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AUTHOR(S)

Lyndell Bruce, Kylie Bellesini, Brad Aisbett, Eric Drinkwater, Peter Kremer

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Original research

A profile of the skills, attributes, development, and employment opportunities for sport scientists in Australia

Lyndell Bruce [a,*], Kylie Bellesini [a], Brad Aisbett [b], Eric J. Drinkwater [a], Peter Kremer [a]

[a] Deakin University, Centre for Sport Research, Australia
[b] Deakin University, Institute of Physical Activity and Nutrition, Australia

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ABSTRACT

Objectives: The purpose of this study was to document the technical and transferrable skills required for sport scientists, and perceived employment opportunities both currently and in the future with a particular emphasis on comparisons between academic and applied sport scientists.
Design: Cross-sectional survey methodology.
Methods: 117 Australian sport science employees completed an online survey capturing demographic information, perceptions about the importance of technical skills, transferable skills, future employment opportunities as well as free-text information on future careers, challenges, and opportunities for the profession. Descriptive statistics were used to summarise information and comparisons made between academic and applied sport science participants.
Results: Participants were predominantly male and 35 years or younger, with half reporting they held only one position within the industry. Most technical and transferrable skills were rated as important (>4.0 out of 5.0), with practitioner-focused skills rated somewhat more important by applied sport scientists compared to scientific-focused skills rated somewhat more important by academics, and applied sport scientists generally rating transferable skills as more important compared to academics ($d > 0.5$). Value and supply/demand were identified as challenges to the industry with discipline-specific roles and non-elite populations considered areas for future jobs.
Conclusions: Participants felt there would be more jobs in the future and that these would be in discipline-specific roles and/or non-elite populations. Both technical and interpersonal skills were considered important for sport scientists. The greatest challenges are how sport science is valued and the potential oversupply of sport science graduates.
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Practical implications

- Technical skills are valued by sport scientists and should be included in student curriculum
- The industry needs to demonstrate to employers the importance of sport science roles and appropriate renumeration
- There is optimism from within the industry that there will be more employment opportunities in the future

1. Introduction

The sport science industry is still in its infancy (first 50 years) compared to more traditional occupations. Dwyer et al[1] profiled the Australian high performance and sport science workforce in 2013 providing initial insights into the make-up of the industry through demographic (i.e., location) and work-related characteristics (i.e., employment sector, duration, status) of the profession.[1] However, since then, there has been significant evolution in the field and it would be expected that the make-up of the workforce has also evolved. The role of a sport scientist has been more clearly defined, a scope of practice developed, and an accreditation process adopted for sport scientists by the Australian governing body Exercise and Sports Science Australia (ESSA).[2,3] Further, Australian government-funded sporting organisations now require sport scientists to be ESSA accredited[4] and several sporting codes in Australia now have professional women's competitions (e.g., Australian Football League, Super Netball) potentially increasing employment opportunities.[5] While there is greater understanding of the workforce and the sport scientists' role, there is a gap in knowledge on what technical and transferable skills are important in sports science. Technical skills are the abilities and knowledge needed to perform

* Corresponding author.
E-mail address: lyndell.bruce@deakin.edu.au (L. Bruce).

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specific tasks. Transferable skills are skills and knowledge that individuals possess which can be useful to employers across various jobs and industries. A greater understanding may provide knowledge on the skill set required to work as a sport scientist. This information will assist future sport scientists and those designing sport science courses and professional development to ensure knowledge and skills match the requirements of the sport scientist roles.

It has been estimated that very few graduates from Australian exercise and sports science degrees gain employment as a sport scientist (3%)[6] with poor job security previously identified as a key issue within the sport science profession in Australia.[1] ESSA has identified future workforce trends within exercise and sports science, specifically digital health (e.g., wearable technology), disability, the fitness industry (i.e., wider general population), and sport.[7] While ESSA-accredited professionals were recently surveyed for their perspectives on future trends and needs, <1% of respondents were sport scientists (and non-accredited professionals were not included within the sample group), so little is known about sport scientists' perspectives about the future of their own profession.[7] Clarity around the roles of sport scientist would provide a basis for academic programs to ensure they meet the needs of the practitioner roles their students will be hoping to work in.

This study explores perceptions of skill sets important for those wanting to work in the field of sport science as well as current and future jobs, challenges, and opportunities with a particular emphasis on comparisons between academics and applied sport scientists. Specifically, it examines three research questions: 1) what technical and transferable skills are considered important for sport science roles? 2) has the profile of work opportunities altered over the past 10 years and will this profile change in the next 10 years? and 3) what type of sport science roles will emerge in the future?

2. Methods

To effectively capture as much of the workforce as possible, a purposeful recruitment strategy was utilised. Information about the survey was distributed to members from relevant national and state sporting bodies through utilisation of national memberships and mailing lists, social media campaigns, and dissemination via personal networks. Such recruitment strategies have found to be effective for maximising participant response rates in web-based surveys.[8,9] Survey participants were currently working in all levels of the Australian sports science industry, defined as those whose work specialises in helping an individual athlete or team to improve their sporting performance using scientific knowledge, methods, and applications.[1,10] Emails were directly sent to 410 individuals or organisations inviting them (or their staff) to participate. In addition, social media posts were distributed via Twitter, Facebook, and LinkedIn. Ethical approval for this study was obtained from Deakin University. Participants received a link providing details on the survey and were then asked if they provide consent to participate. All participants were aged 18 years or older and provided informed consent prior to commencing the survey.

The research team developed the survey instrument through initial questions extracted from the 2013 Australian High Performance and Sport Science Workforce survey.[1,10] Survey items were then added, modified, or removed to ensure they addressed the research questions. Pilot testing of the online survey tool indicated no issues with question structure and survey navigation. The final survey included questions separated into nine sections, with this paper reporting on results from four sections which enabled us to answer the specified research questions posed. The remaining sections of the survey (see Supplementary File 1) focused on topics including to employment relationships, career decision and supervision, and training and are not specifically aligned with the present research questions and will be analysed and presented in additional work. The first section contained participant demographics including age, location, and education history as well as current employment information (e.g., number of jobs, status, sector, length). Section two asked participants to rate listed technical and transferable knowledge, skills, and technical competencies on a 6-point Likert scale (not important, slightly important, moderately important, important, very important or unsure). Section three required participants to indicate their level of agreement on statements related to work status (full-time, part-time, intern and volunteer roles) and the number of roles relative to 10 and 5 years ago, and in 5 and 10 years (strongly disagree, disagree, undecided, agree, strongly agree, NA (have not experienced)). The final section comprised three free-text questions that focused on current challenges, opportunities, and future jobs (1. What do you see are the current changes facing the sport science industry?; 2. What are the opportunities for the future in sport science?; 3. Where are the jobs of the future in sport and sports science?). Study data were collected and managed using the REDCap (Research Electronic Data Capture) survey software.[11,12] Data collection was completed over a seven-week period between October and December 2019 and the survey took approximately 20 min to complete.

Descriptive statistics (means, proportions) were used to summarise demographic and employment profile variables, as well as technical and transferrable skills measures. Since the sample reflected two distinct participant subgroups – academic and applied sport scientists – data from section two is also reported according to these two subgroups based upon participants' main employment title (see question 11i of Supplementary File 1). Where participants were engaged in more than one position, the primary employment title was used for classification. Participants who selected the university or research institution option were classified as academic sport scientists ($n = 33$) and all other responses were categorised as applied sport scientists ($n = 79$) ($n = 5$ were not classified as they did not complete the relevant question). Chi square analyses were used to test for associations between subgroup (academic versus applied sport scientists) and each variable. Normality of distributions for each of the technical and transferrable skills variables were assessed using visual and statistical methods. Visual assessment revealed most distributions were adequate. In addition, skewness and kurtosis values were generally below thresholds (skewness $> \pm 2.0$; kurtosis $> \pm 7.0$) that may distort results.[13] Scores on current and future work opportunities were summarised as means, and differences examined using repeated measures ANOVA with Bonferroni corrected pairwise comparisons as appropriate. Significance of effects were accepted at $p < .05$ and magnitudes of effects assessed using Cramer's (V) (<0.3 = no/weak association, 0.3–0.5 = moderate association, >0.5 = strong association), Cohen's (d) (0.2 = small, 0.5 = medium, 0.8 = large), and the partial eta-squared (η_p^2) (0.01 = small, 0.06 = medium, 0.14 = large) statistics. All analyses were performed using Stata 16SE (StataCorp). Responses to the free-text questions were reported quantitatively. Free text responses were exported into Microsoft Excel and coded for recurring content. Author 1 reviewed all text and generated the initial categories and then classified responses accordingly. The appropriateness of the categories and classification of text to these was reviewed by Author 5. Any inconsistences were discussed until a consensus classification was achieved.

3. Results

The final sample consisted of 117 participants and details of these are presented in Supplementary File 2. ESSAs 2020 annual report indicates there are 353 accredited sports scientists in Australia,[14] however, this likely underrepresents the number of people working in a sport science role in Australia. For the purposes of this survey we based our estimate of the total number of potential participants on that reported by Dwyer et al[1] plus some expected growth in the industry (i.e., n ~450 plus 200 for a total of 650) and from this estimated our response rate as ~18%. Eighty percent of participants were based in the states of Victoria, New South Wales, and Queensland, 67% were male, and 57% were aged 35 years or younger. In terms of highest completed education, one third reported this as either a bachelor's degree or graduate

certificate/diploma/Honours and two thirds as a Masters or PhD. Participants highest qualifications were mostly (94%) completed within sport science. Just over a quarter of participants (27%) reported currently studying in sport science. Approximately one third (35%) indicated their primary area of training to be exercise and sport science while a further 23% specifically indicated strength and conditioning as their primary area of training. Thirty percent reported involvement in the sport science industry for >15 years and only a small percentage (4%) for less than one year. Just under half (44%) reported holding two or more positions and just over half (56%) reported holding only one position. Chi square results indicated subgroup was associated with age group and highest qualification; the academic subgroup had a lower proportion in the 26–35 year age group and higher proportion in the >45 year age group, and a lower proportion had a Certificate/Diploma/Degree as their highest qualification (see Supplementary File 2).

Perceived importance of technical and transferrable skills for participants' main position in sport science are summarised in Tables 1 and 2. The technical skills items could be classified as characteristically more applied (involving practical/hands-on work) or more academic (involving research/teaching) and we have summarised findings accordingly. Overall, 'knowledge of contemporary sport-specific research and practice', 'ability to practice in an inclusive manner', 'able to analyse the demands of a sport and athlete capability' and 'able to plan and implement evidence-based interventions to achieve performance goals' were rated as important practitioner-focused applied technical skills (>4.5). In addition, more scientific-based academic technical skills including the 'ability to critically assess collected data', 'translate research outcomes into evidence-based practice', 'assess data critically to identify meaningful effects', 'translate outcomes of data analysis into meaningful information for service users/stakeholders' and 'critically evaluate the efficacy of interventions' were all rated as important (≥4.5). Skills including 'athlete nutrition analysis, provision of nutrition or supplement advice', and 'psychological skills training' were considered only moderately important (<3.0). Comparisons between the academic and applied subgroups indicated most differences were small in magnitude, however several differences were moderate or large ($d \geq \pm 0.5$) and are italicised in Table 1. Overall, there was a general pattern whereby applied technical skills were rated as somewhat/more important by applied sport scientists and academic technical skills were rated as somewhat/more important by academics.

Most transferrable skills were rated as important (≥4.5) and only two skills ('administration skills including planning, marketing and budgeting', and 'creating appropriate relationships with relatives and carers') were perceived to be of moderate (<4.0) importance (see Table 2). Comparisons between the academic and applied subgroups indicated most differences were small in magnitude, however, differences on some items were moderate/large ($d \geq \pm 0.5$) and these are italicised in Table 2. Overall, there was a generally consistent pattern whereby applied sport scientists rated each transferrable skill as more important for their role relative to their academic counterparts; the only exception to this was for the skill of 'mentors new graduates and emerging sport scientists in the subfields of sports'.

Perceptions of current (relative to 10 years ago) and future (in 10 years relative to now) work opportunities in sport science according

Table 1
Perceived importance of technical skills for their position for total sample and for academic and applied subgroups (Mean, SD).

Variable	All ($n = 117$)	Academic ($n = 33$)	Applied ($n = 79$)	d
Knowledge of contemporary sport specific research and best practice	4.6 (0.8)	4.7 (0.9)	4.5 (0.8)	0.19
Able to practice as a sport scientist in an inclusive and non-discriminatory manner	4.6 (0.8)	4.6 (0.8)	4.6 (0.8)	−0.06
Able to analyse the demands of the sport and the capabilities of the athlete	*4.6 (0.8)*	*4.0 (1.1)*	*4.8 (0.5)*	*−1.05*
Able to assess collected data critically to determine its validity and reliability	4.6 (0.6)	4.6 (0.6)	4.6 (0.7)	0.08
Able to translate research outcomes into evidence-based practice	4.6 (0.7)	4.7 (0.5)	4.6 (0.8)	0.26
Able to assess data critically to identify meaningful effects	4.6 (0.7)	4.4 (0.9)	4.6 (0.6)	−0.22
Able to translate outcomes of data analysis into meaningful information for service users and others	4.6 (0.7)	4.6 (0.7)	4.6 (0.7)	0.00
Able to plan evidence-based interventions to achieve the performance goals of individuals and groups	4.5 (0.9)	4.3 (1.1)	4.6 (0.8)	−0.35
Able to evaluate critically the efficacy of sports science interventions	4.5 (0.7)	4.6 (0.6)	4.5 (0.7)	0.09
Interpretation of quantitative sports performance data	4.4 (1.0)	4.2 (1.2)	4.5 (0.9)	−0.34
Ethical practices in sports science	4.4 (1.0)	4.7 (0.7)	4.4 (1.0)	0.27
Able to formulate specific development goals to improve performance for both individuals and groups	4.4 (0.9)	3.9 (1.1)	4.6 (0.8)	−0.74
Able to practice appropriate and best principles in data management	4.4 (0.9)	4.6 (0.6)	4.3 (0.9)	0.31
Able to appraise new/emerging evidence, technologies, techniques in sport	4.4 (0.7)	4.4 (0.6)	4.4 (0.7)	0.06
Designing of training programs or interventions	4.3 (1.2)	4.3 (0.8)	4.3 (1.3)	0.04
Interpretation and evaluation of scientific research	*4.3 (0.9)*	*4.8 (0.6)*	*4.2 (1.0)*	*0.67*
Able to use data to evaluate and develop programs for service users	4.3 (1.0)	4.2 (1.0)	4.3 (1.0)	−0.12
Able to assess safety before, during and after interventions, and formulates responses	4.3 (1.0)	4.2 (0.8)	4.3 (1.1)	−0.09
Implementation of training programs or interventions	4.2 (1.2)	4.0 (1.1)	4.3 (1.2)	−0.24
Quantitative measurement of sport demands	4.2 (1.0)	3.9 (1.3)	4.3 (0.9)	−0.38
Understanding of measurement error and methodology limitations	4.2 (1.0)	4.4 (0.6)	4.0 (1.1)	0.41
Monitoring of athlete training responses and training load	4.1 (1.3)	3.7 (1.4)	4.2 (1.3)	−0.39
Design and implementation of scientific research	*4.1 (1.1)*	*4.7 (0.7)*	*3.8 (1.2)*	*0.83*
Assessment of athlete physiological capacities	3.8 (1.3)	3.4 (1.2)	3.9 (1.3)	−0.41
Athlete recovery practices	*3.7 (1.3)*	*3.0 (1.4)*	*3.9 (1.2)*	*−0.68*
Knowledge of the ASADA and/or WADA code	*3.7 (1.5)*	*2.8 (1.5)*	*4.0 (1.3)*	*−0.90*
Assessment of fitness components including anthropometry	3.5 (1.4)	3.0 (1.4)	3.6 (1.4)	−0.45
Selection, calibration, and operation of appropriate field and/or laboratory apparatus	3.5 (1.2)	3.7 (1.2)	3.4 (1.2)	0.17
Injury rehabilitation and management	*3.5 (1.4)*	*2.8 (1.3)*	*3.8 (1.3)*	*−0.78*
Athlete technique analysis	3.3 (1.3)	2.9 (1.4)	3.4 (1.2)	−0.40
Assessment of athlete decision making skills	3.1 (1.5)	2.9 (1.6)	3.1 (1.4)	−0.16
Assessment of athlete motor skills	3.1 (1.5)	2.9 (1.7)	3.2 (1.4)	−0.20
Performance enhancement through use of psychological skills training	2.9 (1.4)	2.6 (1.5)	3.0 (1.3)	−0.28
Athlete nutrition analysis	2.7 (1.3)	2.2 (1.1)	2.8 (1.4)	−0.47
Provision of nutrition or supplement advice	*2.4 (1.3)*	*1.9 (1.3)*	*2.6 (1.2)*	*−0.56*

1 = not important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = very important, 6 = unsure.
SD = standard deviation, d = effect size.
Italicised text refers to responses that produced a moderate or large effect size ($d \geq \pm 0.5$) in the comparison between academic and applied.
'Unsure' responses excluded from analysis.

Table 2
Perceived importance of transferrable skills for their position for total sample and for academic and applied subgroups (Mean, SD).

Variable	All ($n = 117$)	Academic ($n = 33$)	Applied ($n = 79$)	d
Communication skills in both written and oral form	4.8 (0.5)	4.7 (0.5)	4.9 (0.4)	−0.40
Uses appropriate communication techniques in interactions with service users and others	*4.7 (0.5)*	*4.5 (0.6)*	*4.8 (0.4)*	*−0.70*
Creates positive and professional relationships with service users in a sports science environment	*4.7 (0.7)*	*4.3 (1.0)*	*4.8 (0.4)*	*−0.84*
Ability to think on your feet and adapt to the demands of role and context	*4.7 (0.5)*	*4.5 (0.8)*	*4.8 (0.4)*	*−0.68*
Think of creative solutions to real world/applied problems	4.7 (0.6)	4.6 (0.8)	4.7 (0.5)	−0.22
Interdisciplinary collaboration and decision making	4.6 (0.7)	4.4 (0.7)	4.6 (0.7)	−0.29
Able to think strategically and contribute to organisational goals	4.5 (0.7)	4.2 (0.9)	4.7 (0.5)	−0.75
Awareness of role and how it fits into broader organisational structure	*4.5 (0.8)*	*4.1 (1.1)*	*4.7 (0.5)*	*−0.81*
Able to manage conflict effectively	*4.3 (0.8)*	*4.0 (0.9)*	*4.5 (0.8)*	*−0.63*
Management of athletes and support staff	*4.2 (1.1)*	*3.2 (1.3)*	*4.5 (0.7)*	*−1.49*
Mentors new graduates and emerging sport scientists in the subfields of sports science	4.0 (1.1)	4.2 (0.9)	3.9 (1.1)	0.27
Creates appropriate relationships with relatives and carers (where relevant) of service users[1]	3.8 (1.4)	3.5 (1.4)	3.9 (1.3)	−0.33
Administration skills including planning, marketing, and budgeting	3.6 (1.0)	3.4 (1.0)	3.6 (1.1)	−0.18

1 = not important, 2 = slightly important, 3 = moderately important, 4 = important, 5 = very important, 6 = unsure.
SD = standard deviation, d = effect size.
Italicised text refers to responses that produced a moderate or large effect size ($d \geq \pm 0.5$) in the comparison between academic and applied sport scientists 'Unsure' responses excluded from analysis.
[1] Relevant for sport scientists who might work with youth or athletes with a disability whereby communication is required with them in addition to the athlete.

to experienced sport scientists (≥10 years) are summarised in Table 3. For current opportunities there was moderate agreement (all $M > 3.5$) that there were more full-time, part-time/casual, paid intern/honorarium, and unpaid intern/volunteer opportunities relative to 10 years ago. Results of ANOVA indicated no differences among ratings for each of the four types of opportunities and the effect size was small. There was also moderate agreement (all $M > 3.5$) that there would be more future opportunities in 10 years' time relative to now. ANOVA indicated no differences among ratings for each of the four types of opportunities and the effect size was small. Participants thought most future sport science roles would be more 'generalist (multi-discipline)' ($n = 62$, 67.4%) than 'specialist' ($n = 30$, 32.6%) when asked to select either response to the question 'which of the following do you think the majority of future sport science roles will be?'.

Key categories to emerge from quantitative content analysis of the three open questions are presented in Supplementary File 3. Responses for 'challenges to the industry' question were summarised according to 15 categories with 'supply versus demand' and 'value of sport science' the most frequently endorsed responses. 'Opportunities for the industry' responses were summarised into 13 categories with 'structural change' and a broad 'data' topic the most frequently endorsed. Responses for 'jobs of the future' were summarised according to 15 categories with the most frequently endorsed responses reflecting potential jobs with 'non-elite populations' and that jobs would be more 'discipline-specific'.

4. Discussion

The purpose of this study was to document the technical and transferrable skills needed for the sport scientist in 2020 and beyond, and the perceived employment opportunities both currently and in the future. Most technical and transferrable skills were rated as important by respondents. Although most effects were moderate, applied sport scientists (i.e., those not working in academia) rated practitioner-focused applied technical skills as somewhat more important, with scientific-focused academic technical skills rated as somewhat more important by academics. And apart from mentorship, applied sport scientists generally rated each transferrable skill as more important comparative to those working in academia. Overall, there was modest agreement for both current and future employment opportunities, with respondents in free text responses viewing future opportunities to be 'discipline specific' in nature and in non-elite populations. Challenges to the industry included concern around the value of sport scientists and a potential oversupply of graduates while the future jobs were likely to be in non-elite populations and/or discipline specific in nature.

Technical skills that require application of knowledge (e.g., able to analyse the demands of the sport and the capabilities of the athlete) were rated as being very important, whereas discipline-specific skills (e.g., assessment of fitness components including anthropometry) were not rated as highly. The need to have contemporary discipline-specific knowledge is a required attribute with it being rated equal highest. Previous research has shown that technical knowledge, instruction, and feedback provided by strength and conditioning coaches is viewed as essential by athletes to enable delivery of effective coaching.[15] Statements related to research design and methodology were rated more highly by academic participants, while most of the remaining statements were rated higher by the practitioners. This is likely due to the nature of the work and participants' employment sector. Sixty-six percent of the technical skills were rated 4 (important) or above and this may reflect university sport science programs being required to meet ESSA accreditation requirements.[16] They may focus on meeting the technical skill set as the transferable skills are often harder to assess in the education setting, as opposed to the applied field. Opportunities for students to develop transferrable skills are needed in addition to the technical skills and knowledge they acquire through formal study. The role of work integrated learning (WIL) is important here, as it provides an opportunity to enhance technical skills through 'hands on experience' by applying the theoretical knowledge learned at university in a real world, practical setting.[16,17] Work integrated learning are educational activities that integrate academic learning of a discipline with

Table 3
Perceived current and future work opportunities according to those having ≥10 years' experience in sport science industry ($n = 41$).

Variable	Full-time	Part-time/casual	Paid intern/honorarium	Unpaid intern/volunteer	F	df_{corr}	p	η_p^2
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)				
Current opportunities ('more now than 10 years ago')	3.9 (1.1)	4.1 (0.7)	3.6 (0.9)	3.8 (1.1)	2.1	2.3, 84.3	0.13	0.05
Future opportunities ('more 10 years in future than now')	3.6 (1.1)	3.8 (0.8)	3.5 (0.9)	3.5 (0.9)	1.2	2.6, 98.4	0.31	0.03

1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree.
Note: $n = 8$ cases missing data and 'not applicable (have not experienced)' responses excluded from analysis.

its practical application in the workplace. Internships, distinct from WIL also provide sport science students and graduates with opportunities to develop transferrable skills in an applied setting.[18] However, internships can be highly competitive with limited number of internships available compared to sport science students and graduates.[19]

All except two of the transferable skills were ranked as being important with communication skills (both written and oral) being the highest rated skill. Interpersonal skills such as effective communication and the ability to develop relationships, including the coach-athlete relationship have been shown to be important.[15,20] In line with the technical skills, applied sport scientist participants were more likely to rate these skills higher than the academic participants. The only transferrable skill rated higher by the academic participants was 'mentors new graduates and emerging sport scientists in the subfields of sports science'. The importance of interpersonal skills is likely to determine the effectiveness of knowledge translation even for the sport scientist with advanced technical knowledge, so should be included in professional development plans.[21] Development of interpersonal skills may be something that universities wish to expand on in their graduate training. Providing students with the opportunity to train real clients (i.e., not their peers) may assist in developing the interpersonal skills.

Participants believed that future job opportunities would be in the areas of non-elite sport and be discipline specific with the area of 'data', a specific growth area based upon free text responses. However, this contradicted the dichotomous responses to the question asking whether jobs would be generalist or specialist in nature, with two-thirds of respondents indicating generalist. The number of free responses of discipline specific nature ($n = 16$) is lower than the 62 participants who suggested roles are more likely to be generalist in the future. Furthermore, some of the 16 free text responses were individuals listing multiple disciplines (e.g., skill acquisition and psychology) which were considered distinct responses. Previous research has shown that for teams who have fewer staff, roles are more generalist in nature, whereas elite level clubs had greater staff numbers and thus greater specialisation.[22] There is a potential contradiction in responses with respondents suggesting more jobs in the non-elite section but also being discipline specific. It is possible that the non-elite environments participants are suggesting, have fewer resources than professional settings, so employing multiple discipline-specific sport scientists may not be possible. If multiple sport scientists are unable to be employed in an organisation, a generalist research-practitioner role (blend of academic and applied practitioner across multiple disciplines) can be beneficial for knowledge translation within organisations.[21] The volume of responses suggesting data is a potential growth area indicates that this discipline-specific role may be more likely in professional or well-funded organisations who can employ multiple sport scientists. These roles have and will likely continue to evolve due to a growth in technology and data that has led to increased opportunities in different support roles within sport teams.[23] Specifically, data scientists have become a distinct layer within the integrated support team.[24] Future research should look to further explore whether there is a need for discipline-specific knowledge at the professional level, but a need for generalist sport scientists in non-elite populations. This would provide graduates with a clearer pathway into sport science and allow them to make informed decisions on the career choices.

Another area of concern identified in the current study was around the value of sport science, including how organisations and coaches value (or don't) sport scientists. Some participants reported via open ended questions that sport scientists were not valued in an organisation and are often under remunerated in comparison to other staff. In 2021, ESSA released a salary guide for accredited sport scientists working within Australia.[25] This provides a salary range guide for organisations employing sports scientists for entry level positions ($70,000 - $79,999) through to senior positions (minimum 10 years' experience) ($120,000+). Sport scientists could use this guide to inform employers of their value and assist them in salary negotiations. Responses also indicated that when funding was an issue, sport scientists are the first staff to lose their positions suggesting that organisations do not value the contribution of sport scientists as highly as other positions within the organisation (e.g., coaches). A further value-related concept reported by participants in their free-text responses relates to the oversupply of graduates willing to work in sport science, and the potential exploitation that can occur where people work for free or very little renumeration under the guise of internships or gaining experience. There have not been any reports into the actual number of sport science roles relative to the number of graduates looking to work in sport science, so this is currently a perceived and anecdotally reported oversupply.

Work integrated learning is an important aspect of any university program[16] and may encompass not only on the job learning and experience, but simulations, case studies and similar learning experiences. While experience gained during study is important and contribute to an individual's development, there seems to be an expectation of post-graduation experience. However, the amount of experience that may be expected to be acquired post-graduation for limited remuneration is of concern. As a result, two major accrediting bodies, ESSA and BASES have released positions statements regarding internships in sport science.[17,26] Both statements outline what an internship is, potential benefits and considerations, such as renumeration, length, 'working' hours and outline good practices. They also have reference guides to assist employers in determining whether an internship is most appropriate, or they should engage an employee for the role. Further education is required so sporting organisations recognise the value of sport scientists and therefore provide appropriate remuneration. Furthermore, universities need to educate undergraduate and postgraduate students around WIL, internships, and the appropriate expectations they should have in addition to the types of roles they should be undertaking as an intern. It is important to recognise that a core concept of the ESSA guidelines state that an internship experience should be mutually beneficial for the both the graduate and the organisation.

We were unlikely to reach all sport scientists with our sampling methods. The ESSA 2020 annual report showed that 353 people were registered as an accredited sport scientist and 75 as a high-performance manager.[14] However, it is expected that more people may classify themselves as a sport scientist and/or strength and conditioning coach than are accredited with ESSA due to the relative recency of accreditation requirements within Australia. Therefore, our sample size may represent a small sample of sport scientists within Australia. The absence of reliability and validity information on the current and previous survey upon which this was based[1] is a limitation of this study. It is recommended that future research in this area include this preliminary assessment. It was thought that the increase in professional women's competitions may have led to participants to listing women's sport as a future opportunity (i.e., more jobs in the future), however, only 6% of responses suggested women's sport as a future opportunity. This is somewhat surprising; however, the participants may already believe that roles with these organisations (i.e., professional women's teams) have been filled and thus, they are not a future opportunity. Participants may have been thinking beyond gendered terms when providing responses, as the top three most common responses (non-elite populations, discipline specific and data) could occur in any sport context. While participants may not have responded with women's sport as a future growth opportunity, anecdotally there are more sport scientists working in female sport than 10 years ago.

5. Conclusion

A large range of technical and transferable skills were rated as important by respondents. Participants were somewhat optimistic there would be more jobs for sport scientists in the future. They believe these opportunities would arise in non-professional sport, be discipline-specific and the field of 'data' may provide more opportunities

than other areas. The greatest challenges of the industry were the value, both in terms of how sport science is valued within an organisation and the monetary value of sport scientists, and the supply and demand of sport scientists.

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Declaration of interest statement

No interests to declare.

Confirmation of ethical compliance

Ethical approval was obtained from Deakin University Ethics Committee.

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Appendix A. Supplementary data

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