Exploring the Practical Knowledge of Eccentric Resistance Training in High-Performance Strength and Conditioning Practitioners

Mellissa Harden[1,2,3], Claire Bruce[1], Alex Wolf[2], Kirsty M Hicks[1], Glyn Howatson[1,4]

[1]Department of Sport Exercise and Rehabilitation, Faculty of Health and Life Sciences, Northumbria University, Newcastle-Upon-Tyne, UK

[2]English Institute of Sport, UK

[3]Directorate of Psychology and Sport, University of Salford, Salford, UK

[4]Water Research Group, School of Environmental Sciences and Development, Northwest University, Potchefstroom, South Africa

Corresponding author:

Glyn Howatson
Department of Sport Exercise and Rehabilitation
Faculty of Health and Life Sciences
Northumbria University
Newcastle-Upon-Tyne
UK
Tel: +44 (0) 191 227 3575
Email: glyn.howatson@northumbria.ac.uk

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ABSTRACT

Habitual use of eccentric exercise has been recognised to increase strength and power; however the current body of knowledge has limited potential to understand the application of such resistance training in athletic populations. In order to develop appropriate applied research, that relates to elite athletic populations, it is vital to appreciate the practical knowledge of strength and conditioning practitioners operating in high-performance environments. This study summarised the questionnaire responses from 100 strength and conditioning practitioners operating in performance sport relating to questions such as the training effects to various eccentric resistance training regimes, the rationale for the use of these techniques and the knowledge supporting its application. The combination of closed and open-ended questions enabled a thematic analysis to be conducted. There was evidence that practitioners employed a variety of eccentric training methodologies; however, there was interest in gaining greater understanding of the training dose to bring about the optimal adaptive changes, and importantly how this might translate to sport-specific performance. In addition, practitioners would welcome recommendations associated with eccentric training, whilst concurrently minimising the issues of excessive fatigue, muscle damage and soreness. The training effects of interest included neural, architectural and morphological adaptations and, importantly, translation to performance of sports specific skills. Collectively, these responses called for more practically relevant research to be conducted within the high-performance environment, alongside more opportunities for professional development through learning and knowledge sharing opportunities. The outcomes summarised in this work should inform future applied research projects and educational content relating to eccentric training.

KEY WORDS: lengthening, questionnaire, training practice, coaches, exploratory

INTRODUCTION

Strength and conditioning (S&C) coaches must offer greater variety and more complex loading paradigms using diverse resistance training approaches to continually support neuromuscular development and nurture longer-term progression of athletic performance [4]. One potential methodology to provide a potent training stimulus is the use of accentuated eccentric resistance exercise [30]. Eccentric resistance training is classed as an advanced training method when the application involves emphasising the descending phase of an exercise and can draw upon the greater force producing capacity of eccentric muscle actions [13,22]. The intensity of this stimulus can be submaximal (less than 100% maximal concentric voluntary contraction; MVC) or indeed supramaximal, where the eccentric movement is in excess of 100% of MVC.

Inherently, the maximum force producing capacity of eccentric muscle actions exceeds that of concentric or isometric muscle actions [16,18], which is due in part to 1) lower neural activation from cortical descending drive (detected using surface EMG) per unit of force, and the preferential recruitment of faster motor units in comparison to isometric and concentric actions [14]; and 2) mechanical processes [21] that affect the excitation-contraction coupling processes and non-contractile cell ultrastructure compared to isometric and concentric actions. Consequently, greater external load can be used during the descending phase of an exercise (in contrast with the ascending phase) to create the potential for a higher-intensity stimulus to prompt distinct neuromuscular, morphological and molecular muscle responses undergoing lengthening actions [14,15]. The specific responses following the habitual use of higher-intensity eccentric exercise include increased strength and neural activation, and increased hypertrophy than can collectively be translated to generate more power [1,9,10]. For this reason, there is a great deal of interest in eccentric training, particularly high intensity eccentric training for athletes, and from coaches and S&C practitioners; especially those who operate within strength-power based sports where strength an power are important determinants of performance [1,8].

Often, the current body of research pertaining to high-intensity eccentric resistance training employs non-athletic populations that are prescribed training in a manner that is removed from a high-performance environment. However, there are a few limited examples where higher intensity eccentric training has been employed in trained populations [5,8,11,26], but in general there is a dearth of information that could be of value to elite athletes. Importantly, the current body of evidence has limited potential to understand the application for training prescription and adaptation in an athletic population. In order to develop appropriate applied research that could positively impact on practice in elite environments, it is vital to appreciate the practical knowledge of high-performance S&C practitioners and consider real-world performance challenges and questions that will be useful to inform the day-to-day work of the end user and other stakeholders. Consequently, this study aimed to gain an insight into the knowledge of eccentric resistance training in high-performance S&C practitioners in regard to application to the high-performance athlete. Collation of experiential knowledge has the potential to inform future applied research projects and educational content. Importantly, we employ a thematic analysis to ascertain and quantify responses between respondents to identify areas of commonality and importance.

METHODS

Participants

Prior to data collection, the study was ratified by Northumbria University Research Ethics Committee. Respondents were recruited through the use of online platforms (Twitter and Facebook and email networks) to canvass participation from high-performance sport networks. These individuals were considered to provide information-rich responses relevant to elite athletes. Respondents were encouraged to pass on details of the investigation to other high performance practitioners working within elite athlete environments. This method of recruitment is referred to as 'chain sampling' which is a nonprobability sampling technique used as a means to capitalise on expertise [29]. To meet the inclusion criteria respondents must previously specialised, or currently specialising, in the S&C professions; have worked or are working with elite athletes at National, International and/or Olympic level. Prior to completing the questionnaire, subjects provided electronic informed consent.

Procedures

The electronic questionnaire was distributed to a volunteer cohort of high-performance S&C practitioners which took approximately 10-15 minutes to complete. The questionnaire comprised of a combination of closed and open-ended questions. Open-ended questions were included to gather richer and more detailed explanations and comments without inducing bias from the investigator [27]. Specifically, the questions offered space for the respondents to provide details of the methods they have used to employ eccentric exercise, to describe their experiences when implementing eccentric exercise and to express their perspectives about the usefulness of eccentric exercise in athletes' physical preparation regimes. The format of these questions ensured that the respondents had the opportunity to suggest areas that they would like to see investigated, which might otherwise be missed in the questionnaire. Overall, five open-ended questions were included in the questionnaire that addressed; observations, limitations or concerns and noteworthy remarks about the application of eccentric training regimes, followed by questions addressing research areas of interest and any additional comments about the use of eccentric training within the athletes' physical preparation programmes.

The remaining questions were closed questions in multiple choice format. These questions addressed practitioner demographics and the background of sports and athletes that the respondents have worked with. Next, the questions addressed the programmes that have been used to employ eccentric exercise with athletes (i.e. methods and equipment used, set-repetition schemes, training loads). A subsequent section addressed how (and if) different methods of eccentric exercise have been used and whether there is a perceived benefit in using these methods. Prior to distributing the questionnaire, a pilot questionnaire was distributed to four practitioners to assess suitability for the intended audience. The questionnaire was distributed using an online survey tool (Bristol Online Surveys, Bristol, UK).

Importantly, establishing generalisations across the responses enabled the investigators to draw inferences that resonate with the broader target population of S&C practitioners operating in elite athletic environments, given that the information was derived from a large sub-group of this broader target population [27]. Consequently, should scientific research address these themes, the outcomes would hold relevance to the applied setting in elite sport and could be used to inform practice in these specific environments [23]. To ensure validity of the generalities, criteria based on the 'non-foundational approach' [27] was used as a framework. The framework addressed the clarity of a response, and coherence of a group of responses, to offer consistency within a given theme which made sense when taken together, and when displayed to the reader through direct quotations. Importantly, the responses and themes were evaluated for relevance, impact and value pertaining to an S&C context operating with elite level athletes.

Statistical Analyses

Responses were extracted from the online survey tool. Analysis procedures included frequency counts and percentage calculations of closed-ended question and Likert-type scale responses. Responses to open-ended questions (qualitative data) were coded with NVivo software (QSR

NVivo 11). Thematic analysis for qualitative responses established emerging themes [24,25,28], that were grouped into lower and higher order themes [23]. Themes were refined through repeated reviews of raw responses [6]. To enhance trustworthiness of the results, analyst triangulation was used whereby a second researcher independently analysed a sample of the responses to establish agreement between researchers [23].

RESULTS

Characteristics of Respondents

There were 100 respondents who met the inclusion criteria, 95% were male and 5% female. The mean ± standard deviation for age was 34 ± 8 years and the average duration working within the S&C discipline was 11 ± 8 years. Current job roles included: S&C Coach (56%), Senior S&C Coach (31%), Academic (7%), High Performance Director (4%), S&C Consultant and Academic (1%), Sports Scientist (1%). These roles were part of a sports institute (41%), professional sports club (31%), higher education or collegiate system (15%), private sector or independent business (7%), consultancy (5%) or a National Governing Body (3%). Current roles have been held for 4 ± 4 years. Collectively, the respondents reported 124 cases of working with Olympic level athletes, 105 cases of working with International level athletes and 84 cases of working with National level athletes across a broad range of sports (sliding, skiing and bobsleigh; court, volleyball, netball, basketball, tennis; aquatic, swimming and water polo, canoe/kayak; combat, judoka and tai kwon do; pitch sports, rugby, soccer, Australian Rules, cricket; ten pin bowling). The average time spent with a single sport was 4 ± 3 years. The S&C specific qualification included; accreditation provided by S&C professional bodies: National Strength and Conditioning Association (20%), UK Strength and Conditioning Association (47%), Australian Strength and Conditioning Association (7%), Weightlifting (2%); and specific academic S&C qualifications: MSc (16%), BSc (5%), PhD (2%), or none (8%).

Application of Eccentric Training Methods

The majority of respondents reported that they have prescribed eccentric training that included the use of a heavier load during the eccentric phase versus the concentric phase (otherwise referred to as accentuated eccentric loading) within athlete programmes across a broad range of sports (75%). A variety of eccentric resistance training methods that are currently used by practitioners (or methods that practitioners would like to use) is summarised in Figure 1. For descriptors of eccentric training methods see Table 1.

Insert Figure 1 about here

Insert Table 1 about here

The reasons underpinning the response *'never used and not inclined to use'* associated with the methods shown in Figure 1 were; equipment access (57%), lacking knowledge about the training method (39%), inappropriate athlete population (36%), unconvinced about the value of the method (29%), supervision issues due to large athlete training groups (23%), high risk of injury (11%), associated with excessive muscle soreness (11%), a lack of scientific evidence supporting its use (7%), the stimulus is not a priority for the required adaptations (3%), concerns of overtraining (2%), disapproval from coaches and/or medical staff (2%), or the application is overcomplicated (1%). Respondents reported using varied pieces of equipment to employ eccentric training with their athletes (Figure 2) that were used to target a variety of adaptations (Figure 3).

Insert Figure 2 about here

Insert Figure 3 about here

Collectively, respondents provided 160 examples of eccentric training regimes that have been used in practice. Programmes were categorised based on the repetition range: ≤ 6 repetitions (n = 110) or > 6 repetitions (n = 50). This repetition range is a common threshold used for strength versus hypertrophy/muscular endurance training programmes, respectively [3]. Exercise selection and the prescription of key training variables are summarised in Figure 4. To inspire eccentric training prescription, the source(s) of information that respondents currently use and have used include; scientific journals (61%), S&C colleagues (58%); influential practitioners (52%), personal experiences (52%), professionals or academics (40%), the internet (24%), books (20%) and certification or courses (8%).

Insert Figure 4 about here

Perceptions of and Experiences when Using Eccentric Training

The majority of respondents (84-98%) considered supramaximal and submaximal eccentric training as an '*above average* to *extremely effective'* training tool to prevent injuries, enhance muscle size and structure, increase mechanical function and enhance sports specific performance. A large portion of respondents (62-75%) considered supramaximal and submaximal eccentric training '*above average* to *extremely important'* to athletes who do not have a predominant eccentric specific action or skill in their sport (cycling, for example). The majority of respondents considered themselves between '*above average'* to '*extremely knowledgeable'* about the underpinning science (89%) and training methods (90%) relating to supramaximal and submaximal eccentric training. The majority of respondents rated themselves as '*above average'* to '*extremely confident'* to use submaximal eccentric training with athletes (93%), but fewer rated themselves as '*above average'* to '*extremely confident'* to use supramaximal eccentric training with athletes (68%).

Key themes that emerged from the qualitative data arose in two prominent dimensions; 1) experiences when using eccentric resistance training in athlete programmes, and 2) current thoughts and views about eccentric resistance training within athlete programmes. Collectively, underpinning these two dimensions were 40 lower order themes grouped into six higher order themes (Figure 5 and Figure 6).

Insert Figure 5 about here

Insert Figure 6 about here

With regard to experiences when using eccentric resistance training in athlete programmes (Figure 5), respondents reported positive neuromuscular adaptations and minimal detrimental effects on other aspects of performance. However, the major barriers associated with the practical application of eccentric exercise was the impracticality of applying eccentric loads:

> *"Primarily, equipment causes the biggest barriers. In particular, the ability to supramaximally load the eccentric portion of the lift safely and with user-friendly ease and stability". (P57 – Senior S&C coach)*

When eccentric regimes were applied, athlete and coach perceptions were acute muscle soreness:

"Athletes felt very uncomfortable with the programme due to the amount of muscle soreness experienced." (P25 – Senior S&C coach)

However, respondents expressed the relatively rapid dissipation of muscle soreness in subsequent sessions:

"[The athletes] got used to it over the first few weeks of the programme so [muscle soreness] became less of an issue." (P13 – S&C coach)

Additionally, athlete and coach perceptions included the substantial within-session demand that high-intensity eccentric exercise places on the athlete;

"Athletes need to be very mentally engaged, and exercises are both physically and mentally fatiguing. Exercises were not performed as desired if the athlete was tired/fatigued or not mentally engaged." (P39 – S&C coach)

With regard to current thoughts and views about eccentric resistance training within athlete programmes (Figure 6), a concern among respondents is the debilitating effects of muscle soreness and fatigue, and the higher risk of injury and safety concerns associated with the application of heavy loads required for high-intensity eccentric exercise:

"[A concern is] fatigue from eccentric protocols, especially with sprint running athletes, and risk of injury and the safety with general lifting equipment with regards to loading supramaximal eccentric and failing." (P40 – Senior S&C coach)

"[Heavy loads] offers the potential for increased connective tissue injury and spinal stress and injury." (P95 - S&C coach).

Additionally, the athletes overall physical and psychological preparedness limits the use of very high-intensity eccentric exercise in a performance context:

"I have been unwilling to try with 'normal' key lift gym exercises (e.g., squats and deadlifts, etc.) – I think this is because of the technical and psychological limitations the individual may have." (P24 – S&C coach)

"Many athletes are not 'strong enough' to need eccentric overload training." (P12 – S&C coach)

In order to improve their eccentric training practice, respondents suggested that they would like to see more learning opportunities and knowledge sharing:

> *"[I would like to have] discussions with coaches who have used eccentric training extensively for a number of reasons. To understand rationales and how that dictated the details within programmes and subsequent outcomes." (P45 – S&C coach)*

In order to promote evidence-based practice practitioners would like to see practically relevant scientific enquiry:

> *"[I would like to see] more practice-based evidence from the high-performance environment rather than from journals using non-elite athlete." (P35 – Senior S&C coach)*

Finally, respondents offered a variety of performance questions that they would like to see addressed in forthcoming scientific inquiry. The prevalent questions include; the transfer of benefits to sports performance, assessment of different methods of implementation and the dose-response effects of different forms of eccentric training regimes specifically relating to neural, morphological and architectural adaptations.

DISCUSSION

The aim of this investigation was to gain an insight into what S&C practitioners know and use with regard to eccentric resistance training for the high-performance athlete. It was not feasible to discuss all themes in detail; therefore this section addresses the most prevalent comments made by the sampled population. This exploratory investigation documented that practitioners reported positive training effects following the habitual use of high-intensity eccentric resistance exercise and offered numerous examples of different programmes that have been used in their practice. A number of practitioners highlighted issues with the practicality of applying eccentric resistance training when operating within an S&C setting. Specifically, they mentioned the need for safe and manageable methods when applying heavy external loads. Practitioners expressed concern about the detrimental effects of muscle soreness and fatigue resulting from high-intensity eccentric resistance exercise. Whilst high intensity eccentric exercise can result in muscle damage, soreness and strength loss [19], the magnitude is likely to be less in well trained individuals due to the protection afforded by the repeated bout effect [20]. Specific performance questions that were prevalent among the sample related to the dose-response effects to various eccentric resistance training regimes. The training effects of interest included neural, morphological and architectural adaptations and, importantly, performance of sports specific skills. In order to develop future practice, practitioners made reference for the desire to see more practically relevant scientific investigations conducted with direct application to high-performance, alongside more opportunities for learning and knowledge sharing. This information could be used to provide some direction for future research projects and dissemination of knowledge across relevant networks and platforms.

The efficacy of habitual high-intensity eccentric resistance exercise to induce positive neuromuscular and morphological adaptations justifies the use of this training method with athlete populations. However, the majority of peer reviewed journal articles that have implemented eccentric resistance training have used untrained or moderately trained populations and often employ single-joint, isokinetic exercise [1,9,10,18] that likely have limited application to multi-joint, sport specific or compound exercise in an elite sport environment. Firstly, athletes that are physically well-conditioned and unlikely to respond in the same manner as untrained individuals [2]. Secondly, movement performed in sport tends to require multi-joint coordination and forces tend not to be isokinetic [32]. Consequently, multi-joint exercise using free-weights is likely to be more applicable when considering the transfer of training effects to sports performance. Hence, the information retrieved from the current study suggests that high performance S&C practitioners view the vast majority of eccentric training studies to be of limited value, particularly when attempting translation to training prescription and adaptation in athletic populations. Somewhat dichotomously, scientific journals were reported as the main source of information that inspires the prescription of eccentric resistance training. However, it seems apt to emphasise the request from practitioners for more practically relevant investigations to be conducted within the higher-performance context.

Some investigators have successfully employed an eccentric exercise stimuli within athletes' training programmes using methods that could be reproduced in an S&C context [5,8,11,26]. These studies use a programme content, exercise selection, loading parameters, performance markers, training duration and athlete characteristics that are likely to have a larger impact on the performance environment. However, studies of this nature are not common, and are more exception than the rule; whilst they have the promise of good of ecological validity, there are very few examples and definitive inferences are not possible. However, more investigations that appreciate a performance context seems wholly warranted to continue to broaden our understanding of the adaptive response to different eccentric training regimes for athletic development. With the responses of the present study in mind, it would be useful if future research included the measurement of training effects that considered neural, morphological and architectural adaptations and, importantly, translation to sports-specific performance.

A number of practitioners highlighted issues with the practicality of applying eccentric resistance training when operating within an S&C setting. Specifically, they mentioned the need for safe and manageable means of applying heavy external loads. When coupling eccentric-concentric movement, manual assistance can be provided by athletes or practitioner to adjust the load between the eccentric and concentric phase of the exercise. However, this does not always provide the opportunity to maximise the load for the eccentric phase safely and efficiently. The use of an incline leg press machine could reduce spinal compression versus squat exercise, but the adjustment of the load or the performance of eccentric-only repetitions poses a significant logistical constraint. Alternatively, the 2-1 method overcomes this (see Table 1 for definition). However, the use of very heavy loads during single limb movement could cause misalignment of the spine, pelvis and shoulder girdle during upper or lower limb exercise, thereby heightening the risk of injury. This might be more problematic for those who are less accustomed to high-intensity eccentric exercise, although the advent of specific eccentric devices or custom built machines can aid the application of high-intensity eccentric training stimuli [11,12,17,31]. This approach is likely to be the most efficient and safest options for the application of high-intensity eccentric stimulus during multi-joint exercise to offer a sufficient eccentric training stimulus to strong athletes.

There appears to be a lack of evidence-based prescription of key training variables and clear programming guidelines for implementing high-intensity eccentric resistance training, especially when compared to traditional modes of training. When the basic principles of training are appropriately considered and integrated logically into a training process, adaptation is optimised and fatigue is appropriately managed [7]. Thus, the programming and prescription of eccentric resistance training regimes is central to effective and successful practice. This investigation has highlighted that a major concern is the detrimental effects of excessive muscle soreness and fatigue, and the potential increase the propensity for injury. Inherently, an element of damage and fatigue is likely because of the high-intensity and nature of eccentric muscle actions [1], although the extent of muscle damage will be less with very well-conditioned athletes. However, in line with the above and to avoid excessive and detrimental muscle soreness and fatigue, investigators could look to establish optimal loading regimes or minimal effective dosages.

In the present study two broad eccentric loading themes emerged (Figure 4). One theme comprised of squat or leg press exercise performed for 4-6 sets of 2-6 repetitions with 70% 1 RM load and 100-120% 1 RM load during the concentric and eccentric phase, respectively. The eccentric phase was performed at a tempo 3-4 seconds, with 2-5 mins of rest between sets. This regime was performed 1-2 times per week for 4 or 6 weeks. The other theme comprised of a variety upper and lower-body exercise performed for 3 sets of 6-8 repetitions with a load equivalent to body mass or unloaded during the concentric phase and 100-110% 1 RM during the eccentric phase. The eccentric phase was performed at a tempo of 3-4 seconds with more than 2 minutes rest between sets. This regime was performed 2 times per week for 4 or 6 weeks. These data provide some insight into how eccentric training is currently prescribed by practitioners and provided a broader range of information than other available resources [20,30]. However, it is important to highlight that it is not known to what extent the regimes in the present study are evidence-based and the exact strength training history of the individual athletes who performed these programmes. Whist it might be valuable to know this information, it was beyond the scope of the questionnaire; therefore, readers should exercise caution if considering using to inform training prescription. Irrespective of this, a summary of real-world regimes does provide an insight into the nature of the current prescription of eccentric resistance training in a group of 100 practitioners in elite sport. As an initial step, and given the paucity of evidence-based regimes and guidelines, particularly for athlete populations, this information can be used as an initial step for the design of training protocols in future empirical studies.

A barrier associated with the practical application of eccentric training was a perceived lack of knowledge and experience with some eccentric training methods, which could affect their confidence when prescribing high-intensity eccentric exercise. Practitioners suggested that learning opportunities and knowledge sharing would serve to develop their knowledge and quality of their future practice. Interestingly, the source(s) of information that practitioners least use to inform their eccentric training programme content is certification and courses (8%), which suggests that there may be a lack of education through formal certification or professional development activities. Conversely the currently knowledge is overwhelmingly accrued through journals, other S&C colleagues and other influential practitioners, personal experience and professionals/academics. Therefore, it would seem pertinent to suggest that professionals (scientists and applied practitioners) who are experienced in using eccentric resistance training should integrate their knowledge to develop informal and formal education opportunities. Overall, this would support the professional development of practitioners by upskilling their competencies pertaining to eccentric resistance training practice and improve the application for athletic performance enhancement.

It is suggested that future research looking to explore specific areas of applied practice should consider interviews to attain more detailed information pertaining to a specific area of interest, such as the time at which specific training stimuli are programmed in the annual training plan, for example. This would serve to enhance the quality of the responses and provide greater insight into a given topic area. Notwithstanding, this investigation has gained an insight into what S&C practitioners know and use in regard to eccentric resistance training for the high-performance athlete.

In summary, this study examined what S&C practitioners know and use in regard to eccentric resistance training for the high-performance athlete. Specific performance questions that were prevalent among the sample related to the dose-response effects to various eccentric resistance training regimes. The training effects of interest included neural, morphological and architectural adaptations and, importantly, performance of sports specific skills. Recommendations for training prescription that considers practicality of methods and minimising excessive muscle damage and soreness is likely to be well received. In order to develop future practice, the respondents alluded to more practically relevant scientific investigations to be conducted within the high-performance environment and with elite athletes, alongside more opportunities for learning and knowledge sharing. This work can be used to inform forthcoming applied research projects and educational content that can impact on S&C practitioners operating within an elite sport environment.

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FIGURE LEGENDS

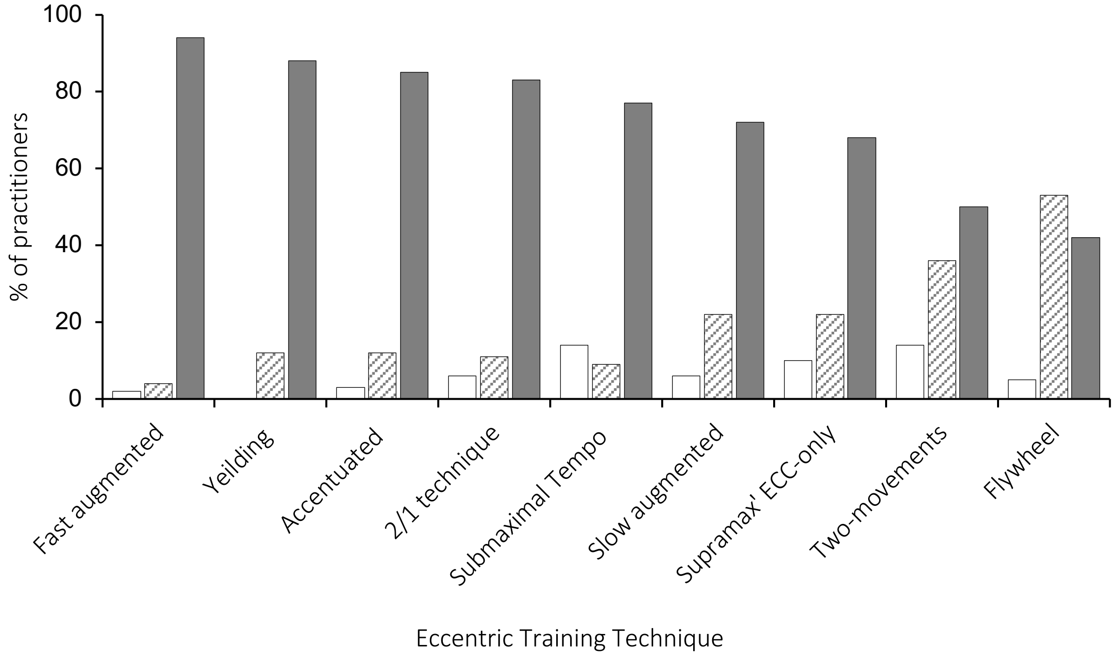

Figure 1. The use of different eccentric training techniques. White bars denote the response; *'never used and not inclined to use'*, striped bars denote the response *'never used, but willing to use'* and dark grey bars denote the response *'have used'*. For a full description of techniques, see Appendix 2: Eccentric Training Techniques.

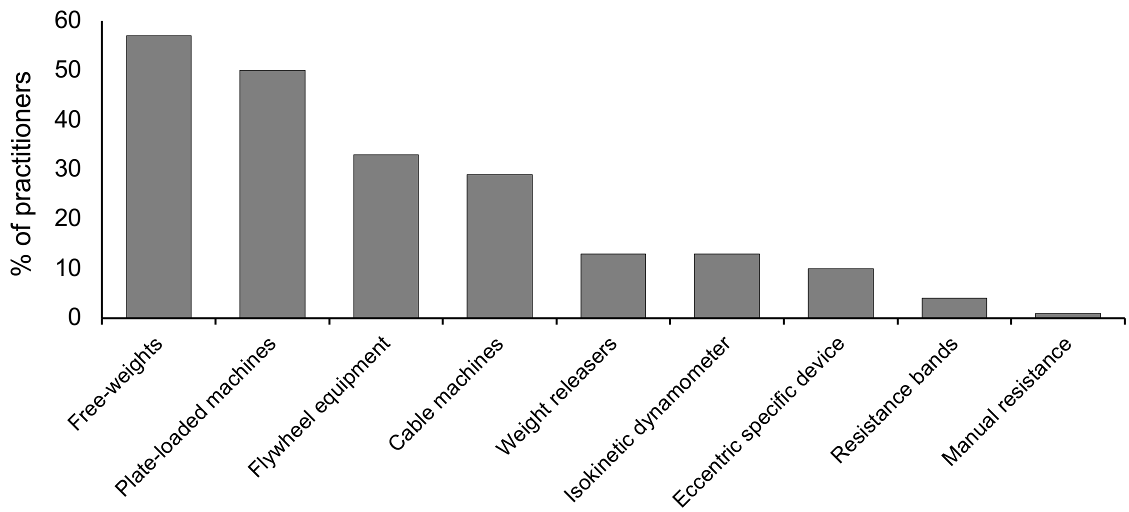

Figure 2. Equipment used to employ eccentric training with athletes.

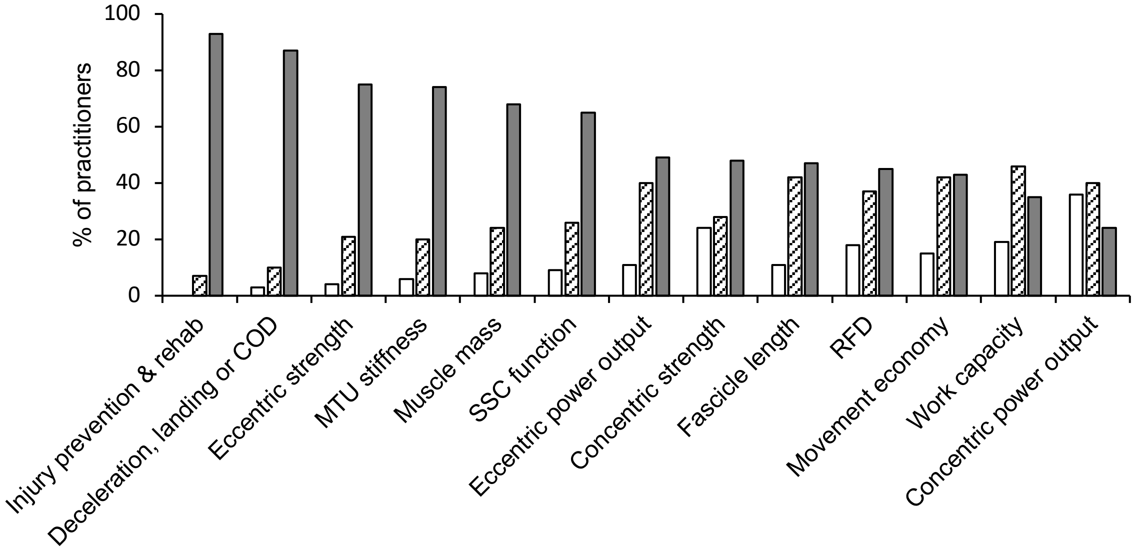

Figure 3. Target adaptations when using eccentric training with athletes. The response address whether practitioners *would not* (white bars), *would* (striped bars) and *have* (grey bars) use(d) eccentric training to target the said adaptation.

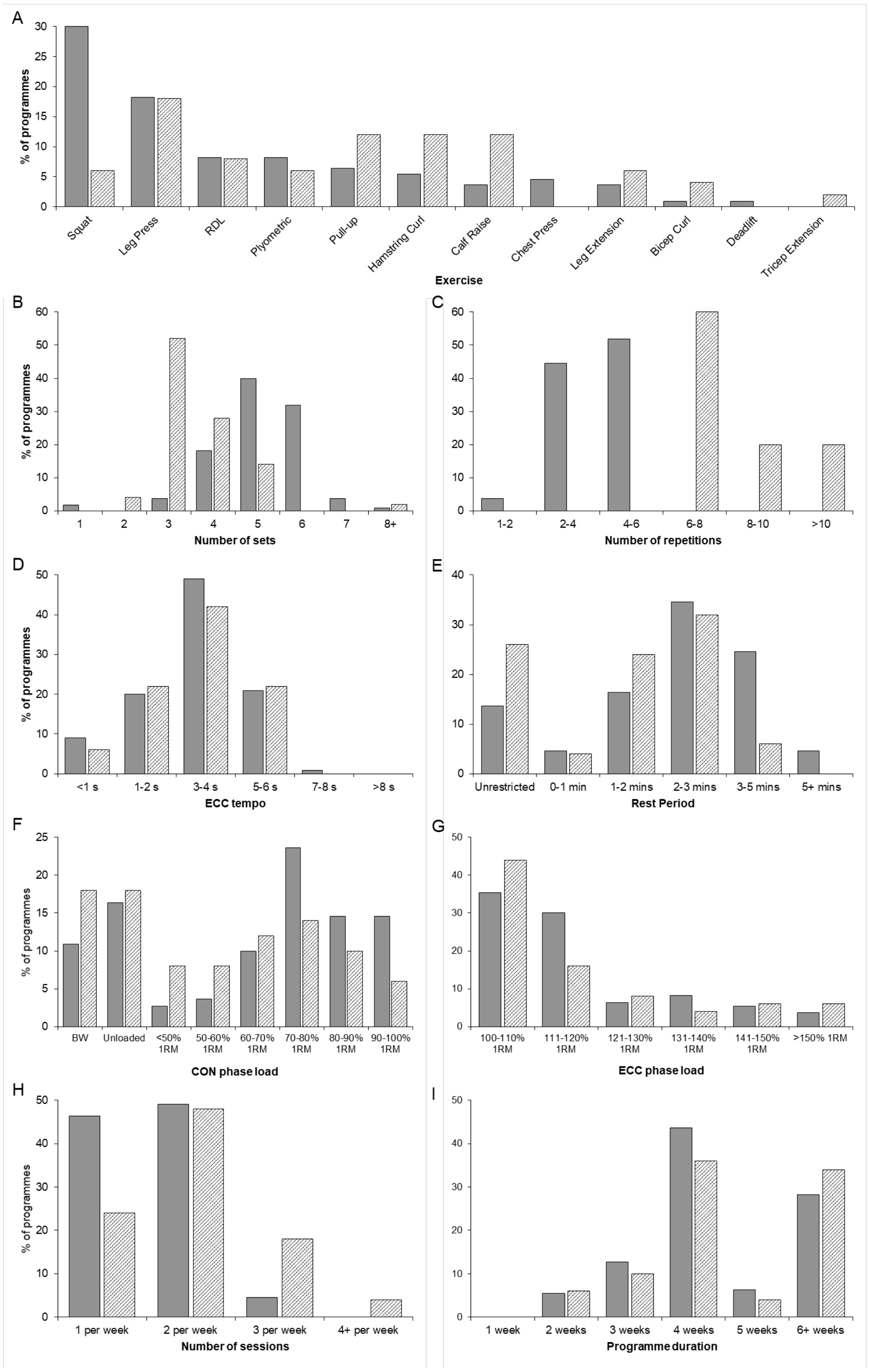

Figure 4. A summary of exercise selection and prescription of key training variables of 110 sample programmes. Programmes that prescribed < 6 repetitions are denoted by dark solid grey bars and > 6 repetitions are denoted by light grey striped bars. (A) exercise selection, (B) number of sets, (C) number of repetitions, (D) eccentric phase tempo, (E) duration of the rest period, (F) load used during the concentric phase, (G) load used during the eccentric phase, (H) number of sessions per week and (I) duration of exercise programme.

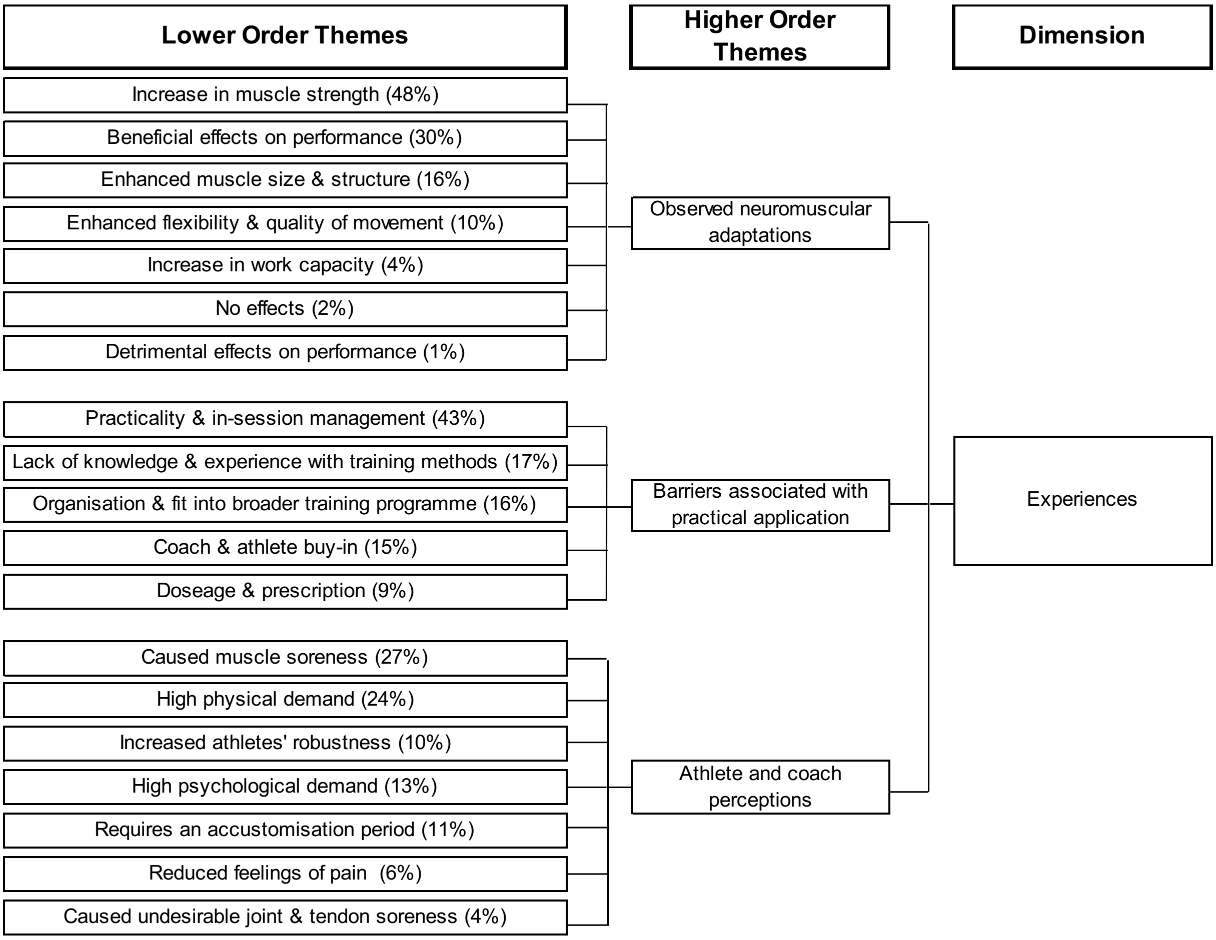

Figure 5. Experiences when implementing eccentric training in athletes' training regimes. (Percentage of respondents in brackets).

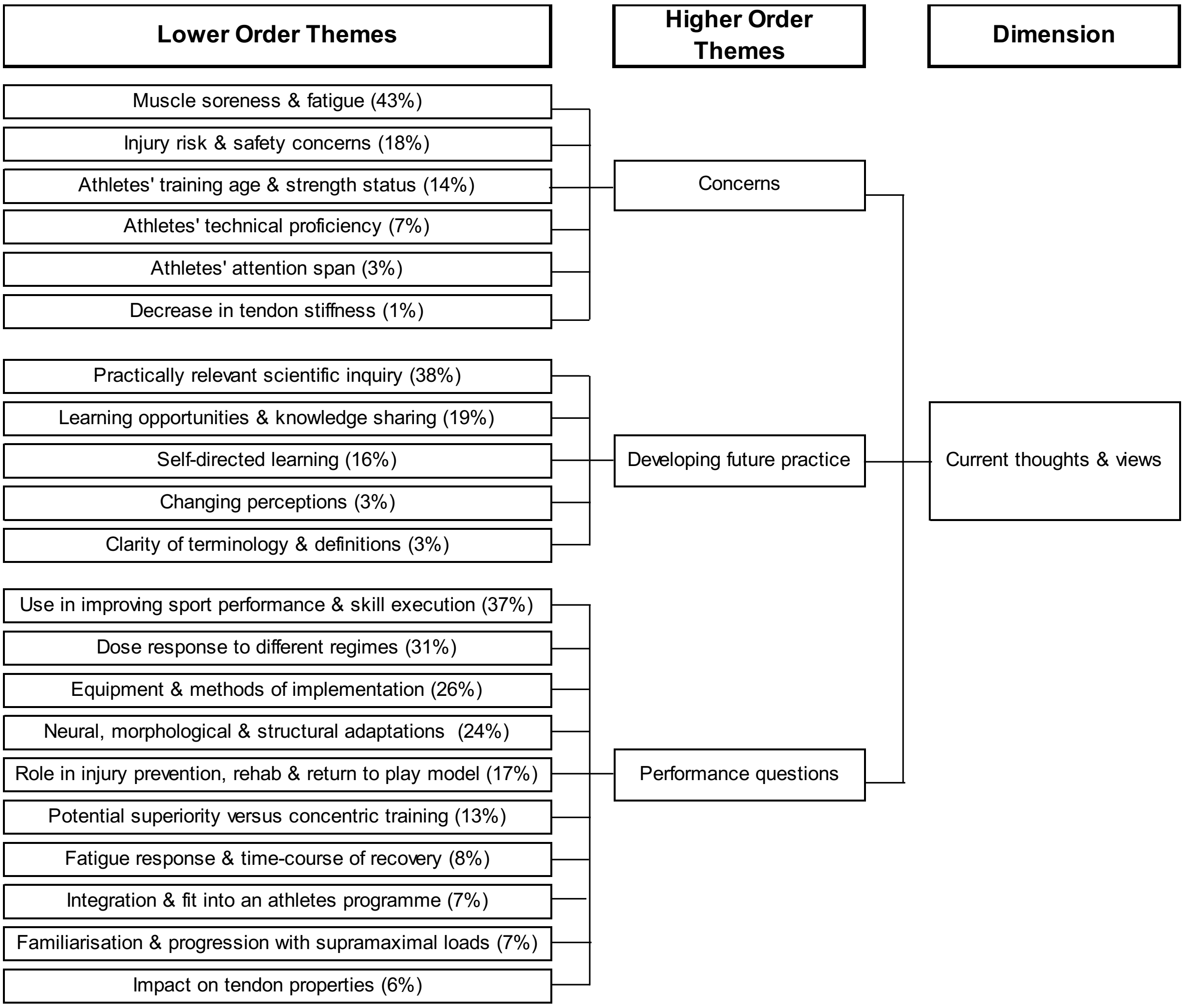

Figure 6. Current thoughts and views about using eccentric training in athletes' training programmes. (Percentage of respondents in brackets).

TABLE LEGEND

Loading Technique:	Brief description:
Augmented (Fast SSC)	Coupled eccentric-concentric movement. Rapid generating of high eccentric force is used to enhance concentric performance, e.g. drop jumps.
Resisted Eccentric	Rapid generating of high eccentric force to resist deformation or buckling under high muscle tension, e.g. depth jump, nordic hamstring exercise.
Accentuated (Supramaximal)	Coupled eccentric-concentric movement. Eccentric movement performed at a pre-determined pace. No emphasis on augmenting concentric performance. Concentric load < 1RM, eccentric load >1RM.
Accentuated (Submaximal)	Coupled eccentric-concentric movement. Eccentric movement performed at a pre-determined pace. No emphasis on augmenting concentric performance. Concentric load < 1RM, eccentric load > concentric load but not > 1 RM.
Accentuated 2/1	Coupled eccentric-concentric movement. Load is lifted concentrically bilaterally, load is lowered eccentrically unilaterally. Load is < 1 RM load for the bilateral exercise.
Tempo	Coupled eccentric-concentric movement. The eccentric phase is performed at a pre-determined tempo. Load is < 1 RM and remains the same absolute load throughout the eccentric and concentric phase of the exercise.
Augmented (Slow SSC)	Similar to 'Augmented Fast SSC'. Eccentric load is greater than concentric load (e.g. using weight releasers or dropping handheld dumbells at the end ROM). Concentric load usually BW, eccentric load exceeds concentric load, but is not > 1 RM.
Supramaximal Eccentric-only	Eccentric-only exercise. The concentric phase is completed with assistance via spotters or equipment. Eccentric load > 1 RM.
Two-movement	The load is lifted concentrically using a compound movement (e.g. deadlift), Load is lowered eccentrically using an isolation exercise (e.g. RDL).
Flywheel	Accelerate and decelerate a rotating flywheel during the concentric and eccentric phase, respectively.

1 RM relates to traditional 1 repetition maximum; SSC: Stretch-shortening cycle; ROM: Range of movement; BW: Bodyweight; RDL: Romanian/stiff legged deadlift