The results show that home advantage is significantly more pronounced in lower divisions. This effect manifests itself through a higher frequency of home wins, fewer draws, and greater sensitivity to travel distance in amateur divisions. In contrast, more professional leagues may benefit from standardised conditions, which mitigate home advantage. Overall, the findings highlight the strong influence of professionalisation on competitive balance. The study contributes to a deeper understanding of how contextual factors shape match outcomes and demonstrates the need for differentiated analysis across league levels when examining systematic advantages in sports.

Keywords: *Home advantage; Amateur football; Professional football; Competitive balance; Spectator effects; Travel distance*

Introduction

The phenomenon of home advantage is a central and widely examined topic in sports economics. It is among the best-documented empirical regularities in sport and has been analysed from different perspectives, such as spectator effects and referee decisions (Courneya & Carron 1992, Pollard & Pollard 2005). Research in this area frequently focuses on the influence of spectators on match outcomes (e.g., Dilger & Vischer 2022, Pollard 2006). Complementary or alternative approaches emphasise referee bias—that is, the impact of officiating decisions on the final result (Dilger & Vischer 2024, Cueva 2020, Sors et al. 2021).

The majority of existing research has concentrated on professional football, while amateur football is often only considered in comparison or as a secondary point of reference. However, investigating home advantage specifically in the amateur context is highly worthwhile. Even in the lower divisions, everyday factors play a big role: the presence of local fans, the distance the away team has to travel, or the strong identification of players with their home club. These influences can shape how a match unfolds, sometimes without players or referees even realising it. Comparing amateur and professional football can therefore yield valuable insights into the role of professionalisation, structural conditions, and organisational environments in the emergence of home advantage.

[±]Researcher, University of Muenster, Germany.
[*]Researcher, University of Muenster, Germany.

This study aims to contribute to the still relatively limited body of research on home advantage in amateur football. The central research question of this paper is:

To what extent does home advantage *vary across different division levels?*

To address this question, a total of 357,530 matches from all German men's football leagues in the 2023/2024 season were automatically collected using a Python script. Where available, data include match results, spectator attendance, the addresses of home and away teams, as well as previous season standings. The German football system is hierarchically structured and consists of various competitive levels (hereinafter referred to as divisions). The designations of these divisions may vary depending on the region within Germany but can be classified in 13 comparable hierarchical division levels. Within each division, competition is further organised into specific competitive groups (hereinafter referred to as leagues). The dataset covers 165 nominally distinct divisions across 28 football associations. This results in 2,058 uniquely named leagues. The top three of these divisions are classified as professionally organised. The subsequent analysis employs suitable regression models to examine these relationships in detail.

Theoretical Background

Research on home advantage in football has shown that it fluctuates over time. Schwartz and Barsky (1977) documented a long-term home advantage across various team sports. Palacios-Huerta (2004) found that in English football the home advantage stood at 56.6 % between 1888 and 1915 but declined to 47.4 % between 1983 and 1996. Biermann (2011) attributes this decline to the increasing professionalisation of football and growing economic disparities between clubs. For the German Bundesliga, Strauß and Höfer (2001) calculated a home win rate of 53.3 %, with 26 % of matches ending in draws and 20.7 % in away wins during the period from 1963/64 to 1997/98. Research by Almeida and Volossovitch (2017) examining Portuguese football demonstrated that amateur leagues exhibited a significantly stronger home advantage, with a 60.36 % home win rate substantially exceeding the percentage observed in professional competitions.

A variety of factors have been discussed in the literature to explain home advantage. Schwartz and Barsky (1977) as well as Loughhead et al. (2003) highlight travel fatigue, environmental familiarity, and crowd support as key influences. However, Clarke and Norman (1995) relativise the importance of travel distance, arguing that modern transportation reduces this burden. Competition rules can also favour the home team, for example when it is automatically qualified for the group stage of a tournament (Strauß & MacMahon 2019). Additionally, referee decisions are considered a possible driver of home advantage (Wallace et al. 2005, Sutter & Kocher 2004), and tactical adjustments made by home teams may also contribute (Pollard 2006).

Spectators receive particular attention in the literature. Boyko et al. (2007) found that higher attendance levels are correlated with stronger home advantage —reflected in

goal differentials and referee-related decisions. The banning of away fans in Argentina's Primera División further amplified this effect, as home advantage increased when visiting supporters were no longer allowed (Colella et al. 2021). The COVID-19 pandemic provided new insights into the role of spectators by creating conditions in which matches were played behind closed doors. Reade et al. (2022) did not find significant effects on match outcomes but observed a decrease in yellow cards for away teams, indicating a reduction in referee bias. In the German Bundesliga, the absence of spectators led to an almost complete neutralisation of home advantage (Dilger & Vischer 2022). Scoppa (2021) observed a similar decline in home advantage in the top divisions of Germany, England, France, Italy, and Portugal. Fischer and Haucap (2021) did not identify a significant reduction in the 2nd and 3rd Bundesliga but confirmed the trend for the 1st division. These findings illustrate that home advantage in football is shaped by a variety of contextual factors and adjusts in response to changing external conditions. In the context of amateur football, Wunderlich et al. (2021) documented a non-spectator driven home advantage during the COVID-19 pandemic, while excluding travel fatigue as a contributing factor in lower leagues due to the comparatively small traveling distances in these competitions.

However, home advantage is not a phenomenon exclusive to football, it has also been documented in other sports. Schwartz and Barsky (1977) demonstrated its existence in major North American professional leagues such as the NFL, NBA, MLB, and NHL, although the effect was found to be weaker in the NFL. Vergin and Sosik (1999) observed that the betting market in the NFL had already accounted for the home advantage. Albert and Koning (2007) confirmed the presence of a cross-league home advantage in American football, which also appears in U.S. college football as well as in the Australian Football League (AFL). In tennis, Koning (2011) identified a statistically significant home advantage among male players, while results for the women's circuit were less conclusive. Research on so-called "ghost games" further supports the view that home advantage is a cross-sport phenomenon that is susceptible to external influences—most notably the presence or absence of spectators. For instance, studies have shown a measurable decline in home advantage in the NBA (Price & Yan 2022, Starke et al. 2024) and MLB (Currea 2021) during matches played without audiences. These findings underline the broader applicability of home advantage across disciplines and highlight how it can be moderated by situational and structural conditions.

Hypotheses

Most of the cited studies focus on professional sports, particularly on the top divisions in football and other team sports. This emphasis is primarily due to the availability of extensive and high-quality data in the professional sector, whereas the amateur domain has so far been examined less systematically. As Schwartz and Barsky (1977) and Loughhead et al. (2003) show, home advantage is strongly influenced by environmental familiarity and crowd support. However, both of these factors—as well as the overall level of performance and the degree of professionalisation—vary substantially across division levels. As professionalisation increases, one can typically

observe a greater density of competitive balance and a reduction in environmental uncertainty, which suggests that home advantage should decrease in higher divisions.

H1: Home advantage *is more pronounced at lower division levels.*

Beyond winning probability, another common indicator for measuring home advantage is the average goal difference between home and away teams (Boyko et al. 2007). As the level of professionalisation increases and teams become more evenly matched in terms of performance, this goal difference is expected to decline. Furthermore, the number of draws is often seen as an additional measure of a league's competitive balance. Greater balance—reflected in smaller goal differences and a higher frequency of draws—is therefore more likely to be observed in the upper division levels, where team quality tends to be more homogeneous.

H2: Matches in higher division levels are more balanced.

Regarding travel distance as a factor influencing home advantage, much of the existing literature refers to older studies. Schwartz and Barsky (1977) and Clarke and Norman (1995) identified travel-related fatigue as a significant factor contributing to home advantage. However, this argument stems from a time when sports teams travelled under relatively basic conditions, faced longer travel times, and had limited access to recovery protocols. In modern professional football, teams benefit from sophisticated logistics, chartered flights, customised travel schedules, and scientifically grounded recovery programs. Accordingly, recent research assumes that travel distance plays only a minor role in professional leagues (e.g., Armatas & Pollard 2014, Pollard & Armatas 2017). Wunderlich et al. (2021) even assume no effect in regional amateur leagues due to minimal travel distances on match outcomes. In contrast, this factor may still impact amateur or semi-professional football, where teams often rely on bus or individual transportation face greater travel inconvenience. Against this backdrop, it is reasonable to assume that travel distance has a more pronounced effect on match outcomes in lower divisions.

H3: Travel distance has a stronger impact on match outcomes in amateur divisions than in professional divisions.

Data and Methodology

To test the hypotheses, a total of 357,530 matches from all German men's football leagues in the 2023/2024 season were automatically collected from kicker.de using a Python script. Where available, the data include match results, spectator numbers, the addresses of home and away teams, as well as league standings from previous seasons. The dataset covers 165 nominally distinct leagues across 28 football associations resulting in a dataset comprising 2,058 concrete leagues spread across 13 hierarchical levels.

Table 1 provides an overview of the different divisions, the corresponding associations, and their assignment to specific hierarchy levels. The top three of these levels are classified as professionally organised. The fourth division level is generally regarded—both in practice and due to promotion and relegation structures, as well as the presence of many reserve teams from Bundesliga clubs—as semi-professional, and therefore marks the dividing line between professional and amateur football.

Table 1. *Associations and Division Numbers*

Association	**Division (German Designation)**	**Hierarchical Division Levels, 1-13**
DFL	1. Bundesliga & 2. Bundesliga	1 - 2
DFB	3. Bundesliga	3
NFV, NOFV, WDFV, RLSW, BFV	Regionalliga Nord, Nordost, West, Südwest & Bayern	4
Badischer Fußball-Verband (FV)	Oberliga, Verbandsliga, Landesliga, Kreisliga, Kreisklasse-A, Kreisklasse-B, Kreisklasse C	5-11
Bayerischer FV	Bayernliga, Landesliga, Bezirksliga, Kreisliga, Kreisklasse A-Klasse, B-Klasse, C-Klasse	5-12
Berliner FV	Oberliga, Verbandsliga, Landesliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C	5-11
FV Brandenburg	Oberliga, Verbandsliga, Landesliga, Landesklasse, Kreisoberliga, Kreisliga, 1. Kreisklasse, 2. Kreisklasse	5-12
Bremer FV	Verbandsliga, Landesliga, Bezirksliga, 1. Kreisliga A, 2. Kreisliga B, 3. Kreisliga C, 1. Kreisklasse, 2. Kreisklasse	5-12
Hamburger FV	Verbandsliga, Landesliga, Bezirksliga, Kreisliga, Kreisklasse, Kreisklasse-B	5-10
Hessischer FV	Hessenliga, Verbandsliga, Gruppenliga, Kreisoberliga, Kreisliga-A, Kreisliga-B, Kreisliga-C, Kreisliga-D	5-12
FV Mecklenburg-Vorpommern	Oberliga, Verbandsliga, Landesliga, Landesklasse, Kreisoberliga, Kreisliga, 1. Kreisklasse	5-11
FV Mittelrhein	Verbandsliga, Landesliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C, Kreisliga-D	5-11
FV Niederrhein	Oberliga, Landesliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C, Kreisliga-D	5-11
Niedersächsischer FV	Oberliga, Landesliga, Bezirksliga, Kreisliga, 1. Kreisklasse, 2. Kreisklasse, 3. Kreisklasse, 4. Kreisklasse, 5. Kreisklasse	5-13
FV Rheinland	Oberliga, Rheinlandliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C, Kreisliga-D	5-11
Saarländischer FV	Oberliga, Saarland-Liga, Verbandsliga, Landesliga, Bezirksliga, Kreisliga A, Kreisliga B	5-11
Sächsischer FV	Oberliga, Landesliga, Landesklasse, Kreisoberliga, 1. Kreisliga, 2. Kreisliga, 3. Kreisliga, 1. Kreisklasse, 2. Kreisklasse	5-13

FV Sachsen-Anhalt	Oberliga, Verbandsliga, Landesliga, Landesklasse, Kreisoberliga, Kreisliga, 1. Kreisklasse, 2. Kreisklasse	5-12
Schleswig-Holsteinischer FV	Oberliga, Landesliga, Verbandsliga, Kreisliga, Kreisklasse-A, Kreisklasse-B, Kreisklasse-C	5-11
Südbadischer FV	Oberliga, Verbandsliga, Landesliga, Bezirksliga, 1. Kreisliga, 2. Kreisliga, 3. Kreisliga	5-11
Südwestdeutscher FV	Oberliga, Verbandsliga, Landesliga, Bezirksliga, A-Klasse, B-Klasse, C-Klasse, D-Klasse, Reserveklasse	5-13
Thüringer FV	Oberliga, Verbandsliga, Landesklasse, Kreisoberliga, Kreisliga, 1. Kreisklasse, 2. Kreisklasse	5-11
FV Westfalen	Oberliga, Verbandsliga, Landesliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C Kreisliga-D	5-12
Württembergischer FV	Oberliga, Verbandsliga, Landesliga, Bezirksliga, Kreisliga-A, Kreisliga-B, Kreisliga-C	5-11

The variable *ProfessionalDummy* in Table 2 distinguishes between the top three division levels, which are classified as part of the professional sector, and all remaining divisions, which belong to the amateur sector. The fourth division level is classified semi-professional and is therefore not part of the professional sector. The variable *Distance* (in km) serves as a proxy for travel distance and is calculated using the Haversine formula, which measures the straight-line distance between the postal codes of the home and away teams. The necessary latitude and longitude coordinates were retrieved from the GeoNames platform. In rare cases where multiple coordinates were listed for a single postal code due to differing reference points, the mean of these coordinates was used. The actual venue of the matches was not taken into account in the distance calculation—this limitation must be acknowledged in the context of the analysis.

To approximate the sporting strength of the teams, league standings and points earned in the previous season were used. Unlike in other studies, established betting odds could not be included here, as such data are not available for lower division levels. It should be noted that point totals from the previous season could be negative in some cases due to point deductions. Standings and points were only used as control variables if both teams had played in the same league during the previous season. Especially in amateur football, league compositions change frequently due to promotion, relegation, and team withdrawals or registrations. As a result, teams for which no previous season data were available were excluded from the models, which reduced the final sample size accordingly.

Table 2. *Descriptive Statistics*

Variables	**N**	**Mean**	**Std. Dev.**	**Min**	**Max**
Home_Win	357,530	0.489	0.5	0	1
Home_Pts	357,530	0.636	0.481	0	1
Draw	357,530	0.147	0.354	0	1

Away_Win	357,530	0.364	0.481	0	1
DivisionLevel	357,530	9.299	1.512	1	13
ProfessionalDummy	357,530	0.997	0.053	0	1
ScoreDiff	356,532	0.476	3.339	-34	40
Distance	285,069	18.255	28.565	0	756.758
Spectators	58,275	584.065	4100.245	1	81,365
H_PrevSeasonPos	334,148	7.413	4.314	1	21
H_PrevSeasonPts	334,148	38.164	17.189	-6	107
A_PrevSeasonPos	334,079	7.416	4.315	1	21
A_PrevSeasonPts	334,079	38.143	17.2	-6	107

Table 3 presents the key variables used to analyse differences in home advantage. The dependent variables are disaggregated by *DivisionLevel*. A clear pattern emerges: The average home win rate and the mean goal difference both increase as the division level decreases. At the same time, the proportion of draws declines. In practice, this means that matches in the lower leagues are less balanced: home teams not only win more often but also by larger margins, while draws, which usually signal evenly matched opponents, are much rarer. Compared to the professional divisions, several lower-tier divisions also show a descriptive increase in away wins. The observed level of home advantage in the professional divisions falls within an expected range, as reported in previous seasons or other studies, and does not represent an outlier in this context.

To test our hypotheses, we employ two different regression models. For our dependent variables *Home_Win*, *Draw*, and *Home_Points*, we apply binary logistic regression. The regression equation for a binary regression model is as follows:

$$P(Y = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k)}}.$$

Table 3. *Dependent Variables per Division Level*

DivisionLevel		Home_Win	Draw	Away_Win	ScoreDiff
1	Mean	0.437	0.264	0.297	0.395
	N	306	306	306	306
2	Mean	0.457	0.232	0.310	0.336
	N	306	306	306	306
3	Mean	0.454	0.265	0.280	0.346
	N	381	381	381	381
4	Mean	0.443	0.233	0.322	0.322
	N	1,530	1,530	1,530	1,530
5	Mean	0.466	0.194	0.338	0.346
	N	3,621	3,621	3,621	3,621
6	Mean	0.466	0.186	0.347	0.404
	N	9,354	9,354	9,354	9,350
7	Mean	0.475	0.174	0.350	0.420
	N	23,265	23,265	23,265	23,259
8	Mean	0.477	0.166	0.355	0.431
	N	54,002	54,002	54,002	53,969
9	Mean	0.485	0.154	0.360	0.456
	N	88,622	88,622	88,622	88,439
10	Mean	0.495	0.133	0.370	0.508
	N	103,268	103,268	103,268	102,907
11	Mean	0.499	0.123	0.376	0.518
	N	58,432	58,432	58,432	58,182
12	Mean	0.505	0.119	0.374	0.535
	N	13,521	13,521	13,521	13,360
13	Mean	0.508	0.127	0.363	0.651
	N	922	922	922	922
Total	Mean	0.488	0.146	0.364	0.475
	N	357,530	357,530	357,530	356,532

Y is the binary dependent variable (*Home_Win*, *Draw* or *Home_Points*), β_0 is the intercept, e is the base of the natural logarithm, $\beta_1, \beta_2, \ldots, \beta_k$ are the coefficients estimated by the logit model and $x_1, x_2, \ldots, x_k$ are the independent variables.

In the case of the linear regression with *ScoreDiff* as the dependent variable, the regression equation is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + \varepsilon_i$$

Y_i is the dependent variable (*ScoreDiff*), X_{ki} is the explanatory variable k for observation i, β represents the regression coefficients, and ε denotes the error term.

Empirical Results

Table 4 presents a series of regression models. In Model 1, the analysis tests whether the binary distinction between professional and amateur football influences the probability of a home win. This variable has a statistically significant effect, where 0 represents the amateur sector and 1 the professional divisions. Model 2 disaggregates this effect further by including dummy variables for individual division levels. Here, the coefficients show an increasing pattern from higher to lower divisions, showing that home advantage tends to increase as one moves further down the league pyramid. Most coefficients do not reach statistical significance in this basic specification.

Model 3 adds the control variables spectator attendance (*Spectators*) and travel distance (*Distance*), both of which are statistically significant. Their inclusion reinforces the division-specific effects already observed in the previous model. In Models 4 and 5, team strength is controlled for using two alternative indicators, league position (*PrevSeasonPos*) and points from the previous season (*PrevSeasonPts*). These models are only estimated for matches in which both teams competed in the same division during the prior season. Both control variables show highly significant effects, improve overall model fit, and confirm that the division-level effects on home advantage remain robust.

Table 5 presents results from subsample analyses, focusing on professional football in Models 1 and 2 and amateur football in Models 3 and 4. Models 1 and 3 include division level, travel distance, and spectator attendance as explanatory variables. In Models 2 and 4, additional control variables are added to account for team strength, thereby helping to identify the likely favourite. In Models 1 and 2, division level 4—commonly referred to as the Regionalliga—is assigned to the professional divisions. Due to the presence of promoted and relegated teams and the frequent inclusion of reserve teams from Bundesliga clubs, this division is often considered semi-professional. Division level continues to play a role here.

Table 4. *Binary Regression Home Win*

	(1)	(2)	(3)	(4)	(5)
	Home_Win	**Home_Win**	**Home_Win**	**Home_Win**	**Home_Win**
ProfessionalDummy	0.156*				
	(0.014)				
2.DivisionLevel		0.079	0.283	0.0463	0.0325
		(0.626)	(0.100)	(0.838)	(0.885)
3.DivisionLevel		0.065	0.664**	0.506	0.458
		(0.672)	(0.001)	(0.076)	(0.108)
4.DivisionLevel		0.023	0.956***	0.506	0.437
		(0.850)	(0.000)	(0.093)	(0.146)
5.DivisionLevel		0.116	1.056***	0.712*	0.632*
		(0.332)	(0.000)	(0.022)	(0.041)
6.DivisionLevel		0.115	1.058***	0.683*	0.596
		(0.325)	(0.000)	(0.028)	(0.054)
7.DivisionLevel		0.150	1.161***	0.794*	0.706*
		(0.197)	(0.000)	(0.011)	(0.023)
8.DivisionLevel		0.161	1.156***	0.798*	0.710*
		(0.163)	(0.000)	(0.011)	(0.023)
9.DivisionLevel		0.192	1.141***	0.668*	0.581
		(0.096)	(0.000)	(0.036)	(0.067)
10.DivisionLevel		0.233*	1.156***	0.766*	0.677*
		(0.043)	(0.000)	(0.016)	(0.033)
11.DivisionLevel		0.249*	0	0	0
		(0.031)	(.)	(.)	(.)
12.DivisionLevel		0.271*			
		(0.020)			
13.DivisionLevel		0.284*			
		(0.032)			
Distance_Level			0.000**	0.000	0.000
			(0.005)	(0.059)	(0.073)
Spectators			0.000***	0.000*	0.000
			(0.000)	(0.045)	(0.083)
H_PrevSeasonPos				-0.092***	
				(0.000)	
A_PrevSeasonPos				0.098***	
				(0.000)	
H_PrevSeasonPts					0.034***
					(0.000)
A_PrevSeasonPts					-0.034***
					(0.000)
Constant	-0.200**	-0.250*	-1.282***	-0.959**	-0.835**
	(0.002)	(0.030)	(0.000)	(0.003)	(0.009)
N	357530	357530	46075	23997	23997
R^2	0.000	0.000	0.000	0.037	0.041

*Note: p-values in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001; Home_Win = 1 for home win, 0 otherwise; (1) basic model only with professional dummy, (2) basic model with division levels, (3) includes controls, (4) includes PrevSeasonPos control, (5) includes PrevSeasonPts control.*

Table 5. *Binary Regression Home Win – Subsamples*

	(1)	(2)	(3)	(4)
	Home_Win	**Home_Win**	**Home_Win**	**Home_Win**
1.DivisionLevel	0	0		
	(.)	(.)		
2.DivisionLevel	0.279	0.106		
	(0.103)	(0.633)		
3.DivisionLevel	0.650**	0.642*		
	(0.002)	(0.021)		
4.DivisionLevel	0.833***	0.632*		
	(0.000)	(0.038)		
Distance	0.000	0.000	0.001***	0.001**
	(0.586)	(0.656)	(0.000)	(0.005)
Spectators	0.000***	0.000**	0.000***	0.000**
	(0.000)	(0.004)	(0.001)	(0.005)
H_ PrevSeasonPos		-0.014		-0.098***
		(0.287)		(0.000)
A_ PrevSeasonPos		0.046***		0.103***
		(0.001)		(0.000)
5.DivisionLevel			0	0
			(.)	(.)
6.DivisionLevel			0.059	0.043
			(0.322)	(0.602)
7.DivisionLevel			0.186**	0.184*
			(0.001)	(0.022)
8.DivisionLevel			0.197***	0.211*
			(0.001)	(0.011)
9.DivisionLevel			0.190**	0.088
			(0.007)	(0.376)
10.DivisionLevel			0.216**	0.202*
			(0.002)	(0.039)
11.DivisionLevel			0	0
			(.)	(.)
Constant	-1.084***	-1.226**	-0.369***	-0.424***
	(0.000)	(0.002)	(0.000)	(0.000)
N	1921	1171	44154	22826
R^2	0.007	0.015	0.000	0.040

*Note: p-values in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001; Home_Win = 1 for home win, 0 otherwise; (1) subsample professional divisions, (2) subsample professional divisions with further controls, (3) subsample amateur divisions, (4) subsample amateur divisions with further controls.*

Table 6 follows the same structure as Table 4, but instead of a binary logistic regression, it employs the goal difference as the dependent variable of a linear regression. Significant effects for division level are observed only in Model 3. Likewise,

the additional variables—travel distance, favourite identification (by previous season table position or points), and spectator attendance—also show significant effects exclusively in this model.

Table 6. *Linear Regression Score Difference*

	(1)	(2)	(3)	(4)	(5)
	ScoreDiff	**ScoreDiff**	**ScoreDiff**	**ScoreDiff**	**ScoreDiff**
ProfessionalDummy	0.117				
	(0.269)				
2.DivisionLevel		-0.058	0.188	-0.195	-0.225
		(0.828)	(0.401)	(0.474)	(0.406)
3.DivisionLevel		-0.049	0.678*	0.112	0.0338
		(0.849)	(0.011)	(0.743)	(0.921)
4.DivisionLevel		-0.072	1.064***	0.334	0.223
		(0.729)	(0.000)	(0.351)	(0.531)
5.DivisionLevel		-0.049	1.143***	0.464	0.349
		(0.805)	(0.000)	(0.207)	(0.339)
6.DivisionLevel		0.0088	1.259***	0.540	0.420
		(0.964)	(0.000)	(0.143)	(0.251)
7.DivisionLevel		0.025	1.315***	0.596	0.476
		(0.894)	(0.000)	(0.107)	(0.193)
8.DivisionLevel		0.036	1.338***	0.632	0.514
		(0.849)	(0.000)	(0.088)	(0.163)
9.DivisionLevel		0.061	1.269***	0.457	0.345
		(0.750)	(0.000)	(0.226)	(0.358)
10.DivisionLevel		0.113	1.240***	0.486	0.379
		(0.555)	(0.000)	(0.197)	(0.311)
11.DivisionLevel		0.123	-1.575	-2.198	-2.671
		(0.521)	(0.408)	(0.227)	(0.140)
12.DivisionLevel		0.140			
		(0.467)			
13.DivisionLevel		0.256			
		(0.244)			
Distance			0.001**	0.001*	0.001*
			(0.001)	(0.018)	(0.023)
Spectators			0.000***	0.000	0.000
			(0.000)	(0.262)	(0.434)
H_PrevSeasonPos				-0.147***	
				(0.000)	
A_PrevSeasonPos				0.151***	
				(0.000)	
H_PrevSeasonPts					0.053***
					(0.000)
A_PrevSeasonPts					-0.053***

					(0.000)
_cons	0.359***	0.395*	-0.941**	-0.255	-0.133
	(0.001)	(0.038)	(0.001)	(0.501)	(0.724)
N	356532	356532	46076	23999	23999
R^2	0.000	0.000	0.000	0.078	0.090

*Note: p-values in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001; ScoreDiff = H_Goals – A_Goals; (1) basic model only with professional dummy, (2) basic model with division levels, (3) includes controls, (4) includes PrevSeasonPos control, (5) includes PrevSeasonPts control.*

Table 7 provides a more detailed breakdown between professional and amateur football based on partial samples. Here, too, with a few exceptions, we observe stronger effects in the amateur leagues in Models 3 and 4, which underlines the greater relevance of the factors examined in the lower leagues. Models 1 and 2 cannot confirm this significantly. It is interesting to note that 11th Division Level appears to be an exception in terms of *ScoreDiff* in both Table 6 and 7.

Table 7. *Regression Score Difference – Subsamples*

	(1)	**(2)**	**(3)**	**(4)**
	ScoreDiff	**ScoreDiff**	**ScoreDiff**	**ScoreDiff**
1.DivisionLevel	0	0		
	(.)	(.)		
2.DivisionLevel	0.186	-0.077		
	(0.245)	(0.707)		
3.DivisionLevel	0.664***	0.414		
	(0.001)	(0.113)		
4.DivisionLevel	0.869***	0.596*		
	(0.000)	(0.035)		
Distance	0.000	0.000	0.002***	0.002***
	(0.554)	(0.668)	(0.000)	(0.000)
Spectators	0.000***	0.000**	0.000***	0.000**
	(0.000)	(0.001)	(0.000)	(0.003)
H_PrevSeasonPos		-0.020		-0.156***
		(0.123)		(0.000)
A_PrevSeasonPos		0.070***		0.158***
		(0.000)		(0.000)
5.DivisionLevel			0	0
			(.)	(.)
6.DivisionLevel			0.197*	0.170
			(0.015)	(0.096)
7.DivisionLevel			0.286***	0.266**
			(0.000)	(0.006)
8.DivisionLevel			0.333***	0.336***
			(0.000)	(0.001)
9.DivisionLevel			0.277**	0.173
			(0.003)	(0.149)

10.DivisionLevel			0.263**	0.221
			(0.004)	(0.061)
11.DivisionLevel			-2.555	-2.468
			(0.180)	(0.171)
Constant	-0.617**	-0.804*	0.000567	-0.020
	(0.006)	(0.026)	(0.995)	(0.865)
N	1921	1171	44155	22828
R^2	0.017	0.041	0.000	0.083

*Note: p-values in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001; ScoreDiff = H_Goals – A_Goals; (1) subsample professional divisions, (2) subsample professional divisions with further controls, (3) subsample amateur divisions, (4) subsample amateur divisions with further controls.*

Table 8. *Binary Regression Draw*

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	Draw	**Draw**	**Draw**	**Draw**	**Draw**
ProfessionalDummy	-0.689***				
	(0.000)				
2.DivisionLevel		-0.175	-0.258	-0.453	-0.452
		(0.350)	(0.185)	(0.083)	(0.084)
3.DivisionLevel		0.001	-0.251	-0.543	-0.543
		(0.991)	(0.272)	(0.092)	(0.092)
4.DivisionLevel		-0.168	-0.657**	-0.726*	-0.720*
		(0.240)	(0.008)	(0.032)	(0.033)
5.DivisionLevel		-0.396**	-0.809**	-0.864*	-0.857*
		(0.004)	(0.001)	(0.013)	(0.014)
6.DivisionLevel		-0.452***	-0.869***	-0.939**	-0.929**
		(0.001)	(0.001)	(0.007)	(0.008)
7.DivisionLevel		-0.529***	-1.021***	-1.088**	-1.076**
		(0.000)	(0.000)	(0.002)	(0.002)
8.DivisionLevel		-0.590***	-1.022***	-1.113**	-1.101**
		(0.000)	(0.000)	(0.002)	(0.002)
9.DivisionLevel		-0.681***	-1.026***	-1.098**	-1.086**
		(0.000)	(0.000)	(0.002)	(0.002)
10.DivisionLevel		-0.849***	-1.303***	-1.316***	-1.303***
		(0.000)	(0.000)	(0.000)	(0.000)
11.DivisionLevel		-0.942***	0	0	0
		(0.000)	(.)	(.)	(.)
12.DivisionLevel		-0.972***			
		(0.000)			
13.DivisionLevel		-0.897***			
		(0.000)			
Distance			-0.000	-0.000	-0.000
			(0.059)	(0.322)	(0.332)
Spectators			-0.000	-0.000	-0.000

			(0.083)	(0.075)	(0.078)
H_PrevSeasonPos				0.011*	
				(0.015)	
A_PrevSeasonPos				-0.013**	
				(0.003)	
H_PrevSeasonPts					-0.003**
					(0.007)
A_PrevSeasonPts					0.004**
					(0.004)
Constant	-1.073***	-1.022***	-0.497	-0.407	-0.446
	(0.000)	(0.000)	(0.051)	(0.260)	(0.218)
N	357530	357530	46075	23997	23997
R^2	0.000	0.003	0.002	0.002	0.002

*Note: p-values in parentheses; * p < 0.05, ** p < 0.01, *** p < 0.001; Draw = 1 for draw, 0 otherwise; (1) basic model only with professional dummy, (2) basic model with division levels, (3) includes controls, (4) includes PrevSeasonPos control, (5) includes PrevSeasonPts control.*

Table 8 follows the same structure as Tables 4 and 6 and uses the binary variable *Draw* as the dependent variable. This serves, alongside *ScoreDiff*, as a proxy for the competitive balance within the respective divisions. The analysis reveals significant effects for division level, suggesting systematic differences in match outcomes across the division hierarchy. However, no significant effects are observed for spectator attendance or travel distance, indicating that these factors do not appear to influence the likelihood of a draw in this context. The broader picture is nonetheless clear: draws are systematically less likely in lower divisions. This signals reduced competitive balance: rather than producing evenly matched contests, amateur football more often delivers decisive outcomes, typically in favour of the home team.

As additional robustness tests, we conducted subsample analyses based on Table 8, as well as estimations using the binary variable *Home_Points* (indicating whether the home team earned at least one point) and separate estimations for *Away_Win*. Using Home_Points and Away_Win as alternative dependent variables yields the same pattern: amateur clubs gain disproportionately at home. These tests confirmed the effects identified in the main models. This underlines that the main findings are not model-specific but reflect a systematic structural difference.

Discussion

In the following section, we discuss the implications of our hypotheses before addressing the limitations of our study and outlining directions for future research.

H1: Home advantage *is more pronounced at lower division levels.*

While Model 1 in Table 4 suggests that home advantage is generally higher in professional leagues than in amateur football, the more detailed analysis of individual divisions reveals that home advantage intensifies with decreasing division level within

the amateur hierarchy. This finding may result from both the oversimplified binary classification in Model 1 and fundamental differences between professional and amateur football, such as distinct fan behavior patterns across these levels. Despite this initial result, Models 2-5 of Table 4 and all specifications in Table 5 support our hypothesis, showing statistically significant effects where division-specific effects and appropriate controls reveal the expected hierarchical pattern with *Home_Win* as the dependent variable. When using goal difference as an alternative indicator for home wins (Table 6), we observe corresponding effects, but these are only significant in Model 3. In contrast, the alternative proxy *Home_Points* confirms the expected pattern across robustness tests. Additionally, goal difference regains significance in the subsample models presented in Table 7. Overall, the increase in home advantage appears to be driven primarily by a decline in draws. While the number of away wins, and therefore overall wins, increases slightly as well, the rise in home wins is more substantial. Across almost all models, we find robust evidence that home advantage intensifies in lower divisions.

H2: Matches in higher division levels are more balanced.

This hypothesis is primarily supported by the results in Table 8, which displays the number of draws per division level. With minor exceptions, the number of draws decreases as division level decreases, lending support to the hypothesis. However, the second indicator for competitive balance, namely goal difference, does not show statistically significant effects in all models. While trends in the data point in the expected direction, the results are not consistently significant across all specifications.

H3: Travel distance has a stronger impact on match outcomes in amateur divisions than in professional divisions.

To evaluate this hypothesis, we examine the variable *Distance* (in km) across all models. In most cases, it shows a statistically significant effect, particularly in the subsample analyses of amateur football shown in Tables 5 and 7. This supports the assumption that travel distance plays a more important role in amateur football, likely due to limited infrastructure and fewer resources. Furthermore, longer distances may amplify home advantage in lower divisions as fewer away fans are willing to undertake extensive travel, thereby reducing the support for the visiting team and strengthening the home atmosphere.

Taken together, the results provide compelling evidence that the degree of professionalisation in football is a central explanatory factor for the extent of home advantage. Within amateur football, home advantage intensifies progressively as the level of professionalisation decreases. While in the top divisions improved travel logistics, standardised match conditions, balanced squad quality, professional support structures, and technological tools help mitigate home advantage, a markedly different picture emerges in amateur football: Here, conditions are more heterogeneous, infrastructural resources are more limited, and teams often operate with significant constraints.

These differences are reflected in the empirical findings: Home advantage is not only more pronounced at lower division levels, but can also be attributed to lower

competitive balance and a greater influence of external factors such as travel distance. Particularly noteworthy is the significant decline in the number of draws in the lower divisions—an indicator of reduced competitive parity as evenly matched teams would theoretically produce more draws and closer margins of victory—accompanied by a noticeable increase in home wins and, to a lesser extent, away wins. Moreover, amateur divisions show stronger effects of travel distance on match outcomes, suggesting that logistical constraints, longer travel times, and a lack of recovery infrastructure play a meaningful role in shaping performance.

Overall, the findings clearly show that home advantage varies systematically across division levels. Most notably, the amateur sector exhibits a clear pattern of progressively intensifying home advantage as division level decreases, driven by structural disparities between home and away teams that compound at lower levels. This study thus provides a valuable contribution to understanding the conditions under which home advantage in football intensifies or diminishes, and highlights the importance of a differentiated perspective based on competition level and organisational context.

Beyond our core hypotheses, the study also highlights the relevant influence of spectators on home advantage. For players and coaches, the findings suggest that a higher degree of professionalisation can help mitigate existing biases or systematic advantages. However, several limitations must be acknowledged. First, travel distances are measured as straight-line kilometres between postal codes, which may under- or overestimate actual burdens. Second, the inclusion of control variables is constrained by data availability. Not all control variables are available across all division levels, and established variables such as betting odds—commonly used in professional settings—are not accessible for the amateur sector. As a result, certain relevant information is missing from the dataset, which limits the precision of the analysis. Third, the scope of the study is limited to German football leagues and a single season. Future research should expand the temporal dimension and aim to build a broader dataset that includes leagues from other countries and even across different sports. In addition, future studies should systematically incorporate the degree of professionalisation of each division as a structural variable in empirical models.

Conclusion

This study provides comprehensive evidence that the extent of home advantage in football is closely linked to the degree of professionalisation within a league. By analysing over 350,000 matches across 13 hierarchical levels in German men's football, the findings confirm that home advantage is not a uniform phenomenon, but one that varies systematically along the structural gradient of the sport.

In lower, amateur-level leagues, where clubs often operate under less standardised conditions and with limited resources, home teams benefit disproportionately from environmental familiarity, crowd support, and logistical asymmetries. The data show a clear decrease in the number of draws and a relative increase in home wins, suggesting a lower level of competitive balance. Additionally, travel distance plays a statistically significant role in determining match outcomes in these leagues – a factor that appears largely irrelevant at the professional level due to better infrastructure, transportation, and

preparation. By contrast, top-tier leagues with higher degrees of professionalisation exhibit more balanced competition.

These findings have important implications for sports governance and future research. They suggest that behavioural phenomena like home advantage cannot be fully understood without accounting for the structural and organisational context in which matches are played. Moreover, they call for greater attention to the unique challenges of amateur football when designing policies aimed at improving fairness and integrity in competition.

The study highlights the value of large-scale, data-driven approaches for uncovering nuanced dynamics in sport and contributes to a more differentiated understanding of performance determinants across football's diverse competitive landscape.

Literature

Albert J, Koning RH (eds.) (2007) *Statistical thinking in sports*. Chapman & Hall/CRC, Boca Raton, FL.

Almeida CH, Volossovitch A (2017) Home advantage in Portuguese football: Effects of level of competition and mid-term trends. *International Journal of Performance Analysis in Sport*, 17(3), 244–255. https://doi.org/10.1080/24748668.2017.1339256

Armatas V, Pollard R (2014) Home advantage in Greek football. *European Journal of Sport Science*, 14(2), 116–122. https://doi.org/10.1080/17461391.2012.686062

Biermann C (2011) *Die Fußball-Matrix: Auf der Suche nach dem perfekten Spiel*. Kiepenheuer & Witsch, Cologne.

Boyko RH, Boyko AR, Boyko MG (2007) Referee bias contributes to home advantage in English Premiership football. *Journal of Sports Sciences*, 25(11), 1185–1194. https://doi.org/10.1080/02640410601038576

Clarke SR, Norman JM (1995) Home advantage of individual clubs in English soccer. *The Statistician*, 44(4), 509–521. https://doi.org/10.2307/2348894

Colella F, Dalton PS, Giusti G (2021) *All you need is love: The effect of moral support on performance*. CentER Discussion Paper 2021-005, Center for Economic Research, Tilburg.

Courneya KS, Carron AV (1992) The home advantage in sport competitions: A literature review. *Journal of Sport and Exercise Psychology*, 14(1), 13–27. https://doi.org/10.1123/jsep.14.1.13

Cueva C (2020) *Animal spirits in a beautiful game: Testing social pressure in professional football during the COVID-19 lockdown*. https://osf.io/download/5f5b5a452c735500aeea1e5f/

Currea J (2021) *Effect of COVID-19 in the 2020 MLB playoffs*. University of Texas at Tyler Lyceum Poster Presentations. https://scholarworks.uttyler.edu/lyceum2021/event/posterpresentations_undergrad/57

Dilger A, Vischer L (2022) No home bias in ghost games. *Athens Journal of Sports*, 9(1), 9–24. https://doi.org/10.30958/ajs.9-1-1

Dilger A, Vischer L (2024) Change in home bias due to ghost games in the NFL. *Journal of Economics and Statistics*, 244(5–6), 585–604. https://doi.org/10.1515/jbnst-2023-0097

Fischer K, Haucap J (2021) Does crowd support drive the home advantage in professional football? Evidence from German ghost games during the COVID-19 pandemic. *Journal of Sports Economics*, 22(8), 982–1008. https://doi.org/10.1177/15270025211019855

Koning RH (2011) Home advantage in professional tennis. Journal of Sports Sciences, 29(1), 19–27. https://doi.org/10.1080/02640414.2010.516762

Loughhead T, Carron AV, Bray SR, Kim AJ (2003) Facility familiarity and the home advantage in professional sports. *International Journal of Sports and Exercise Psychology*, 1(3), 264–274. https://doi.org/10.1080/1612197X.2003.9671719

Palacios-Huerta I (2004) Structural changes during a century of the world's most popular sport. *Statistical Methods and Applications*, 13(2), 241–258. https://doi.org/10.1007/ s10260-004-0094-6

Pollard R (2006) Worldwide regional variations in home advantage in association football. *Journal of Sports Sciences*, 24(3), 231–240. https://doi.org/10.1080/02640410500141836

Pollard R, Armatas V (2017) Factors affecting home advantage in football World Cup qualification. *International Journal of Performance Analysis in Sport*, 17(1–2), 121–135. https://doi.org/10.1080/24748668.2017.1303950

Pollard R, Pollard G (2005) Long-term trends in home advantage in professional team sports in North America and England (1876–2003). *Journal of Sports Sciences*, 23(4), 337–350. https://doi.org/10.1080/02640410400021559

Price M, Yan J (2022) The effects of the NBA COVID bubble on the NBA playoffs: A case study for home-court advantage. A*merican Journal of Undergraduate Research,* 18(4), 3–14.

Reade J, Schreyer D, Singleton C (2022) Eliminating supportive crowds reduces referee bias. *Economic Inquiry*, 60(3), 1416–1436. https://doi.org/10.1111/ecin.13088

Schwartz B, Barsky SF (1977) The home advantage. *Social Forces*, 55(3), 641–661. https:// doi.org/10.2307/2577461

Scoppa V (2021) Social pressure in the stadiums: Do agents change behavior without crowd support? *Journal of Economic Psychology*, 82, 102344. https://doi.org/10.1016/j.joep. 2020.102344

Sors F, Grassi M, Agostini T, Murgia M (2021) The sound of silence in association football: Home advantage and referee bias decrease in matches played without spectators. *European Journal of Sport Science,* 21(12), 1597–1605. https://doi.org/10.1080/1746 1391.2020.1845814

Starke S, Vischer L, Dilger A (2024) Change in home bias due to ghost games in the NFL. *Jahrbücher für Nationalökonomie und Statistik*, 244(5–6), 585–604. https://doi.org/ 10.1515/jbnst-2023-0097

Strauß B, Höfer E (2001) *The home advantage in team sports*. In Papaioammou A, Goudas M, Theodorakis Y (eds) Proceedings of the 10th World Congress of Sport Psychology, Vol. 4, Christodoulidi Publications, Thessaloniki, 210–212.

Strauß B, MacMahon C (2019) *Heimvorteil*. In Güllich A, Krüger M (eds) Sport in Kultur und Gesellschaft. Springer, Berlin, Heidelberg, 1–14.

Sutter M, Kocher M (2004) Favoritism of agents: The case of referees' home bias. *Journal of Economic Psychology*, 25(4), 461–469. https://doi.org/10.1016/S0167-4870(03)00013-8

Vergin RC, Sosik JJ (1999) No place like home: An examination of the home field advantage in gambling strategies in NFL football. *Journal of Economics and Business*, 51(1), 21–31. https://doi.org/10.1016/S0148-6195(98)00025-3

Wallace HM, Baumeister RF, Vohs KD (2005) Audience support and choking under pressure: A home disadvantage. *Journal of Sports Sciences*, 23(4), 429–438. https://doi.org/10.1080/ 02640410400021666

Wunderlich F, Weigelt M, Rein R, Memmert D (2021) How does spectator presence affect football? Home advantage remains in European top-class football matches played without spectators during the COVID-19 pandemic. *PLOS ONE*, 16, e0248590. https://doi.org/ 10.1371/journal.pone.0248590