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Practitioner usage, applications, and understanding of wearable GPS and accelerometer technology in team sports.

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ABSTRACT

Monitoring training load is essential for optimizing the performance of athletes, allowing practitioners to assess training programs, monitor athlete progress, and minimize the risk of injury and overtraining. However, there is no universal method for training load monitoring, and the adoption of wearable global positioning system (GPS) and accelerometer technology in team sports has increased the volume of data and therefore the number of possible approaches. This survey investigated the usage, applications, and understanding of this technology by team sports practitioners. Seventy-two practitioners involved in team and athlete performance monitoring using GPS and accelerometer technology completed the survey. All respondents reported supporting the use of GPS technology in their sport, with 70.8% feeling that GPS technology is important for success. Results showed 87.5% of respondents use data from wearable technology to inform training prescription, while only 50% use the data to influence decisions in competition. Additionally, results showed GPS metrics are used more than accelerometer-derived metrics, however both are used regularly. Discrepancies in accelerometer usage highlighted concerns about practitioners' understanding of accelerometer-derived metrics. This survey gained insight into usage, application, understanding, practitioner needs, and concerns and criticisms surrounding the use of GPS and accelerometer metrics for athlete load monitoring. Such information can be used to improve the implementation of this technology in team sport monitoring, as well as highlight gaps in the literature that will help to design future studies to support practitioner needs.

Keywords: GNSS, training load, athlete monitoring, coaching, wearable technology

INTRODUCTION

Over the last two decades, there has been a rapid increase in the adoption of wearable global positioning system (GPS) and accelerometer technologies for tracking and monitoring athlete performance (12,20). The devices used in team sports are predominantly trunk-mounted and usually combine GPS receivers with an accelerometer, magnetometer, and gyroscope (7,12,23). This provides the capability to report GPS-derived metrics such as total distance, maximum speed, and high-speed running distance, alongside accelerometer-derived metrics such as the number or intensity of impacts, and estimation of load from the accumulation of instantaneous accelerations experienced by the athlete (*e.g.*, PlayerLoad, Dynamic Stress Load, or Body Load) (4,21,35). The importance of monitoring athlete performance is widely accepted and publicized (17,28,36,37). Some key areas of athlete performance in which this technology has been applied are athlete load monitoring (8,14,35), training optimization (14,27), tactical analysis (3,30), and injury risk reduction (8,35). The technology allows practitioners to gain greater insight into athlete performance and help to make informed decisions regarding athlete load management (17,27,37). This, combined with the introduction of new and improving technologies, means the area of athlete monitoring is ever evolving to optimize practices (29,37).

A previous survey investigating training load monitoring methods in professional football found all 41 professional football clubs surveyed used GPS technology (1). Moreover, they found almost all professional football clubs surveyed (39 out of 41) used accelerometers for athlete load monitoring during training but none during competition. Similarly, a study of 12 practitioners representing the 12 English rugby Premiership clubs identified all used GPS technology, the study highlighted the importance placed on GPS metrics by clubs for both performance and injury risk management (38). Contrastingly, only 17% of 33 amateur rugby union clubs used GPS technology (18). However, some amateur rugby coaches said they would use GPS devices if they had access to them, suggesting that the use of this technology is limited by some barriers (*e.g.*, financial) at lower competition levels. Consequently, to facilitate the adoption of wearable technology in sport, we should try to understand the practitioners' perceptions, and applications when using such technology on a regular basis.

Strength and conditioning coaches and athletic trainers in NCAA Division 1 sports (24), and professional football coaches (1) report there is no consensus on the most applicable metrics for monitoring the external loads an athlete can handle, and they struggle to find time to manage all the data captured by wearable technology (24). Moreover, it is accepted that there are no universally adopted methods of monitoring athlete load (1,32). This study adds to limited evidence surrounding the approaches of practitioners using trunk-mounted GPS and accelerometer technology to monitor athlete load in team sports. Therefore, investigating the various approaches to monitoring athlete load using GPS technology is necessary to progress the field (35). With increasing literature and development of accelerometers within GPS player tracking systems, the current utilization of accelerometer-derived metrics is of interest (6,9,16,26,31). However, the number of metrics this technology can provide may leave practitioners faced with too many options to make meaningful use of. While it might seem that with more data comes more knowledge, this can be futile if practitioners cannot use it to draw informed and insightful conclusions (25,26). Therefore, ensuring the understanding of the more complex accelerometer-derived metrics offered by new technologies and companies may be of interest to practitioners.

Consequently, this study aims to explore the opinions, understanding and practices of practitioners using trunk-mounted GPS and accelerometer technology in team sports. This information is vital in highlighting issues, understanding practitioner needs, and supporting optimal practice.

METHODS

Experimental Approach to the Problem

This survey investigates the usage, applications, understanding, and opinions of the practitioners involved in monitoring athletes and teams using wearable GPS and accelerometer athlete monitoring in outdoor and invasion team sports. This survey consisted of 50 items (*i.e.*, a series of closed, semi-closed, and open questions), across three sections: section 1 gathering background information, *e.g.*, job role(s), years of experience, and sport(s) involved in; section 2 assessing opinions of wearable technology; and section 3 identifying current practices, *e.g.*, applications, understanding, concerns and criticisms. Prior to distribution, the survey design was reviewed by a panel of seven researchers and practitioners not involved in the study, to ensure content and face validity.

Subjects

Seventy-two respondents met the inclusion criteria, with 7.7 ± 5.8 years of experience in their role, and with experience of using GPS technology for regular athlete load monitoring in team sports. The survey was aimed at any coaching, sport science, and medical staff involved in athlete load monitoring using trunk-mounted GPS and accelerometer technology. To account for variations in job roles, all respondents were required to have experience regularly using GPS and accelerometer technology for athlete load monitoring in at least one outdoor or invasion team sport, and responses were considered from the perspective of their current or most relevant (if multiple) role. As a result, all aforementioned job roles were considered collectively. Responses were excluded if a survey was less than 50% complete, if the respondent had not reported experience in any team sports, or if the respondent did not identify the use of any GPS player tracking technology. Only one survey could be completed from each IP address and participants were given 3 months to complete the survey from the first time it was accessed. The median time to complete the survey was 8 min 23 s [interquartile range [IQR]: 6 min 37 s]. Informed consent was obtained from all subjects in an anonymous format prior to beginning the survey. The study protocol received ethical approval from the Research Ethics Committee at the University of Suffolk (Ref: RETH20/049).

Procedures

A cross-sectional online survey was conducted using Qualtrics Survey Software (Qualtrics XM, Provo, UT, USA) from May 2021 to May 2022, to maximize participant availability across sports and regions, covering a full season. An anonymous web link was distributed via methods of social networking, enabling contact with relevant groups and individuals, sport science and coaching networks, and online noticeboards within the appropriate communities. The survey included a series of closed, semi-closed, and open questions. Closed questions consisted of 5-point Likert scales (1 – 5 representing "strongly disagree" to "strongly agree") exploring opinions, 11-point rating scales (0 being the lowest to 10 being the highest) to gain insight into applications and understanding, and percentage scales to express extent of usage in training or matches. Semi-closed questions were multiple choice with the option to add text to provide additional information. Finally, two open questions asked respondents to demonstrate their understanding of a metric and express any concerns with GPS and accelerometer technology.

Statistical Analysis

Survey responses were exported from Qualtrics and collated in Excel (Microsoft Corporation, Redmond, WA, USA). Closed responses were analysed via descriptive statistics (Likert – frequency count, percentage; rating scale – median and IQR), with Likert scale data coded as: 1 "strongly disagree"; 2 "disagree"; 3 "neither agree nor disagree"; 4 "agree"; and 5 "strongly agree". Semi-closed responses were also analysed through frequency counts. These results have been expressed as absolute values or as a percentage of the total responses. Six-phase thematic analysis was conducted on open question responses regarding concerns, criticisms and any additional comments made. Following an initial familiarization phase, aiming to read and engage with all responses to fully understand them, the responses were coded by identifying meaning and associating to similar meaning terms (*i.e.*, words, sentences) (phase 2). Repetition of the coding process refined the coding terms, which were developed into themes (phase 3; *i.e.*, identifying patterns that encompass broader shared meanings), refined into subthemes (phase 4; *i.e.,* highlighting important or distinct features), and labelled appropriately (phase 5). Phases 3 to 5 were reviewed by a second researcher to reach consensus and confirm findings, and finally reported (phase 6) (10). Open responses relating to practitioner level of understanding were assessed by two researchers, independently of each other, coding and categorizing them against standardized agreed guidelines *e.g.*, 'good' (demonstrates understanding with correct definition including multiple specific details), 'moderate' (some correct details given *e.g.*, "accumulation or sum of accelerations" or "accelerations in X,Y,Z axes"), 'poor' (very vague definition *e.g.*, "measures accelerations" or "athlete load metric"), 'irrelevant' (response left blank or not given as a definition *e.g.*, "I prefer using other metrics") or 'incorrect' based on the content of each response. Responses were disregarded as copied if identical or near identical quotes could be found in an internet search. Discrepancies in categorization by the researchers were discussed until an agreement was met.

RESULTS

Respondents

Across the 72 practitioners, 85 total roles were identified (12 selecting multiple roles); 44 sport scientists, 26 strength and conditioning coaches, 6 coaches, 5 sports therapists, and 4 physiotherapists. Multiple competition levels were also identified by the respondents (32 selecting multiple); results identified 50 with experience at a professional level, 25 at semi-professional, 15 at amateur level, and 29 at youth/academy level. Some combinations of options may be selected to describe an individual role - e.g. 'professional' and 'academy'. Respondents came from eighteen different sports that met the inclusion criteria (20 selected multiple, 102 total selections). The most common sports were soccer/football (n = 49), rugby league or union (n = 19), Gaelic football (n = 6), cricket (n = 5) and field hockey (n = 5).

Usage

Across all respondents, 16 different player tracking system manufacturers were identified as being used. The most common manufacturers of systems used by the respondents for athlete monitoring in team sports were Catapult (n = 32) and STATSports (n = 27). Others identified by multiple respondents were K-Sport (n = 5), GPSports (n = 2), Johan (n = 2), Kinexon (n = 2), and Polar (n = 2). Fieldwizz, GPExe, McLloyd, Spinitalia, SPT, Titan, VX Sport, and WIMU Pro were each identified once.

Table 1 displays all Likert responses from the survey. All 72 respondents ‘support’ or ‘strongly support’ the use of GPS technology in their sport, while 94.4% (n = 68) feel others around them also support this and 34.8% (n = 25) of practitioners rate their own support as higher than their perception of the support from other staff. Only one respondent considers their own support to be lower than support from other staff.

Table 1 – Likert scale statements, frequency of responses (on scale of 5 [strongly agree] to 1 [strongly disagree]), and bar graphs representing distribution (separate scale per question).

****Table 1 here****

The majority (70.8%) of practitioners agree (n = 34) or strongly agree (n = 17) that the application of GPS technology is important for success in their sport, with only 8.3% disagreeing (n = 4) or strongly disagreeing (n = 2). Additionally, 65.3% of respondents agree (n = 30) or strongly agree (n = 17) that the use of GPS technology has improved player performance. Furthermore, as shown in Figure 1, 69.4% of practitioners agree (n = 30) or strongly agree (n = 20) that they are happy with how GPS technology is currently used in their club, however 69.4% also agree (n = 23) or strongly agree (n = 27) that GPS technology should be used more. This latter result is supported by 79.2% disagreeing (n = 30) or strongly disagreeing (n = 27) that the technology should be used less. However, 79.2% agree (n = 36) or strongly agree (n = 21) that GPS technology could be used differently/more effectively.

**** Figure 1 here ****

Figure 1 – Likert scale responses showing the opinions of current usage of GPS technology in team sport.

When asked whether they felt GPS technology was cost-effective, 31.9% indicated disagree (n = 18) or strongly disagree (n = 5), 43.1% agree (n = 21) or strongly agree (n = 10), and 25% neither agree nor disagree (n = 18). Of the 31 practitioners that agree or strongly agree, 71%

have been involved at a professional competition level. Contrastingly, 60% of the practitioners involved in amateur clubs (n = 9/15) disagree or strongly disagree that GPS technology is cost-effective.

Application

Results showed that both GPS and accelerometer functions are used more in training sessions (median [IQR] GPS 100% [90 - 100%]; accelerometer 100% [40.75 – 100%]) than matches (GPS 100% [91.25 – 100%]; accelerometer 100% [1 – 100%]). These results indicate that 91.5% and 84.3% of respondents are using GPS in more than half of training sessions and matches, respectively. Where 67.4 % and 72% are using accelerometer functions in more than half of training session and matches, respectively.

The range of metrics employed by practitioners is demonstrated in Figure 2. The most common metric is GPS-derived 'total distance', used by 93% of respondents (n = 67), and the most common accelerometer-derived metrics are 'PlayerLoad or Body Load or Dynamic Stress Load', used by 39% of respondents (n = 28). Conversely, in a later question, 56% of respondents indicated that they use accelerometer-derived load metrics such as these (n = 40).

****Figure 2 here****

Figure 2 – GPS-derived (dark grey) and accelerometer-derived (light grey) metrics used by practitioners in the monitoring of athlete training load (n=72).

Decision Making

GPS and accelerometer technology inform training and competition to different extents, with 87.5% either agreeing (n = 28) or strongly agreeing (n = 35) that data from this technology informs training prescription. In contrast to this, only 50% either agree (n = 23) or strongly agree (n = 13) that the data influences decisions in competition (Table 1). Open questioning also highlighted the role in decisions regarding substitutions in competition and drill choice during training. On a scale of 0 – 10, 0 being never and 10 being all the time, practitioners reported that accelerometer-derived metrics predominantly informed decisions regarding training periodization (median [IQR] 6.5 [1.75 - 8]), followed by injury rehabilitation (6 [3 - 8]), training load monitoring (6 [3 – 7.75]), injury prevention (4 [1.5 – 7.5]), and match load monitoring (3 [0 - 6]).

Understanding

Likert scale responses showed 84.7% of respondents agree (n = 29) or strongly agree (n = 32) that GPS metrics are easy to understand, with only 47.2% either agreeing (n = 30) or strongly agreeing (n = 4) that accelerometer-derived metrics are easy to understand. Overall, practitioners rated their understanding of accelerometer-derived metrics as 7 [5 - 8] out of 10. Furthermore, 38 respondents also gave a brief definition to demonstrate their understanding. Comparisons of practitioners' rating of their understanding against the accuracy of the definition they provided showed there were similar ratings across the respondents despite a wide variation in actual understanding demonstrated by the definitions given. For example, practitioners demonstrating 'good' understanding in their response rated themselves 7 [5.25 – 8.75], while practitioners demonstrating 'poor' understanding rated themselves 7 [6 -7], and those demonstrating 'moderate' understanding rated themselves 8 [5 - 8]. Table 2 summarizes all ratings of understanding relative to the evaluated accuracy of their definitions provided.

Table 2 – Median and interquartile ranges of practitioners' ratings of their own understanding (on a scale from 0 to 10) categorized by their assessed understanding (assessed by researchers against agreed definitions).

****Table 2 here****

Practitioner Needs

Figure 3 shows that 93.1% of practitioners feel wearable technology requires further standardization of metrics and processes (n = 32 strongly agree, n =35 agree), with the remaining 5 responding neutrally. Similarly, 70.8% expressed the need for more access to wearable technology, while 25% felt neutral (n = 18), only 3 respondents felt that they would not benefit from more access. Finally, 90.3% of practitioners agreed (n = 48) or strongly agreed (n = 17) that there is a need for further education surrounding wearable technology.

****Figure 3 here****

Figure 3 – Likert scale responses highlighting some potential areas for improvement surrounding current wearable technology application.

Figure 4 displays that 47.2% agree (n = 24) or strongly agree (n = 10) there is enough relevant research regarding GPS and accelerometer-derived athlete monitoring in their sport or discipline, while 29.2% disagree (n = 20) or strongly disagree (n = 1), and 26.4% feel neutral (n = 18). Moreover, practitioners feel further research for GPS-based athlete monitoring (77.8%), accelerometer-based athlete monitoring (91.7%), and quantification of athlete load (86.1%) would be beneficial.

****Figure 4 here****

Figure 4 – Likert scale responses regarding the current opinion on research availability, and some areas for further research.

Concerns and Criticisms

Twenty-six respondents left additional comments regarding concerns, criticisms, and areas for development of specifically accelerometer-derived load metrics. Some common themes were evident in the responses (Table 3).

Table 3 – Comments regarding concerns, criticisms, and areas for development of accelerometer-derived load metrics from 26 respondents.

****Table 3 here****

DISCUSSION

This study aimed to explore the opinions and practices of practitioners using trunk-mounted GPS and accelerometer technology on a regular basis in team sports. Gaining insight into usage, application, understanding, practitioner needs, and concerns and criticisms surrounding the use of GPS and accelerometer metrics for athlete load monitoring. Responses have highlighted the support from practitioners and the extent to which data from GPS player tracking systems is applied for athlete load monitoring. The technology is used and applied in training sessions for load monitoring, training prescription, and supporting rehabilitation. However, the results have identified concerns for the cost-effectiveness at lower competition levels, understanding of metrics (specifically accelerometer-derived), and optimization of practices.

All respondents indicated that they support the use of GPS technology in their sport, however, notably, 34.8% of practitioners still rated their own support as being higher than their perception of the support from other staff (Table 1). A previous survey of 41 professional football clubs found all 41 used GPS technology, and 95.1% (n = 39) used accelerometers for athlete load monitoring during training, however they highlighted that no clubs were using GPS or accelerometer monitoring during competition, and professional practitioners (consisting of fitness coaches, strength and conditioning coaches, and sport scientists) identified coach buy-in as a barrier to effective training load monitoring practices (1). In contrast, our study identified high levels of perceived support from other (94.4%), and a large majority feeling that GPS technology is important for success (70.8%) and has improved player performance (69.4%). The findings of our study also indicate a considerable increase in the use of wearable technology during competition highlighting that 50% use the data to influence decisions in competition, meanwhile 87.5% of respondents use data from wearable technology to inform training prescription. Therefore, it seems that GPS and accelerometer-based technology plays a role in many aspects of athlete monitoring while helping to inform decision-making predominantly during training, as well as during matches to a lesser extent (15,33). This suggests that attitudes towards technology for athlete load monitoring may have changed since Akenhead and Nassis' study in 2016 (1), which could be attributed to an increased awareness and development of the technology (12,13,19,24,29).

Additionally, the results have demonstrated that the GPS functions of this technology are used more than the accelerometer functions. From Figure 2, and previous literature, it is clear that distance and speed-associated metrics, as well as running accelerations and deceleration event counts (calculated from GPS data), are far more popular amongst practitioners (5,8,19,38). This could be attributed to a greater understanding of GPS data (21), practitioners in this study reported they find it easier to understand GPS metrics (84.7%) than accelerometer-derived metrics (47.2%) (Table 1). This could be due to familiarity and clearer quantification available with distance and speed-associated metrics (5,8,19), which may lead to greater value to practitioners (38). West et al. (38) recognized a similar finding from a survey of 12 practitioners from the English rugby Premiership, highlighting the greater importance placed on GPS metrics. Conversely, the lower usage of accelerometer-derived metrics could speak to a lack of value or understanding that leads to a lack of application of these metrics (6,7,38). Practitioners reported that more than half of the time, accelerometer data alone influences decisions regarding training load, training periodization, and rehabilitation, while decisions regarding match load are informed approximately 30% of the time. However, there is a potential discrepancy between reported data collected (72% use in more than 50% of matches) and data used (~30% of match load decisions). Firstly, this may demonstrate that while the technology is used, the data is not always being applied. In some contexts, the misuse or lack of use of data could suggest inefficient practice within a department (29,33). Highlighting the importance of considering methods to optimize practice when implementing GPS and accelerometer technology. Secondly, this suggests that this may be the result of some uncertainty or lack of understanding of where these metrics originate, and so about their meaning. This is supported by a 2022 FIFA quality report (29) regarding player tracking systems that emphasizes the importance of considering the data collection protocols when interpreting data, such as playing environment (15,29,34) e.g. the presence of a roof, stadium, or open field, and satellite availability (15,16,23,26,33). This is also concurrent with suggestions from previous literature that the GPS unit should be consistently used by the same player to minimize inter-unit variation, and attached using appropriate garments (13), to enable comparisons between sessions (7,21,26,33).

The insight that practitioners may not completely understand accelerometer-derived metrics became repeatedly apparent throughout the survey responses. A comparison of practitioners' perception of the level of their understanding and their consequent provision of a definition highlighted the possibility that, in some cases, practitioners may unknowingly lack understanding and consequently misuse or misinterpret the metrics (6). In a review of wearable technology for athlete load monitoring, Cardinale and Varley (13) concluded that practitioners gravitate toward metrics that are easier to measure when monitoring athlete load. This may explain the previously identified lesser use of accelerometer-derived metrics, and may also present a causality dilemma between lack of use by practitioners and a number of common misconceptions apparent from definitions of accelerometer load metrics provided by the respondents in this study (Table 2), for example '*Amount of force and impact placed to the feet when running' and 'variation of speed of the player, partially reflecting the muscle load experienced*'. Similarly, 5 practitioners rated their understanding as 7/10, then gave definitions classified as 'poor' by the authors when prompted, while the 4 'incorrect' definitions provided were from 3 practitioners rating their understanding as 6/10, and another practitioner rating as 7/10 (Table 2). Overall, these findings suggest that practitioners' perception of their understanding of these metrics is potentially higher than their actual understanding. As a result, it would be recommended to implement an educational process to facilitate the comprehension of these metrics to sport scientists and coaches, which should increase the chances of buy-in from practitioners and improve the implementation of GPS technology into athlete load monitoring (19).

Our findings have highlighted that many practitioners recognize the need for improved educational processes as results demonstrate a clear demand among practitioners for further education (90.3%). One practitioner commented: "*We as a staff find it hard to really understand these metrics or exert any influence upon them in order to prescribe certain training loads*", suggesting that, for some, further education is a necessity. Additionally, practitioner responses highlighted the need for improving accessibility, and standardization for wearable technology in sport, a theme that is also apparent in literature (11,21,26,38). Similarly, multiple practitioner comments support this, such as "*[Needs] standardization, position statements on standard methods of practice to make comparing studies more streamlined*". This coincides with responses, and existing literature, suggesting there is a lack of published research and normative data that can provide context and guidance for practitioners (13,19,29). Many expressed they would benefit from further research being made available for GPS-based athlete monitoring (77.8%), accelerometer-based athlete monitoring (91.7%), and research to quantify athlete load (86.1%) (Figure 4). For example, "*There needs to be a greater investigation of these metrics. Currently there remain many questions about its optimal application*", as well as "*Need further research to highlight its relationship with specific drills and how it can be used in periodization*". These could be resolved with further education of practitioners and standardization of practice and metrics. Future research should work towards quantifying arbitrary metrics and standardizing data collection and data analysis practices for consistency, in an effort to ultimately improve practitioner understanding and interpretation of data (11,21,26,38).

This study is not without limitations. In this study, we were unable to make comparisons between competition level and sport. This was due to the respondents' ability to select multiple sports and competitions levels to best reflect their background, responsibilities, and experience.

As a result, often multiple competition levels identified components of a role that may exist in parallel - e.g. 'professional' and 'academy' or 'amateur' and 'youth'. Separating into groups for comparison would lack sufficient sample size, statistical power and we would be unable to ensure that a true comparison can be made (22). Similarly, respondents were able to identify multiple ‘roles’ from pre-identified job titles (sport scientist, strength and conditioning coach, coach, sports therapist, and physiotherapist) to best reflect their responsibilities. As a result, we were unable to separate opinions of one role from another. A direction for future research could include greater emphasis on how the applications of GPS technology differ between job roles. This was not possible in this study, as to isolate and report the responses of the ‘coaches’ would be biased; a prerequisite for participating was that the respondent personally uses GPS technology for athlete load monitoring within their club. Consequently, it is also acknowledged that this study may be subjected to participants’ response bias whereby only those with strong opinions regarding this topic may have felt compelled to complete the survey (2).

Additionally, none of the questions were compulsory. As a result, it was possible to submit incomplete surveys. To ensure full consent, only surveys with over 50% completion were accepted for data analysis as ceasing to respond was considered as withdrawal of consent. Similarly, surveys were removed from analysis if not appropriate for the sample, for example, not from a team sport or omission of sport, lack of response indicating the use of GPS technology, or lack of identification of technology used. In total, 5 participants were removed prior to data analysis, therefore some responses were disregarded. As incomplete and non-submitted surveys were considered to not consent to participate, the Qualtrics Survey software did not monitor the number of surveys started and not submitted. As the survey was distributed through online networks, there is no accurate method of identifying the audience reached and therefore measuring the completion rate.

Finally, while a survey approach was chosen due to the efficiency and global reach for data collection, this method may have limited the evaluation of finer nuances in the use and application of GPS and accelerometer athlete load monitoring (2). Future research should consider using interviews or a greater depth of open questioning and could focus on evaluating sports and competition levels separately allowing the potential for comparison, and a greater understanding of specific applications across team sports. As these findings also identified requirements to work towards quantifying arbitrary metrics, standardizing data collection and data analysis practices for consistency, and to improve interpretation of results, future research should also consider studies to further improve data collection practices i.e. garment attachment methods, more longitudinal studies to better understand practical applications and interpretations of certain metrics in sporting environments. Achieving a consensus in data collection practices, better quantification, and improved understanding between practitioners could improve the potential uses and successful application of GPS and accelerometer-derived athlete load monitoring in sport (13,26,38).

PRACTICAL APPLICATIONS

This study explored the opinions and perceptions of practitioners using trunk-mounted accelerometer and GPS player tracking systems in team sports, identifying the support from practitioners and the extent to which data from GPS player tracking systems is applied for athlete load monitoring. This has suggested changing attitudes towards GPS technology compared to earlier studies. Key findings from this study suggest a lack of understanding of accelerometer-derived metrics compared to the GPS-derived metrics, resulting in a perceived lack of value, or potential to misuse or misinterpret these. Consequently, it is recommended to facilitate and encourage practitioner education on the use of GPS and accelerometer technology. It has been recognized that understanding practitioner support for technology being implemented, enabling their needs, and encouraging discussion and agreement in practices amongst staff can be critical to the successful implementation of GPS and accelerometer technology. As a result, it is also important to consider the accessibility of the technology and software and standardize and optimize practices and metrics.

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