

# Characteristics of transplant athletes competing at national and international transplant games

Thomas Hames, Sheila Leddington-Wright, Charles Douglas Thake, Mike Price 

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## ABSTRACT

**Objective** To describe the characteristics of athletes with solid-organ transplants (TxA) attending the British and World Transplant Games.

**Methods** 220 TxA completed an online survey to explore transplant history, medications, training advice and support and limitations to training.

**Results** TxA were predominantly caucasian, male, kidney recipients in their mid-forties and approximately 11 years post-transplant. The majority of TxA took some form of medication (immunosuppressants 88%, steroids 47%, antihypertensives 47%, statins 28%, antiplatelets 26%, antibiotics/antivirals/antifungals 20%). Stem cell recipients were least likely to require medication. Post-transplant complications were experienced by 40% of TxA, with 53% of these being rejection. Although over half the participants (57%) initially received exercise or training advice post-transplant, only 34% of these received this from their consultants or immediate medical team. Only 1% had been specifically directed towards transplant sport. Half of the TxA (53%) perceived there were limitations preventing them from performing at their potential, 45% considered they did not recover from training as well as non-TxA while 29% felt they trained equally to non-Tx's. Only 6% considered medication impaired training. TxA competed for a range of reasons from social and health benefits to winning medals.

**Conclusions** TxA compete at the British and World Transplant Games for a diverse range of reasons. Athletes manage a range of medications with a range of exercise and health experiences pre-transplant. TxA face a lack of both general and specific exercise training and recovery guidance. The individuality of each TxA's background should be considered and is likely reflected in their exercise capacity and goals.

## INTRODUCTION

Determining the characteristics of athletic populations enables optimisation of training and performance.<sup>1–3</sup> For coaches and other members of the support team in daily contact with athletes, knowledge of their specific requirements is essential.<sup>4</sup> Some athlete groups though (eg, asthma, diabetes, disability) present the support team with an additional challenge of managing medical conditions and medication around daily

## Key messages

### What is already known on this topic

- Athletes with solid-organ transplants (TxA) demonstrate reduced physiological responses to exercise.
- Reduced peak oxygen uptake results from chronic reductions in muscle mass and muscle quality prior to surgery.
- Post-transplant, physiological responses may not recover due to immunosuppressant drug interactions.
- Competitors in transplant events are reported to be predominantly male kidney recipients between 42 and 46 years of age, managing comorbidities and concurrent medications. The characteristics and needs of TxA has received little attention.

### What this study adds

- The majority of TxA manage multiple medications, often being specific to their transplant type.
- Many competitors attend the Games for the health-related benefits and fitness, competing for enjoyment, with a smaller proportion competing to win.
- Few competitors follow any structured training advice from exercise professionals.
- Each TxA's journey differs with respect to transplant type and exercise experience which is likely reflected in their exercise capacity and goals.

### How this study might affect research, practice or policy

- There is a need to understand current TxA training practices and develop appropriate high performance, sport-specific training guidance post-transplant for those recipients wishing to compete.
- Practitioners should be aware that a TxA desire to compete is multifaceted and often beyond that of athletic competition alone. Each competitor has a unique background to consider.

training and competitions. A group of athletes facing considerable medication challenges are athletes with solid-organ transplants. Transplant recipients also demonstrate reduced physiological responses to exercise, such as peak oxygen uptake ( $VO_{2peak}$ ). Post-transplant, reduced  $VO_{2peak}$  may be a result of chronotropic incompetence in an otherwise well-functioning allograft, such as for heart recipients or allograft dysfunction. However,



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Health and Life Sciences, Coventry University, Coventry, UK

### Correspondence to

Dr Mike Price;  
mike.price@coventry.ac.uk



key contributors to reduced  $VO_{2peak}$  are chronic reductions in muscle mass and muscle quality prior to surgery that may not recover post-transplant due to immunosuppressant drug interactions.<sup>5</sup> Although position stands relating to athletes with asthma<sup>6</sup> and diabetes<sup>7</sup> exist, the characteristics and needs of athletes with solid-organ transplants (TxA) has received little attention.

Since the inaugural Transplant Games in 1978 participant numbers have grown from 99 competitors representing five countries to 1500 competitors representing 69 countries at the 2017 World Transplant Games in Malaga.<sup>8</sup> Despite this increase in participation, there is limited empirical data regarding demographics, physical characteristics and medication regimes of TxA attending the Games. Existing data suggests participants at Transplant Games have predominantly been male kidney recipients with a mean age of 42–46 years<sup>9–13</sup> Data from the 1996 US Transplant Games<sup>9</sup> and 2012 Latin American Transplant Games<sup>13</sup> reported a high proportion (52%) of competitors managing one or more comorbid conditions while a small proportion (7%) experienced graft rejection within the 12 months prior to competition. Competitors at these events managed concurrent medications with continuous immunosuppressant management evident among nearly all TxA. In addition to medications, TxA differ from other athlete groups as they compete with respect to age across a range of events. As such, typical training guidelines are unlikely able to cater for the wider age range of TxA's. Furthermore, the specific journey of each transplant recipient differs considerably.<sup>14</sup> To our knowledge, no study examining TxA has concurrently reported the training advice received, perceptions of training and performance limitations alongside generic transplant information which has the potential to support both transplant recipients and practitioners presurgery and postsurgery. The aim of this study was to determine the characteristics of TxA attending the British and World Transplant Games.

## METHOD

### Participants

A survey-based study was completed by 220 English speaking TxA's (male: 139, female: 81). Gatekeeper consent for national and international standard athletes was provided from the World Transplant Games Federation, Transplant Sport UK and national team managers as part of the institutional ethics process. The questionnaire was advertised on the World Transplant Games Federation and Transplant Sport UK websites. The survey was open for ~10 weeks from 12 June 2017 to 1 September 2017. No reminders to complete the survey were posted. Participants provided individual consent which was built into the questionnaire. Inclusion criterion was successful entry into the 2017 British or World Transplant Games which, in doing so, confirmed the TxA had met the required conditions for competition, that is, having received one or more life supporting allografts (kidney, liver, heart, stem cell, lung, pancreas, intestine), be more

than 6 months post-transplant and with a stable allograft and medically fit as signed off by their doctor.<sup>8</sup>

### Survey procedure

A 63-question survey was developed to explore training practices, recovery postexercise, training advice and support undertaken and experienced by TxA and is fully available as online supplemental appendix 1. Questions relating to TxA characteristics (sex, age, height, body mass (enabling body mass index calculation; BMI, mass/height<sup>2</sup>; kg/m<sup>2</sup>), nationality and ethnicity), transplant history (initial reason for transplant and age at transplant), medications, complications, source of exercise/training advice and reasons for attending Tx Games are reported here.

Participants completed the survey on the Bristol Online Survey platform using a web link available through the World Transplant Games Federation web page and consenting national team web pages. Further recruitment occurred through word of mouth at both the British Transplant Games (Glasgow; 27 July 2017–30 July 2017) and the World Transplant Games (Malaga; 24 June 2017–30 June 2017). The survey was piloted using transplant athletes (n=4) to assess clarity and practicality of completion. Feedback from the pilot study indicated the survey allowed participants to reflect on their journey from illness to athlete and what they have been able to achieve through physical training. Furthermore, participants indicated they were happy to answer all questions, taking between 15 and 20 min to complete.

### Statistical analysis

Survey analysis was predominantly descriptive in nature with frequency distributions for the whole group and for males and females, type of transplant, etc as appropriate reported. Normality was determined using the Kolmogorov-Smirnov test prior to independent t-tests and two-way analysis of variance for the comparisons between subgroups for sex, age, height, body mass and BMI.

### Patient and public involvement

Athletes with solid organ transplants were involved in piloting the questionnaire and will be involved in the dissemination plans of this research.

## RESULTS

### Participant characteristics

The overall ratio of male:female TxA was 63:37%. Within the five largest subgroups based on transplant type liver recipients had fewer males whereas stem cell and lung recipients had more males (table 1). With the exception of lung recipients, where males and females were of similar mass (p=0.686), males were generally heavier than females (p=0.006). BMI was comparable across the five largest sub-groups. Mean age of TxA was similar across the majority of subgroups with similarly large age ranges across groups. Time since transplant was also

**Table 1** Characteristics of competitors attending the British and World Transplant Games (n=220)

			Transplant type								
			All	Kidney	Liver	Heart	Stem cell	Lung	Heart & Lung	Kidney & Pancreas	Pancreas
N			220	95	50	35	21	11	4	3	1
Sex	Male	n	139	61	27	23	16	9	1	2	–
	Female	n	81	34	23	12	5	2	3	1	1
Age (years)	All	Mean (±SD)	45±15	42±15	47±17	48±13	51±17	42±16	40±7	40±3	53
		Range	77	63	63	50	75	52	18	6	–
	Male	Mean (±SD)	45±16	43±15	49±20	45±13	52±18	43±18	39	39±4	–
		Range	77	63	63	49	75	52	0	6	–
	Female	Mean (±SD)	44±14	42±15	44±13	52±12	48±15	38±4	41±9	42	53
		Range	53	53	40	41	33	15	18	–	–
Mass (kg)	All	Mean (±SD)	73±16	73±15	73±16	76±17	75±16	68±13	59±11	88±22	52
		Range	103	102	71	63	52	48	24	43	–
	Male	Mean (±SD)	78±15	78±14	80±16	82±15	79±16	68±15	57	99±13	–
		Range	97	93	65	56	52	48	–	18	–
	Female	Mean (±SD)	64±12	64±14	65±11	65±15	62±5	65±6	60±13	65	52
		Range	63	62	40	46	13	8	24	–	–
Height (cm)	All	Mean (±SD)	172±11	171±10	172±11	176±10	177±12	173±6	162±7	165±12	158
		Range	54	50	56	35	45	20	16	23	–
	Male	Mean (±SD)	177±9	175±8	178±10	181±7	181±10	174±6	151	172±3	–
		Range	55	38	48	23	31	18	–	4	–
	Female	Mean (±SD)	164±8	164±10	165±7	166±8	164±8	169±5	165±2	151	158
		Range	35	41	25	27	18	7	4	–	–
BMI (kg. m2)	All	Mean (±SD)	24.5±4.1	24.9±4.4	24.6±4.4	24.3±4.3	23.4±2.5	22.3±3.5	22.8±3.9	32±3.6	21
		Range	25	24	18	16	9	12	8	7	–
	Male	Mean (±SD)	24.9±3.9	25.6±3.8	25.1±4.5	24.9±3.5	23.5±2.9	22.3±3.9	25	33.5±3.5	–
		Range	23	22	16	11	9	12	–	5	–
	Female	Mean (±SD)	23.7±4.0	23.8±3.8	24±4.2	23±5.8	23±1	22.5±0.7	22±4.4	29	21
		Range	19	18	18	16	2	1	8	–	–

Grouped according to transplant subgroup, as per British Transplant Games and World Transplant Games competitions. BMI, body mass index.

similar across transplant type. The majority of participants (57%) acquired a chronic illness in adulthood resulting in organ transplantation with smaller frequencies for those undergoing transplant as a child (19%), children reaching adulthood prior to transplant (16%) and adults with a sudden onset of illness leading to transplant (9%). Athletes were predominantly white caucasian when considered as the whole group, UK and non-UK countries (90, 95, 83%, respectively). All other ethnic groups represented less than 5% of both UK and non-UK participants.

### Medications and complications

TxA took an average of 5±3 medications each week and were advised to take daily vitamins or minerals (see online supplemental information). The greatest number of weekly medications was reported by lung recipients

(8±4), whereas stem cell recipients managed the least (2±2), 43% (n=9) of whom took no medication. One or more immunosuppressants were managed by 88% of TxA, of which, the most frequent users were heart recipients (100%), while stem cell recipients were least frequent users (10%). Steroid medication was managed by 47% of TxA of which lung recipients managed the most (82%) and liver recipients managed the least (26%). Antihypertensive management (47%) was apparent in all Tx subgroups, heart recipients managed the most (69%) whereas stem cell recipients managed the least (10%). Statin and antiplatelet medications were managed by 28% and 26% of TxA, respectively, predominantly by heart recipients (80%, 37%, respectively) and least frequently by stem cell recipients (0%, 5%, respectively), with no lung recipients taking antiplatelets. Antibiotics/antiviral/

**Table 2** Prevalence of complications within competitive transplant recipients and the five most common subgroups since transplant

	Total	Kidney	Liver	Heart	Stem cell	Lung
No of complications	88/220	37/95	23/50	12/35	8/21	7/11
(Percentage within transplant group)	40	39	46	34	38	64
Rejection, minor rejection (%)	53	51	65	67	13	43
Cancer/lymphoproliferative disease (%)	6	3	4	–	13	29
Other organ damage (%)	10	16	9	–	13	14
Anaemia (%)	2	3	–	8	–	–
Infection (%)	10	11	9	17	–	14
Graft versus host disease (%)	5	–	–	–	50	–
Other (%)	13	16	13	8	13	–

antifungal medication use was reported in 20% of TxA and was observed across all Tx subgroups (eg, lung recipients 90%, kidney recipients 9%). Complications post-Tx were experienced by 40% (n=88) of TxA (table 2). Organ rejection whether minor or complete accounted for 53% of all complications and, while prevalent within all Tx subgroups, rejection complications were greatest among heart recipients accounting for 67% of all complications. Infection and associated organ damage were both experienced by 10% of TxA experiencing complications. Graft versus host disease was experienced among 50% of stem cell recipients.

### Exercise advice

Post-transplant 57% of TxA received training guidance or advice from sources such as; consultant/medical support team (34%), supporting therapists (8%), coach (4%), family and friends (4%), another recipient (2%) or other (5%). When given, training advice consisted of; encouraging physical activity and given some form of criteria (25%), directed towards therapy classes (23%), told to take it gentle and slow but nonspecific (8%). A small proportion of TxA were unclear on what had been advised (3%), whereas only 1% were encouraged to explore the Tx Games.

### Performance limitations

Over half the participants (53%) perceived that there was an existing limitation preventing them from performing at their true potential. Of these, current injury or illness (23%), lack of fitness/strength (18%), fear of overdoing it and lack of motivation (13%), finance and time limitations (10%), medication (8%), a lack of understanding from coaches and supporting networks (8%) were reported. However, 43% of participants (n=96) were actively trying to improve on these factors by increasing levels of activity (37%), seeking further advice from Sports Therapists and Physiotherapists (13%) and factoring in more time to train (6%). Some TxA though believed nothing would change in relation to their current limitations (17%).

### Perceived training intensity

When asked to compare their ability to train to that of an event matched non-TxA 29% felt they trained equally, 21% felt they could train the same for 75% of the time, 19% could train the same 50% of the time, whereas 16% reduced the intensity of their training session from the start of the session. The greatest training adjustments were reported by heart recipients with 37% modifying their sessions from the start and 23% adjusting up to 50% of a training session. When considering the recovery between sessions on back-to-back training day's 55% of all TxA believed they recovered equally to an event matched non-TxA whereas over half (52%) of heart recipients believed their recovery was impaired. For the whole group, 14% believed chronic fatigue impaired recovery, being greatest for the heart-recipients (26%) and least for the lung recipients (9%). Although only 6% of the whole group believed medication impeded their recovery, this was greatest among heart recipients (14%) with no stem cell or lung recipients reporting this.

### Participation reasons

When exploring reasons why TxA participated at various Transplant Games 65% wanted to improve their fitness, 62% attended to be part of the Tx community, 61% competed for fun, 60% participated to encourage a healthier lifestyle, 31% aimed to win international events, 27% aimed to win national events, 20% attended to compete at events they competed in prior to transplant, 16% to compete at new events and 12% attended to break records.

### DISCUSSION

To our knowledge, this is the first study to report the characteristics of TxA's attending the British and World Transplant Games. The main findings were that TxA were generally caucasian, male, kidney recipients in their mid-forties approximately 11 years post-transplant. Stem cell recipients were potentially the only TxA not commonly requiring medication, otherwise, all TxA took some form of medication. A high proportion of all TxA experienced complications post-transplant. Just over half the

participants had received guidance or advice on exercise or training post-transplant, with only 1% being directed towards the Transplant Games or Transplant Sport. A high proportion of TxA perceived there were limitations preventing them from performing at their potential, yet 29% felt they trained equally to non-TxA's. The majority participated at the Transplant Games to improve their fitness and be part of the transplant community. Only a small proportion attended to win titles and break records.

### Participant characteristics

The age, male:female ratio and BMI of the current study are similar to previous reports of TxA.<sup>9,10</sup> Competitors are generally older than expected for non-transplant athletes at international competitions (ie, ~23–28 years)<sup>15,16</sup> as a large proportion of the TxA received their transplant during adulthood subsequent to chronic illness as a child. Furthermore, transplant sport involves competing in age categories up to 70+ years,<sup>8</sup> thus, many older competitors exist than would be expected for non-transplant sport.

### Medications and complications

While medications play a vital role in maintaining a healthy lifestyle and transplant homeostasis, they also carry associated risks. For example, immunosuppressants (eg, tacrolimus or ciclosporin) can increase the risk of infections, for which approximately 20% of TxA in the current study were prescribed antibiotics. Long-term side effects of immunosuppressants include kidney disease, high blood pressure and cholesterol, diabetes, osteoporosis and the risk of certain cancers,<sup>17</sup> which may require further medical intervention. Steroids (eg, prednisone) also carry potential side effects including hypertension, hypercholesterolaemia, high blood glucose, weight gain and anxiety.<sup>12</sup> In comparison to other transplant types, stem cell recipients took the fewest medications. Practitioners working with TxA should be aware of the specific type of transplant and the likely medications taken as well as their effects on exercise—as has been noted for commonly prescribed medications.<sup>18</sup> However, the specific effects of typical transplant related medications on exercise responses are generally unreported as the focus of many such medications are, understandably, to offset allograft rejection. Physical activity and exercise though can play a pivotal role in negating common side effects improving health-related quality of life compared with sedentary transplant recipients<sup>19,20</sup> and comparable to the general population.<sup>21</sup> Indeed, BMI of the current participants was below values associated with graft dysfunction and poor survival (ie, <25 kg/m<sup>2</sup>,<sup>22</sup> <30 kg/m<sup>2</sup><sup>23</sup>). Complications though were experienced by the TxA being predominantly minor or major allograft rejection, which remains the greatest barrier to successful transplantation.<sup>24</sup> Previous research of TxA at the 1996 US Transplant Games reported a greater prevalence of TxA competing with one or more underlying comorbid conditions than this study (79% vs 40%, respectively).<sup>9</sup> Thus, managing complications or comorbid conditions

post-Tx is not regarded as uncommon, for which exercise practitioners should be aware.

### Exercise advice

Although it was encouraging that 57% of TxA were given exercise and training advice post-transplant this generally referred to low intensity exercise for health and 'not to overdo it'. Plausible reasons are most likely related to post-transplant immunosuppressant doses being at their highest during the first 3 months as the risk of acute rejection and allograft loss is also highest.<sup>25</sup> Subsequent tapering of doses means organ recipients are then at an increased risk of community-acquired infection.<sup>26</sup> The acute effects of exercise on immune function depression observed in non-transplant populations<sup>27</sup> could further potentially contribute to increased infection risk. Most of the scientific evidence in support of regular exercise for transplant recipients was published in the last ten years, thus, initial advice given to the current study's participants (~11 years prior) could justifiably have been conservative. The lack of published evidenced based practice for TxA within physiotherapy and sports therapy<sup>28</sup> also appears to exist for exercise and training advice.

### Performance limitations

Over half of the TxA (53%) perceived there to be an existing limitation to their performance, the most frequent responses relating to injury or illness and lack of fitness. Although this study did not assess the specific nature of injuries, it is important to recognise that in non-transplant recipient runners, injuries such as stress fractures accounts for ~69% of all overload injuries.<sup>29</sup> Chronic immunosuppressant and glucocorticoid use by transplant recipients increases the potential for osteoporosis and fractures whether involved in sport or not.<sup>30,31</sup> For example, research assessing injury 8 years post-transplant reported fracture incidence as high as 46% in liver transplant recipients.<sup>32</sup> Predisposing risk factors for injury include age, BMI, health, physical fitness, skill level,<sup>33</sup> excessive loading, insufficient recovery and underpreparedness.<sup>34</sup> A large number of TxA could therefore be at an accentuated risk of injury.

Although less than one-third of TxA considered they could train at a similar intensity as non-transplant recipient athletes, over half felt they recovered as well. The latter maybe a factor of reduced training intensity undertaken or a result of those competitors who were able to train at greater intensity also being those reporting good recovery. Interestingly, over half of the heart-recipients reported recovery was impaired with the majority of athletes reporting recovery being impeded by chronic fatigue also being heart-recipients. It is therefore possible that the heart-recipients may be more physiologically limited dependent on, among other factors, the number of medications taken and the magnitude of sympathetic nervous system re-innervation potentially affecting cardiovascular responses. Transplant athletes as a group, however, may not fully understand their own limitations.



Future studies should assess the physiological responses to exercise and recovery in TxA to enable more specific exercise and training advice to be provided.

### Participation reasons

Although the physiological benefits of exercise for organ recipients have been reported,<sup>19–21</sup> many other reasons exist for exercise participation including; psychological, environmental, behavioural, social and cultural factors.<sup>35</sup> Within the current population four main reasons for competing were reported, two of which were indeed related to physiological aspects; to improve fitness and encourage a healthier lifestyle. The third reason reported was to compete for fun. For a group of non-transplant participants who were younger (18–25 years) but similar to the current population in terms of ethnicity (80% white) and BMI, men exercised for enjoyment more so than women who exercised for weight related reasons,<sup>36</sup> a finding that has recently been observed for TxA.<sup>37</sup> As the current population were Transplant Games competitors, it could be argued that both male and female participants may be more competitively motivated. However, much smaller numbers of competitors aimed to win national or international events with even fewer competing to break records, thus highlighting a predominantly enjoyment-based driver. However, the fourth reason for participation discriminates TxA from conventional athletic competitors by participating to be part of the transplant community. At transplant games events TxA are able to meet peers who have overcome similar adversity and who have received the 'gift of life'<sup>38</sup> which is unique to this population. Social support from friends and family, previously identified as strong associates for physical activity,<sup>35</sup> are also likely to drive TxA who have experienced significant health issues.<sup>14 38</sup> and should be studied further in this population.

### Limitations

While over 200 TxA responded to the survey this was limited to English speakers from 20 nationalities, thus, the characteristics of all nations competing at the World Transplant Games are not represented. The inclusion of TxA's from a wider selection of nations, could consolidate exercise practices and improve training recommendations. Although the predominance of white males within our TxA population is similar to previous studies<sup>9 39</sup> the proportion of black, Asian and minority ethnic groups receiving organs in the UK was not reflected in our sample. Although we did not set out to assess ethnicity per se it is plausible that these recipients face additional health and cultural related challenges, for which participation at transplant events holds a lesser priority.<sup>40 41</sup> Each TxA's journey and training experience should thus be considered. Finally, the survey was only open to TxA over 18 years of age, yet a large part of the 'Transplant Games' philosophy is to inspire those under 18 to increase activity and compete. An understanding of young TxA is essential to optimise their transplant journey.

### CONCLUSION

This study details the characteristics of TxA attending the British and World Transplant Games. With the exception of stem cell recipients, the majority of TxA manage multiple medications, often being specific to their transplant type. Many TxA's attend the Games for the health-related benefits and fitness. Although many TxA compete for enjoyment a smaller proportion compete to win. More specific guidance post-transplant needs to be developed regarding physical activity, exercise, and reduction of injury risk. Each TxA's journey differs with respect to transplant type and exercise experience which is likely reflected in their exercise capacity and goals.

**Contributors** TH developed the questionnaire, collected and analysed data and wrote the initial draft of the manuscript. SL-W contributed to study concept, design of the questionnaire and reviewed the manuscript. CDT contributed to study concept, design of the questionnaire and reviewed the manuscript. MP contributed to study concept, design of the questionnaire, data analysis and edited the manuscript. MP led the manuscript revision with all other authors reviewing edits. TH and MP are the guarantors.

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### ORCID iD

Mike Price <http://orcid.org/0000-0003-4274-0624>

### REFERENCES

- James LP, Haff GG, Kelly VG, *et al*. Towards a determination of the physiological characteristics distinguishing successful mixed martial arts athletes: a systematic review of combat sport literature. *Sports Med* 2016;46:1525–51.
- Hellard P, Avalos-Fernandes M, Lefort G, *et al*. Elite swimmers' training patterns in the 25 weeks prior to their season's best performances: insights into Periodization from a 20-Years cohort. *Front Physiol* 2019;10:363.
- Pollock S, Gaoua N, Johnston MJ, *et al*. Training regimes and recovery monitoring practices of elite British swimmers. *J Sports Sci Med* 2019;18:577–85.
- Johnson SR, Wojnar PJ, Price WJ. A Coach's Responsibility: Learning How to Prepare Athletes for Peak Performance. *Sport J* 2011;22:1–14.
- Williams TJ, McKenna MJ. Exercise limitation following transplantation. *Compr Physiol* 2012;2:1937–79.
- Miller MG, Weiler JM, Baker R, *et al*. National athletic trainers' association position statement: management of asthma in athletes. *J Athl Train* 2005;40:224–45.
- Jimenez CC, Corcoran MH, Crawley JT, *et al*. National athletic trainers' association position statement: management of the athlete with type 1 diabetes mellitus. *J Athl Train* 2007;42:536–45.
- World Transplant Games Federation. Rules for the sports of the 2017 world transplant games. In: *Sports Rules - World Transplant Games Federation*, 2016: 1–14.

- 9 Painter PL, Luetkemeier MJ, Moore GE, *et al.* Health-Related fitness and quality of life in organ transplant recipients. *Transplantation* 1997;64:1795–800.
- 10 Johnson U, Hinic H, Billstrom A. Transplant recipients' experience of participation at the world transplant games in Gothenburg 2011: a study of psychological well-being. *Open Transplant J* 2013.
- 11 Deliva RD, Patterson C, So S, *et al.* The world transplant games: an incentive to improve physical fitness and habitual activity in pediatric solid organ transplant recipients. *Pediatr Transplant* 2014;18:889–95.
- 12 Patel S. Organ transplant medicine. *S Afr Pharm J* 2015;2:22–7.
- 13 Atamañuk AN, Ortiz Fragola JP, Casonu M, *et al.* Physical activity among organ recipients: data collected from the Latin American transplant games. *Transplant Proc* 2017;49:354–7.
- 14 Ledington-Wright S, Price MJ. The transplant athlete: an emerging sporting population. *Br J Sports Med* 2018 <http://blogs.bmj.com/bjsem/2018/03/07/the-transplant-athlete-an-emerging-sporting-population/>
- 15 Hollings SC, Hume PA, Hopkins WG. Relative-age effect on competition outcomes at the world youth and world junior athletics Championships. *Eur J Sport Sci* 2014;14 Suppl 1:S456–61.
- 16 Allen SV, Hopkins WG. Age of peak competitive performance of elite athletes: a systematic review. *Sports Med* 2015;45:1431–41.
- 17 Patel JK, Kobashigawa JA. Heart transplantation. *Circulation* 2011;124.
- 18 Bouchard MP. Medications and exercise. *ACSMs Health Fit J* 2012;16:34–6.
- 19 Painter P, Krasnoff J, Paul SM, *et al.* Physical activity and health-related quality of life in liver transplant recipients. *Liver Transpl* 2001;7:213–9.
- 20 Cicognani E, Mazzoni D, Totti V, *et al.* Health-Related quality of life after solid organ transplantation: the role of sport activity. *Psychol Health Med* 2015;20:997–1004.
- 21 Mazzoni D, Cicognani E, Mosconi G, *et al.* Sport activity and health-related quality of life after kidney transplantation. *Transplant Proc* 2014;46:2231–4.
- 22 Kostakis ID, Kassimatis T, Bianchi V, *et al.* UK renal transplant outcomes in low and high BMI recipients: the need for a national policy. *J Nephrol* 2020;33:371–81.
- 23 Owen RV, Thompson ER, Tingle SJ, *et al.* Too fat for transplant? the impact of recipient BMI on pancreas transplant outcomes. *Transplantation* 2021;105:905–15.
- 24 Knight SR, Alasadi A, Clancy M. The immunology of solid organ transplantation. *Anaesthesia & Intensive Care Medicine* 2018;19:579–82.
- 25 Barlow AD, Saeb-Parsy K, Watson CJ. An analysis of the survival outcomes of simultaneous pancreas and kidney transplantation compared to live donor kidney transplantation in patients with type 1 diabetes: a UK transplant registry study. *Transpl Int* 2017;30:884–92.
- 26 Fishman JA. Infection in solid-organ transplant recipients. *N Engl J Med* 2007;357:2601–14.
- 27 Gleeson M, Walsh NP, British Association of Sport and Exercise Sciences. The bases expert statement on exercise, immunity, and infection. *J Sports Sci* 2012;30:4–15.
- 28 Ledington Wright S, Bloxham A, Hames T, *et al.* Therapeutic perceptions in management of transplant athletes at transplant games. *Phys Ther Sport* 2019;39:114–9.
- 29 Miller TL, Best TM. Taking a holistic approach to managing difficult stress fractures. *J Orthop Surg Res* 2016;11:98.
- 30 Braga Júnior JWR, Neves RMS, Pinheiro MM, *et al.* Prevalence of low trauma fractures in long-term kidney transplant patients with preserved renal function. *Braz J Med Biol Res* 2006;39:137–47.
- 31 Edwards BJ, Desai A, Tsai J, *et al.* Elevated incidence of fractures in solid-organ transplant recipients on glucocorticoid-sparing immunosuppressive regimens. *J Osteoporos* 2011;2011:1–8.
- 32 Guichelaar MMJ, Schmolli J, Malinchoc M, *et al.* Fractures and avascular necrosis before and after orthotopic liver transplantation: long-term follow-up and predictive factors. *Hepatology* 2007;46:1198–207.
- 33 Bahr R, Holme I. Risk factors for sports injuries—a methodological approach. *Br J Sports Med* 2003;37:384–92.
- 34 Aicale R, Tarantino D, Maffulli N. Overuse injuries in sport: a comprehensive overview. *J Orthop Surg Res* 2018;13:309.
- 35 Trost SG, Owen N, Bauman AE, *et al.* Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc* 2002;34:1996–2001.
- 36 Craft BB, Carroll HA, Lustyk MKB. Gender differences in exercise habits and quality of life reports: assessing the moderating effects of reasons for exercise. *Int J Lib Arts Soc Sci* 2014;2:65–76.
- 37 Jooste J, Rogerson D, Hogg M. Transplant recipients' motivational orientation towards sport participation and physical activity enjoyment at the 2019 World Transplant Games in Newcastle-Gateshead UK. *J Hum Sport Exerc* 2020;15:S481–94.
- 38 Slapak M. Sport and transplantation. *Ann Transplant* 2005;10:60–7.
- 39 McBean JM. *An injury surveillance of patients utilising the Durban University of technology (DUT) chiropractic treatment facilities at the 2013 world transplant games, MSC thesis.* Durban University of Technology, 2015. [https://openscholar.dut.ac.za/bitstream/10321/1424/1/MCBEAN\\_2015.pdf](https://openscholar.dut.ac.za/bitstream/10321/1424/1/MCBEAN_2015.pdf)
- 40 Randhawa G, Neuberger J. Role of religion in organ Donation-Development of the United Kingdom faith and organ donation action plan. *Transplant Proc* 2016;48:689–94.
- 41 Pisavadia B, Arshad A, Chappelow I, *et al.* Ethnicity matching and outcomes after kidney transplantation in the United Kingdom. *PLoS One* 2018;13:e0195038.

## The Competitive Organ Transplant Athlete

### Participant Information and Consent

PARTICIPANT INFORMATION SHEET

POST GRADUATE STUDENT PROJECT

SCHOOL OF LIFE SCIENCES

Thank you for considering helping one of our students with their research work. This form explains what you will be asked to do. If you have any questions about this, please ask the student.

By signing this form, you agree to take part in the study. However, please note that you are free to stop taking part at any time.

#### **Information about the project/Purpose of the project**

This project investigates the athletic demographic of the competitive organ transplant recipient.

#### **Why have I been chosen?**

We are approaching all athletes 18+ participating at the World and British Transplant Games to see if they would be willing to take part in an online survey to investigate the sporting history of the organ transplant athlete.

#### **Do I have to take part?**

You do not have to take part in this research project if you do not want to and you do not need to give any reason if you decide not to take part.

#### **What do I have to do?**

By choosing to participate in this project, you will be asked to complete an online questionnaire surveying the athletes participating in the World and British Transplant Games.

1. You will be asked to provide some personal information on your gender, age, nationality, ethnicity, job and education.
2. You will then be asked some background information on your transplant including reason for transplant, duration since transplant and medications.

3. The survey will then ask for information on physical activity levels and sporting background, and current sporting interest.
4. The main section of the survey asks questions relating to a 'normal training week', asking you to provide information on days per week you train, rest, types of training, intensity of training.
5. The final questions will ask you to provide information on how you recover between training sessions, and your beliefs or barriers to improving your performance.

**What are the risks associated with this project?**

Potential information could be visible when filling out this form in a public place, therefore a link to the survey will also be supplied so the survey can be completed at home or in a place of privacy.

**What are the benefits of taking part?**

By participating in this survey, your information will allow us to build an understanding of the range of training undertaken of transplant athletes, and associated perceptions. In the long term, this will enable future research to identify target areas for training interventions and management alongside developing transplantee specific athlete and local education.

**Withdrawal options**

You are free to stop taking part in this study at any time and you do not have to give any reason for this.

Once you are happy and have COMPLETED the survey only then is information irretrievable as answers are pooled together. However, answers cannot be linked to individuals, thus keeping the survey anonymous.

**Data protection & confidentiality**

Your consent to participate in this study will be confidential. Once you have given your consent, this form will be stored securely and appropriately by which only the researcher and supervisor has access to. The consent forms will not be stored with other data that belongs to the study, therefore ensuring no connections. These will be held for the maximum period of 5 years, and then will be destroyed securely. This time frame is determined by the need for access to this information in the unfortunate case of an unanticipated problem or a complaint. At the expiry date this information will be destroyed securely by the Faculty Research Support Officer.

Throughout this investigation, all information is kept anonymous and blind to the researcher. Participants codes are used with the electronic documents so that individuals cannot be identified.

**Who should you talk to if you have questions or you wish to make a complaint?**

If you have any questions or queries Thomas Hames will be happy to answer them. If they cannot help you, you can speak to my Director of Studies.

If you have any questions about your rights as a participant or feel you have been placed at risk you can contact my Director of Studies.

### **What will happen with the results of the study?**

Any data/ results from your participation in the study will be used by Thomas Hames as part of their project work. The data will also be available to Dr Mike Price as director of studies and the supervisory team of Dr Doug Thake and Sheila Ledington Wright. It may also be published in scientific works, but your name or identity will not be revealed.

### **Who has reviewed this study?**

This study has ethical approval from Coventry University

Key contact details

██████████

██████████████████

██████████

██████████████████

Please tick YES below to confirm that by filling in this questionnaire you are confirming that: You give consent to use your questionnaire answers in this research study. You have read and understood the information above about the study You understand that your participation is voluntary and that you are free to withdraw at any time without giving a reason You understand that all the information you provide is anonymous If you do not agree then please tick NO to exit the questionnaire.

YES

NO

---

About you

This section asks you to provide a range of personal information.

**Gender:**

Male Female

**Age:**

**Height (cm):**

**Weight (kg):**

**Nationality:**

Afghan Albanian Algerian

Andorran Angolan Argentinian

Armenian Australian Austrian

Azerbaijani Bahamian Bangladeshi

Barbadian Belorussian Belgian

Beninese Bhutanese Bolivian

Bosnian Brazilian Bruneian

Bulgarian Burmese Burundian

Cambodian Cameroonian Canadian

Chadian Chilean Chinese

Colombian Congolese Croatian

Cuban Cypriot Czech

Danish Dominican Ecuadorean

Egyptian Salvadorean English

Eritrean Estonian Ethiopian

Fijian Finn French

Gabonese Gambian Georgian

German Ghanaian Greek

Grenadian Guatemalan Guinean

Guyanese Haitian Dutchman  
Honduran Hungarian Icelander  
Indian Indonesian Iranian  
Iraqi Irish Israeli  
Italian Jamaican Japanese  
Jordanian Kazakh Kenyan  
Korean Kuwaiti Laotian  
Latvian Lebanese Liberian  
Libyan Liechtensteiner Lithuanian  
Luxembourger Macedonian Madagascan  
Malawian Malaysian Maldivian  
Malian Maltese Mauritanian  
Mauritian Mexican Moldovan  
Monacan Mongolian Montenegrin  
Moroccan Mozambican Namibian  
Nepalese Nicaraguan Nigerien  
Nigerian Norwegian Pakistani  
Panamanian Paraguayan Peruvian  
Filipino Pole Portuguese  
Qatari Romanian Russian  
Rwandan Saudi Scottish  
Senegalese Serbian Singaporean  
Slovak Slovenian Somali  
Spaniard SriLankan Sudanese  
Surinamese Swazi Swede  
Swiss Syrian Taiwanese  
Tadzhik Tanzanian Thai  
Togolese Trinidadian Tunisian  
Turk Ugandan Ukrainian  
American Uruguayan Uzbek  
Venezuelan Vietnamese Welsh

Yemeni Yugoslav Zambian

Zimbabwean Prefer not to answer

**Ethnic origin:**

White

White - Scottish Irish Traveller

Gypsy or Traveller

Other White background

Black or Black British - Caribbean

Black or Black British - African

Other Black background

Asian or Asian British - Indian

Asian or Asian British - Pakistani

Asian or Asian British - Bangladeshi

Chinese

Other Asian background

Mixed - White and Black Caribbean

Mixed - White and Black African

Mixed - White and Asian

Other mixed background

Arab

Other ethnic background

Not known

Prefer not to answer

**Post code:**

**How long have you lived at this post code:**

Dates need to be in the format 'DD/MM/YYYY', for example 27/03/1980.

**Education - Highest current academic qualification:**

**What is your current occupational status?:**

Employed  
Unemployed  
Self employed  
Student Retired

**Is your occupation a FULL time or PART time post?:**

Full time  
Part time

---

**About your transplant****1st Transplant type:**

The following section asks you about your transplant.

Heart  
Kidney  
Liver  
Lung  
Pancreas  
Intestine  
Thymus  
Marrow  
Other

If you selected Other, please specify:

**What was the reason for the transplant?:****How long did it take between initial diagnosis for condition to receiving the 1st transplant?:****Your age at 1st transplant?:**

**Approximate date of 1 organ transplant?:**

Dates need to be in the format 'DD/MM/YYYY', for example 27/03/1980.

(dd/mm/yyyy)

**Further organ transplantations, reason and age at the time of each transplantation?**

Yes

No

**Have you had any complications or rejection episodes post-transplant?:**

If yes, how what was the complication, and how long ago was this?

**Age of donor transplants (if known)?:**

---

## Your medications

The following section explores the medications currently used to manage your transplants and other pathologies while you are competing.

**List any medication you are currently taking:**

	Medication	Dose	Times per day
Medication 1:			
Medication 2:			
Medication 3:			
Medication 4:			
Medication 5:			
Medication 6:			
Medication 7:			
Medication 8:			
Medication 9:			
Medication 10:			

---

**Your sporting background**

The following section explores your participation in sport pre-transplantation.

**Did you participate in sport before your transplant?:**

Yes

No

**At what level did you previously compete?: Name sporting event(s) and whether it was International, National, County or Club level and highest national rank if known?**

**For a regular training week, how many days per week did you train:**

0 1 2 3 4 5 6 7

**For a regular training week, how many sessions per week were you participating in?:**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Gym based training session											
Athletics track based training session											
Field based training session (Jumps / throws)											
Swimming training session											
Cycling training session											
Court based training session											
Other											

**For a regular training week, how long would the average training session last.**

Please don't select more than 1 answer(s) per row.

	0	15 min	30 min	45 min	60 min	75 min	90 min	105 min	120 min	135 min	150 min
Gym based											

training session											
Athletics track based training session											
Field based training session (Jumps / throws)											
Swimming training session											
Cycling training session											
Court based training session											
Other											

The following question uses the Rate of Perceived Exertion scale (RPE) establish how physically demanding you felt each of the sessions were (Borg 1982).

**RPE SCALE - HOW INTENSE DOES IT FEEL?**

1 = Very easy

2 = Easy

3 = Moderate

4 = Somewhat hard

5 = Hard

6

7 = Very hard

8

9

10 = Maximal

**For a regular training week, how intense were the training sessions you participated in. Please tick the average intensity level best related to each**

Please don't select more than 1 answer(s) per row

	N/A - Not applicable	0 - Rest	1 - Very easy	2 - Easy	3 - Moderate	4 - Somewhat hard	5 - Hard	6 -	7 - Very hard	8 -	9 -	10 - Maximal
Gym based training session												
Athletics track based training session												
Field based training session (Jumps / throws)												
Swimming training session												
Cycling training session												
Court based training session												
Other												

**For how many years/months had you been training at this level?:**

---

## Your initial physical activity involvement post-transplant

This section explores your reintroduction to physical activity post-transplant

**Did you receive any advice on exercise post-transplant?**

No

Doctor

Therapist

Coach

Friend

Family

Other recipients

Gym instructor

Personal trainer

Other

**What did they advise you to do?**

**How many months post-transplant did you start to participate in physical exercise (general or as part of rehabilitation)?:**

**What type/s of exercise were you participating in 12 months post-transplant. For a normal week how**

**many sessions were you participating in, and were they GUIDED (devised by another professional) or your own plan. Please don't select more than 1 answer(s) per row.**

	0	1	2	3	4	5	6	7	8	9	10
Resistance training sessions											
Resistance training sessions (GUIDED)											
Gym based bike / treadmill aerobic sessions											
Gym based bike / treadmill aerobic sessions (GUIDED)											
Gym class sessions											
Gym class sessions (GUIDED)											
Running sessions											

Running sessions (GUIDED)											
Outdoor cycling											
Outdoor cycling (GUIDED)											
Swimming sessions											
Swimming sessions (GUIDED)											
Court based sessions											
Court based sessions (GUIDED)											
Other											

**What was your top 3 reasons for wanting to start to compete?:**

---

## Your current sporting interests

This section will explore your current sporting aims, and your competition goals.

**For how many years have you been participating in transplant sports?:**

If you selected Other, please specify:

**What is your current MAIN sporting event?:**

Badminton

Basketball

Cycling - 5k

Cycling - 30k

Darts Golf

Kayak

Padel

Petaque

Squash

Swimming - 50m freestyle

Swimming - 100m freestyle

Swimming - 200m freestyle

Swimming - 400m freestyle

Swimming - 50m breaststroke

Swimming - 100m breaststroke

Swimming - 50m backstroke

Swimming - 100m backstroke

Swimming - 50m butterfly

Swimming - 200m Individual medley

Table Tennis

Ten Pin Bowling

Tennis

Track and Field - 100m

Track and Field - 200m

Track and Field - 400m

Track and Field - 800m

Track and Field - 1500m

Track and Field - 5000m / 3000m

Track and Field - Shot put

Track and Field - Ball Throw

Track and Field - Discus

Track and Field - Javelin

Track and Field - Long jump

Track and Field - High jump

Triathlon

Volleyball Other

If you selected Other, please specify:

**Do you currently have a coach for your MAIN event?**

Yes No

**How long have you been coached towards your MAIN event?**

**How long have you been competing at your current MAIN event post-transplant?:**

**If you also compete in SECONDARY events, highlight which ones you currently compete in?:**

Badminton

Badminton - Doubles Basketball

Cycling - 5k

Cycling - 30k

Cycling - 20k Team

Darts

Darts -Team

Golf

Golf - Team

Kayak

Padel

Petanque

Petanque - Doubles

Squash

Swimming - 50m Freestyle

Swimming - 100m Freestyle

Swimming - 200m Freestyle

Swimming - 400m Freestyle

Swimming - 50m Breaststroke

Swimming - 100m Breaststroke

Swimming - 50m Backstroke

Swimming - 100m Backstroke

Swimming - 50m Butterfly

Swimming - 200m Individual medley

Swimming - 4x50m Freestyle relay

Swimming - 4x50m Medley relay

Table tennis

Table tennis - Doubles

Ten pin bowling

Ten pin bowling - Doubles

Tennis

Tennis - Doubles

Track and Field - 100m

Track and Field - 200m

Track and Field - 400m

Track and Field - 800m

Track and Field - 1500m

Track and Field - 5000m / 3000m

Track and Field - 4x100m Relay

Track and Field - 4x400m Relay

Track and Field - Shot put

Track and Field - Ball throw

Track and Field - Discus

Track and Field - Javelin

Track and Field - Long jump

Track and Field - High jump Triathlon

Volleyball

Other

**If you selected Other, please specify:**

**What is the highest level of competition you currently compete at?:**

World Transplant Games

British Transplant Games

List your Personal Best (PB's) for your events. Only fill in the ones you compete at.

Cycling 5k  
Cycling 30k  
Cycling 20k Team  
Golf  
Kayak  
Padel  
Swimming - 50m Freestyle  
Swimming - 100m Freestyle  
Swimming - 200m Freestyle  
Swimming - 400m Freestyle  
Swimming - 50m Breaststroke  
Swimming - 100m Breaststroke  
Swimming - 50m Backstroke  
Swimming - 100m Backstroke  
Swimming - 50m Butterfly  
Swimming - 200m Individual medley  
Track and Field - 100m  
Track and Field - 200m  
Track and Field - 400m  
Track and Field - 800m  
Track and Field - 1500m  
Track and Field - 5000m/3000m  
Track and Field - Shot put  
Track and Field - Ball throw  
Track and Field - Discus  
Track and Field - Javelin  
Track and Field - Long jump  
Track and Field - High jump  
Triathlon  
Other

**Could you please select the main reasons you continue to participate in sport?:**

For fun

To be part of the transplant community

To encourage a healthier lifestyle

To improve my fitness

To compete at new events

To compete at events I had done BEFORE the transplant

To win national events

To win international events

To break records

Other

**If you selected Other, please specify:****Do you currently have support for your training from any of the following?:**

Chiropractor

Nutritionist

Physiotherapist

Psychologist

Podiatrist

Sports Therapist

Strength and Conditioning coach

Other

**If you selected Other, please specify:**

Who provides you with the support?:

Chiropractor

Coach - Qualified

Doctor

Exercise Physiologist

Exercise Psychologist

Fellow athlete

Gym instructor

Nutritionist

Personal Trainer

Physiotherapist

Sports Scientist

Sports Therapist

Strength and Conditioning coach

Other

**If you selected Other, please specify:**

---

## Your training and event preparation

This section reviews current strategies used to help athletes prepare for training sessions and event preparation.

**Do you currently have a set protocol / warm up to help you prepare for COMPETITION? (Brief description, types of warm up and duration)**

**How long does your normal competition warm up last?**

**Do you currently have a set protocol / warm up to help you prepare for TRAINING sessions? (Brief description, types of warm up and duration)**

**How long does your normal training session warm up last?**

**Is there anything you feel in particular inhibits your event preparation? (E.g. difficulty increasing heart rate, quality of breathing etc)**

**If so, Is there anything you have done to try and improve on this?**

---

## Your training loads (Normal training week)

This section looks at the load and types of training you currently participate in.

When calculating session durations, please round to the nearest 15minutes, e.g: 1=15min, 2=30min, 3=45min, 4=60min, 5=75min, 6=90min,7=105min, 8=120min, 9=135min, 10=150min etc.

**For a normal training week, how many days per week would you regularly train for your events? (all types of training sessions):** 1 2 3 4 5 6 7

**For a normal training week, how many training sessions would this involve? (Include multiple sessions within a day):** 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

**For a normal training week, what types of sessions would you participate in?**

Crossfit

Cycling

Gym based cardiovascular training (Treadmill etc)

Gym based resistance training

Pilates

Road running

Self-directed

Track and Field

Yoga

Other

**If you selected Other, please specify:**

The following questions consider your training load using a scale of 0-10.

Only fill in the types of sessions you participate in, leave blank and SKIP sessions you do not participate in.

In regards to session DURATION, round to the nearest 15 minutes: 1=15min, 2=30min, 3=45min, 4=60min, 5=75min, 6=90min, 7=105min, 8=120min, 9=135min, 10=150min.

In regards to the session INTENSITY question, refer to the Rate of Perceived Exertion scale (RPE) to judge on average how physically demanding sessions felt (Borg 1982).

RPE SCALE - HOW INTENSE DOES IT FEEL?

1 = Very easy

2 = Easy

3 = Moderate

4 = Somewhat hard

5 = Hard

6

7 = Very Hard

8

9

10 = Maximal effort

**If in a normal training week you participate in GYM based sessions, please can you identify what type, how many, the average duration and perceived intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Resistance training (Number of sessions)											
Resistance training (Average RPE)											
Resistance training (DURATION)											
-----											
Aerobic training (Number of Sessions)											
Aerobic training (Average RPE)											
Aerobic training (DURATION)											
-----											

Aerobic classes (Number of sessions)											
Aerobic classes (Average RPE)											
Aerobic classes (DURATION)											

**If in a normal training week you participate in ATHLETICS TRACK based sessions, identify what type, how many, average duration and intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Sprint track sessions (Number of sessions)											
Sprint track sessions (Intensity RPE)											
Sprint track sessions (Average DURATION)											
-----											
Middle distance track sessions (Number of sessions)											
Middle distance track sessions (Intensity RPE)											
Middle distance track sessions (Average											

DURATION)											
-----											
Long distance track sessions (Number of sessions)											
Long distance track sessions (Intensity RPE)											
Long distance track sessions (Average DURATION)											

**If in a normal training week you participate in FIELD (Jump/Throw) sessions, identify what type, how many, average duration and intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Jumping based field sessions (Number of sessions)											
Jumping based field sessions (Intensity RPE)											
Jumping based field sessions (Average DURATION)											
-----											
Throwing based field sessions (Number of sessions)											

Throwing based field sessions (Intensity RPE)											
Throwing based field sessions (Average DURATION)											

**If in a normal training week you participate in CYCLING sessions, identify what type, how many, average duration and intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Sprint cycling sessions (Number of sessions)											
Sprint cycling sessions (Intensity RPE)											
Sprint cycling sessions (Average DURATION)											
-----											
Middle distance cycling sessions (Number of sessions)											
Middle distance cycling sessions (Intensity RPE)											
Middle distance											

cycling sessions (Average DURATION)											
-----											
Long distance cycling sessions (Number of sessions)											
Long distance cycling sessions (Intensity RPE)											
Long distance cycling sessions (Average DURATION)											

**If in a normal training week you participate in SWIMMING sessions, identify what type, how many, average duration and intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Sprint swimming sessions (Number of Sessions)											
Sprint swimming sessions (Intensity RPE)											
Sprint sessions swimming (Average DURATION)											
-----											
Middle distance											

swimming sessions Number of sessions)											
Middle distance swimming sessions (Intensity RPE)											
Middle distance swimming sessions (Average DURATION)											
-----											
Long distance swimming sessions (Number of sessions)											
Long distance swimming sessions (Intensity RPE)											
Long distance swimming sessions (Average DURATION)											

**If in a normal training week you participate in COURT (Volleyball, tennis, table tennis etc) training sessions, identify what type, how many, average duration and intensity using the scales noted above. If you do not do any of these, please SKIP and move to the next.**

Please don't select more than 1 answer(s) per row.

	0	1	2	3	4	5	6	7	8	9	10
Court based training session (Number of sessions)											
Court based											

training session (Intensity RPE)											
Court based training session (Average DURATION)											

**If there are any other type of training you regularly participate in, please give details of: Type of session, Number of sessions, Intensity (RPE) and DURATION (multiples of 15min) in the box below.**

**Do you perceive there is anything currently limiting your ability to perform at your potential?**

Yes No

**If yes, what do you perceive is limiting your athletic ability?**

**Is there anything you are you currently doing to work on this?**

---

## Recovery

The following section explores any current recovery strategies you may have adopted to enhance your ability to compete or train.

**At present, how long do you feel it takes for you to fully recover after a hard training session or competition?:**

Do you currently follow any recovery protocol after competing or following training sessions?:

None at present

Gentle jog

Stretch (When feel tight)

Stretch (After sessions)

Foam roll (When feel tight)

Foam roll (After sessions)

Cryotherapy (Immersed)

Cryotherapy (Ice pack)

Structured plan

Other

**If you selected Other, please specify:**

**If you use a recovery strategy, indicate which type/s of sessions you regularly use it after?**

**For a normal training week, please indicate the proportion of sessions you manage to carry out a recovery protocol after:**

After every session

Only after competition

After a hard session (RPE 7+)

After 75% of sessions

After 50% of sessions

After 25% of sessions

Other

**If you selected Other, please specify:**

**How long following a race or training session do you feel it takes for your heart rate (HR) to return to a resting state?:**

Please don't select more than 1 answer(s) per row.

**In relation to training on BACK to BACK DAYS, how recovered do you feel before starting the second day?**

Please don't select more than 1 answer(s) per row.

	1 = VERY sore, tired stressed, poor recovery	2 = Sore more than normal, tired more than normal, restless	3 = Normal	4 = Feeling good	5 = VERY positive, fresh, relaxed, fully recovered
Fatigue					
Muscle soreness					
Stress level					

Mood					
Heart rate recovery					

**In relation to back to back training sessions occurring on the SAME DAY, how recovered do you feel before starting the second session?**

	1 = VERY sore, tired stressed, poor recovery	2 = Sore more than normal, tired more than normal, restless	3 = Normal	4 = Feeling good	5 = VERY positive, fresh, relaxed, fully recovered
Fatigue					
Muscle soreness					
Stress level					
Mood					
Heart rate recovery					

**Compared to an event matched non-transplantee athlete, do you perceive you can train as the same session load for the same intensity?**

Needs adjusting from the start

25% of the time

50% of the time

75% of the time

100% of the time

**If not 100% of the time, what do you often change about your training session?**

Same session - just longer breaks

Same session - just reduce intensity

Same Intensity - reduce reps / sets

Other

**If you selected Other, please specify:**

**Compared to an event matched non-transplantee athlete, do you perceive you recover equally for back to back training sessions on the SAME DAY?:**

No Yes

**If not, what do you feel is affecting your ability to train at the same load?:**

**Compared to an event matched non-transplantee athlete, do you feel you recover equally for training sessions on BACK to BACK DAYS?:**

No

Yes

**If not, what do you feel is affecting your ability to train?:**

**End of Quiz**

Thank you very much for your time. Your contribution will make a difference by helping to build a knowledge base to develop and support the competitive organ transplantee sporting demographic.

## Supplementary Material

Table 1. Medications characteristics within the five most common transplant sub-groups related to percentage of the sub-group populations.

Medications (One or more)	All	Kidney	Liver	Heart	Stem cell	Lung
Number of transplant recipients	220	95	50	35	21	11
Mean number of medications $\pm$ SD	5 $\pm$ 3	5 $\pm$ 2	4 $\pm$ 3	6 $\pm$ 2	2 $\pm$ 2	8 $\pm$ 4
Immunosuppressants	88%	95%	94%	100%	10%	91%
Statins	28%	22%	6%	80%	-	27%
Steroids	47%	65%	26%	43%	-	82%
Analgesics	1%	3%	-	-	-	-
Antibiotics / antiviral / antifungal	20%	9%	12%	23%	34%	90%
Anti-hypertensives	47%	58%	28%	69%	10%	36%
Anti-inflammatories	4%	1%	16%	-	-	-
Antacid inhibitors	20%	24%	14%	23%	5%	18%
Anti-diabetic	10%	9%	8%	3%	-	63%
Anti-platelets	22%	20%	26%	37%	5%	-
Anti-coagulants	2%	1%	2%	6%	-	9%
Anti-epileptic	1%	2%	-	-	-	-
Anti-depressant / anxiolytics	7%	4%	4%	9%	14%	9%
Anti-retroviral	1%	-	4%	-	-	-
Antihistamine	2%	-	2%	3%	-	9%
Antiparkinsonian	0.5%	1%	-	-	-	-
Respiratory medication	1%	1%	-	-	-	9%
Hormone therapy	11%	9%	6%	20%	19%	-

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Retanoid	1%	1%	2%	-	-	-
Triptants	1%	-	4%	3%	-	-
Gout treatment	8%	8%	2%	20%	-	9%
Gastrointestinal medication	13%	8%	24%	6%	5%	27%
Diuretics	2%	-	25	3%	-	-
Prostate cancer medication	0.5	1%	-	-	-	-
Vitamin /minerals	36%	33%	38%	37%	10%	63%

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