McManus, A., O'Driscoll, J., Coleman, D. A. and Wiles, J. (2016) Strongman training – Needs analysis and integration into strength and conditioning programming: part 2. Professional Strength and Conditioning, 44. pp. 7-15.

Strongman Training (Part 2): Needs analysis and integration into Strength & Conditioning programming.

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Brief Overview:

The article aims to evaluate the integration of strongman based exercises within the practice of strength and conditioning. It should give the reader a clear understanding of the specific physiological and biomechanical traits of each of the exercises discussed in the previous article. This information will then be used to discuss its amalgamation within traditional based exercises within the planning of a periodised programme for strength and conditioning practitioners.

Introduction:

Through its evolution, strongman based exercise now refers to any form of unorthodox style lifting that utilises a multi-joint approach. Often it is associated with the lifting and pulling of unusually shaped objects with examples of common exercises being the pulling and pushing of heavy motor vehicles, log pressing, farmer's walk, Yoke walk, Atlas stones, keg toss and tyre flips (2, 17). Not surprisingly typical strongman exercises are characterised by high neural outputs and maximal total-body effort (19). These exercises are characterised by the triple extension (hip, knee, ankle) movement pattern and have shown to be effective in improving grip strength, trunk stability, gait loading pattern and whole-body conditioning (10). Due to the nature of these exercises, blood lactate levels have been measured as high as $16 mmol \cdot L^{-1}$, compared to $7 mmol \cdot L^{-1}$ when partaking in traditional resistance training (21, 25, 35). This suggests that the physiological (mainly anaerobic) demands of strongman exercises may exceed those in both free weights and machine based resistance training. This high level of physiological stress is largely due to the high level of intensity and maximal load combined with the unpredictable proprioceptive activation the body is placed under.

In light of this, the inclusion of strongman training exercises within the practice of strength and conditioning (S&C) is increasingly being viewed as advantageous, due to their effectiveness in stressing the whole-body across multiple planes (26). With that in mind, it can therefore be considered that strongman exercises could offer a more purposeful solution to training athletes to become both strong and robust; thus, could be classified as highly functional for sporting performance (1, 22). The diverse range of exercises such as the 'keg toss' and the 'Atlas stone' allow for training across the entire force-velocity spectrum and therefore would be suitable as a conditioning tool in a multitude of sports. This is supported by its increased acceptance in sports such as wrestling, rugby, basketball, hockey and American football (2, 17, 20, 35). Despite the growing body of evidence supporting effective strength gains with strongman training, its inclusion within a programme must still be rationalised to ensure training remains both purposeful and discipline-specific. It is therefore important that the S&C coach understands how the key principles of dynamic correspondence relate to the main strongman exercises, along with the physiological implications in order to help ensure scientifically sound training prescription. The S&C coach should also seek to determine the intensity of the exercises relative to their degree of load, whereby athletes who lack a sufficient degree of strength, substitute exercises should be adopted (suggestions made later in the article). The relevant techniques and applications of the exercises, relative to guidelines for prescription have been detailed in article 1, with this article aiming to evaluate the biomechanical and physiological demands relative to their inclusion within a periodised programme.

Biomechanics of Strongman Training:

From a biomechanical perspective it could be suggested that some forms of strongman training such as the 'farmers walk', 'yoke walk' and 'truck pull' offer the ability to train athletes to produce high levels of unilateral ground reaction forces, in an attempt to produce powerful horizontal motion (25). With the majority of traditional based lower body resistance exercises requiring the application of bilateral vertical ground reaction forces (such as squats and deadlifts), it could be considered that the use of some strongman exercises, in particular the asymmetric carries and the truck pull exercise would adhere more to the principle of specificity. This is particularly true for those sports characterised by high levels of horizontal motion where acceleration is a key movement pattern, as seen in hockey, football and netball (41) for example. These sports are also characterised by high levels of propulsive and braking forces (7), due to the requirement for multi-directional movements. It could be argued that more functional forms of traditional resistance training such as multi-directional lunges or jumps seek to train this type of force production (23). Although, the unorthodox style of strongman training offers a greater degree of unpredictability within the movements, and as such could provide a solution for those coaches who question the suitability of well-rehearsed exercises, and their degree of transfer to performance, being largely characterised by stimulus-reactive movements.

It should be noted that, the authors were only able to find two studies pertaining specifically to the biomechanical demands of strongman based exercises. These studies are mainly focused on the kinetic and kinematic constituents of the tyre flip and the heavy sled pull exercise. The tyre flip has been sub-divided previously by Hedrick (20), into four phases which include the first pull, second pull, transition and final push. This model has been adapted in part 1 of this article to the set position, upward movement phase, transition phase and the final push phase (see accompanying figures). A study by Keogh (25), aimed to define the temporal aspects of the tyre flip exercise, using a cross-sectional design whereby the three fastest and three slowest tyre flips were analysed. They further sub-divided the durations of each phase of the tyre flip in alignment with Hedrick's suggestions. The results indicated that the second pull had the greatest duration, followed by the first pull, with the transition phase taking the shortest time. This is widely to be expected due to the changes in primary agonists from first to second pull and the large amount of forces required to overcome the initial inertia. The study further indicated that the second pull was largely the key determinant of tyre flip performance, which was evident due to the variations in second pull duration affecting overall tyre flip performance.

Kinematic analysis of the heavy sled pull, which provides resistance in a similar manner to the truck pull, has been previously reported in six resistance-trained subjects (25), results identified kinematic similarities to the acceleration phase of sprinting; however, significant differences in stride length, stride rate, ground contact times and a higher degree of forward lean during the heavy sled pull was noted. Both stride length and stride rates were observed to be shorter, with longer ground contact times in an attempt to provide greater propulsive force. This appears synonymous with the relative load lifted, and therefore it could be suggested that with even heavier loads such as that of the truck pull exercise, that these changes would be exacerbated further. Research has challenged the use of loads greater than 20% of body mass for resisted sprinting type exercises due to the acute changes in sprint technique observed (32). However, it is also argued that these are only acute changes, with contemporary science indicating overload of the muscles will lead to supercompensation and chronic adaptations (25). This has been demonstrated in a recent pilot study by Morin et al. (31) who analysed 16 amateur soccer players carrying out two weekly sprint sessions (5x20-m) for a period of 8 weeks. The 16 participants were split into an intervention (n=10) and a control (n=6) group, whereby the intervention group carried out each sprint with a sled tow equivalent of 80% body mass. They found significant increases in maximal force production and mechanical effectiveness (defined as more horizontally applied force) than that of a control group. This suggests the use of loads greater than 20% body mass could provide positive adaptations in particular to those sports requiring large amounts of horizontal force application. This is further supported by Cronin (11), who suggests that an increase in 23% of lower-limb strength can improve sprinting speed by up to 2%. Based on Cronin's (11) and Morin's (31) research, it could be suggested that the use of the truck pull exercise could be used to bring about lower-limb strength improvements and enhance speed properties (i.e. greater impulse), to bring about improvements in sprinting speed.

There is limited amounts of research on the biomechanics of strongman training; thus, more research is needed. Both Hedrick (20) and Keogh (25) describe the tyre flip exercise with a second pull, with Keogh noticing that in the slowest tyre flips the duration of second pull was key determining factor. The outline of the tyre flip in article 1, describes both the first pull and the second pull as one upward movement phase, this allows the athlete to transition to the push phase earlier within the movement and allows the continuation of momentum throughout the movement. In order to challenge both the upward movement and push phase further, the use of resistance bands may be used to apply greater resistant force on the athlete. In addition, supplementary exercises such as the ‘jammer’ and ‘prowler’ appear to offer comparable kinematic positions and may aid in the application of vigorous horizontal force application in this way, and subsequently improving tyre flip performance.

It has also been suggested that the inclusion of strongman training within a periodised programme may also lead to greater overall trunk stability in athletes (20,35). This increase in trunk stability could be due to the requirement of large amounts of muscular activation during the torso-bracing pattern, which is a pre-requisite to safe and effective lifting of extremely heavy loads (30). This is further evidenced in the ‘asymmetric carry exercises’ such as the farmers walk, which entail a variety of unbalanced and awkward loading, which is not trained during bilateral conventional lifting. The ability to adapt and include this form of exercise with both variable and static loading, challenges body linkages and requires strong stabilisation to overcome an uneven distribution of load (30). There is however limited information thus far, on both the kinetics and kinematics of strongman exercises, and therefore in order to obtain a more detailed understanding further research is warranted.

Physiology of Strongman Training:

Due to the requirement of maximal strength exertion, it is apparent that a number of distinct physiological responses occur that create a unique internal environment conducive to physiological supercompensation, and ultimately improvements in maximal strength, power and strength endurance. Due to the level of intensity of strongman exercises, high neural outputs are required placing significant demands upon the central nervous system (19). Adaptations such as increased neural excitation, firing frequency and rate coding all occur with exposure to this form of training.

Berning et al. (3) sought to quantify the metabolic demands of the truck pull exercise. The authors recruited six strength-trained athletes who had at least five years of periodised resistance training experience, and had a one-repetition maximum back squat of three times their bodyweight. They were required to pull a heavy motor vehicle weighing 1,960kg a total distance of 400m. It must be noted that even for a professional strongman competitor this is an extreme distance, with competition distances set at 30m. Oxygen consumption and heart rate were measured continuously, with blood lactate measured immediately prior to, and five minutes' post truck pull. They found the exercise to be extremely exhausting with near maximal heart rate sustained over several minutes and blood lactate values averaging 16.1mmol $\cdot L^{-1}$, with the highest value being recorded at 18.4mmol $\cdot L^{-1}$. This high level of blood lactate concentration has been shown to bring about the onset of metabolic acidosis, which could promote adaptations in both lactate tolerance and clearance (34). With a greater tolerance to lactate and a faster clearance rate, the athletes would be able to work harder anaerobically due to the body's ability to delay the build-up of hydrogen ions by converting lactate back into energy at a faster rate. Ultimately, this may allow athletes to sustain high amounts of strength exertion over a greater duration, giving adaptations for improved strength endurance.

However, it must be acknowledged that the truck pull exercise in its acute form could bring about negative implications for training adaptations due to the exhaustive demands placed upon the body. This is of particular importance for those athletes who require large amounts of technical or tactical training. In addition, this form of training will require substantial recovery periods in order for the body to fully recuperate, minimising the risk of injury. In this sense, it is suggested that its positioning within a periodised programme fits in the general preparatory phase (GPP) whereby the focus is on obtaining a sound strength base, and thus reduced levels of technical training are likely to be prescribed. Including this type of exercise requires careful planning, with the S&C coach needing to manipulate the timing, frequency and intensity of this exercise, largely on an individualised basis. This process should negate the potential possibility for overreaching or overtraining syndrome, which can often occur due to the psychological arousal this form of exercise brings.

This high lactate production appears apparent across the majority of strongman exercises, with Keogh (26), observing significant increases in blood lactate values from resting values of 2.4mmol $\cdot L^{-1}$ compared to 10.4mmol $\cdot L^{-1}$ after the carrying out the tyre flip exercise. Final lactate values were measured 2.5 minutes after completing two sets of six repetitions of the tyre flip exercise as explosively as possible. This could largely be explained by the heavy resistance and large muscle groups utilised during strongman exercises, placing excessive physiological demands on the body (29). These high lactate values will undoubtedly bring about increases in testosterone concentration, as is observed during other short term high intensity anaerobic exercises (27). This is also supported by Ghigiarelli et al. (16), who analysed salivary testosterone levels in 15 subjects during three resistance training protocols, one of which was solely strongman training and included the tyre flip, farmers walk, keg carry and Atlas stone lift. The other two protocols were a mixed hypertrophy training and strongman training protocol, and a sole hypertrophy training program. For the hypertrophy training protocol, exercises were carried out based on 75% of individual repetition maximum, calculated through repetitions to failure for the squat, bench press, leg press and seated row. The strongman protocol was not however prescribed based on 1RM, instead the subjects were required to perform 3 sets until muscle failure for the five different strongman exercises. Due to the unfamiliarity of these exercise relevant to their suitable load for each subject, if failure did not occur during the first set, then additional weight was added for the remaining sets. The authors sampled testosterone levels at rest, immediately post protocol and 30 minutes' post resistance protocol. All protocols resulted in a significant increase from baseline testosterone levels, with strongman training increasing baseline levels by 74%, mixed hypertrophy and strongman training by 54% and hypertrophy training in isolation by 137%. Although this evidence suggests that hypertrophy training in isolation brings about greater increases in testosterone concentrations, this study has an important limitation relative to the strongman protocol; the unfamiliarity caused inconsistent prescriptions in intensity, and therefore exercising to failure did not always occur during the initial set. Although it may be argued that hypertrophy training augments greater adaptations in muscle protein synthesis, the use of strongman training may still provide a useful training stimulus if the desired outcome is maximal strength with the additional advantage of heightened trunk activation, due to the un-even lifting nature of certain exercises (30).

Increases in testosterone levels are thought to bring about a series of positive physiological adaptations such as an increase in anabolic state and skeletal muscle changes, which could promote adaptations in both muscular strength and hypertrophy (4). This is likely to have positive implications for sporting performance, and recovery time during sports characterised by repeated anaerobic bouts of energy expenditure, due to the body's enhanced adaptation during the anabolic state. Strongman exercises could therefore be prescribed to bring about internal environmental responses to bring about the onset of muscular hypertrophy (16). Winwood et al. (40) reported chronic morphological adaptations to be similar to that of traditional resistance exercises. In a study of 30 experienced rugby players who were randomly assigned to either strongman or traditional based resistance exercises, participants carried out two weekly sessions for a period of seven weeks whereby exercises were matched through biomechanical similarity and equivalent loading. They reported strongman training to have similar effects to traditional based training in improving body composition and functional performance measures (0.2-7%). These results have been adapted for clarity and are presented in table 1.0. Although these comparable effects have been observed, the methodology around testing procedures could be questioned, with exercises such as the 'bent over row' offering little scope for standardisation. In addition, it was also noted that the seven-week training programme was not monitored by the researchers will could also lead to inaccuracies in results and interpretations. The results of this study may still argue that the large time under tension which is created during the majority of strongman exercises could lead to greater improvements in both isometric and eccentric strength. Zemke et al. (41) suggests that performing asymmetric carrying events would generate a large amount of tension in both the trapezius and upper back musculature, as the strongman attempts to stabilise the load for a prolonged duration. Although this suggestion has some degree of premise, in order to substantiate this claim, further research is warranted.

Table 1.0: Magnitude of changes to functional performance measures after a seven-week strongman or traditional resistance training intervention (adapted from Winwood et al. 40).

Functional Performance Measures	Strongman	Traditional	Effect Size

Vertical Jump Height (cm)	+4.13 ± 6.356	+3.86 ± 5.37	0.09
Horizontal Jump (m)	+0.03 ± 0.115	+0.09 ± 0.11	0.56
5-0-5 Change of Direction test (s)	-0.01 ± 0.13	-0.04 ± 0.07	-0.25
Change of Direction Acceleration (s)	-0.01 ± 0.06	+0.02 ± 0.04	-0.33
30m Sprint Speed (s)	-0.02 ± 0.10	-0.01 ± 0.06	-0.18
5m Sprint Speed (s)	-0.02 ± 0.04	-0.01 ± 0.03	-0.28
Muscle Mass	+0.4 ± 0.8	+0.0 ± 1.0	0.44
Seated 5kg Med Ball Chest Throws (m)	+0.16 ± 0.19	+0.15 ± 0.19	0.05
70kg Sled Pushes, 5m, 10m and 15m (s)	-0.2 to -0.5 ± 0.11 to 0.20	-0.09 to -0.14 ± 0.10 to 0.16	-0.31 to -0.46
1RM Bent Over Row	+14.5 ± 9.0	+4.7 ± 8.8	1.10
1RM Squat	+3.9 ± 16.1	+10.9 ± 13.7	0.47
1RM Deadlift	+10.4 ± 10.9	+17.8 ± 11.8	0.66
Body Fat Mass/Body Fat Percentage	-0.3 ± 2.0	-0.4 ± 1.6	-0.38

These physiological adaptations give support to the use of strongman exercises during the GPP of a periodised programme in an attempt to bring about adaptations in muscular strength and hypertrophy. The necessity to prescribe strongman exercises during this phase to induce a series of morphological adaptations is further strengthened by adherence to the principle of variation. With the exercises offering alternative kinematic and stability demands, all of which have been shown to reduce stagnation and training plateau (40).

Epidemiology / Injury Risk

The contention surrounding strongman exercises is largely based upon concerns about its safety and the perception that it may increase the likelihood of injury to the athlete during training (2). This assumption is mainly based around the intensity of the exercises, and their unorthodox style producing high physiological stresses upon the body. However, it has been counter-argued that this may in itself play a role in injury prevention as oppose to causation, as the athlete's body will have strength in uncontrolled situations, a particular trait in contact sports (41).

Winwood (39), sought to interpret the injury incidence of those participating in strongman exercises. They reported approximately 5.5 injuries occurred per every 1000 hours of strongman training, this equates to 1.5 more injuries occurring per every 1000 hours compared to both powerlifting and weightlifting (8). Although these figures may lend support to the argument that strongman training increases the risk of injury, it should be noted that these studies are retrospective in design, whereby participants exposed to strongman exercises were required to complete a self-reported injury recall evaluation for a period of one year. This has the potential for error in inaccuracies relative to injury recall and injury severity, with the interpretation of minor and major injuries affecting the validity of these results (15, 36). Winwood's (39) results offer support to this argument in that 16% of the injuries sustained were recorded as 'unsure' relative to their nature. Furthermore, without any details pertaining to the level of coaching or techniques adopted during this study, it is difficult to fully attribute any 'recollected injuries' to one specific factor alone. It is widely accepted that one of the major preventers of injury in any form of exercise is the utilisation of effective technique, to ensure postural control and equal distribution of loading (9, 28). As with any form of exercise it could be argued that with sufficient coaching and monitoring of correct technique, the incidence of injuries within strongman exercises may be reduced. It must be further noted that due to the high degree of instability some of the strongman implements possess, additional care should be taken within the early stages of coaching technique. This early precaution is further supported through the results of Winwood's (39) study indicating those lifters who had four or more years of strongman lifting experience endured less injuries in comparison to those less experienced.

The most common sites of injury for the strongman competitor are reported to be the lower back, shoulder, knee, and biceps (similar to that of powerlifting and Olympic weightlifting) (5, 30, 33). With the farmers walk, tyre flip, clean and press, Atlas stones and Yoke walk accounting for 77% of all injuries sustained (38). With the back being a prevalent site of injury, McGill (30), sought to quantify spinal loading and muscular activity during a series of strongman exercises. They reported that compressive spinal loading was highest during the Yoke walk, which was contrary to their prediction of the Atlas stone. These results could be explained due to the initial loading in the Yoke walk exercise adopting a bilateral stance, with the initiation of movement adopting a unilateral stance. During this initiation, the athlete would be required to produce strong hip coordination during the 'leg swing phase', which would require a greater bracing action of the torso musculature, in an attempt to support the extreme load. This gives a clear indication that the loading of this exercise needs to be carefully considered from a unilateral standpoint and not the initial bilateral phase. From this point, coaching should focus on pelvic alignment to minimise and shear stress on the lumbar spine. Maintaining joint alignment and the upregulation of target muscles is synonymous throughout any form of exercise prescription, with particular focus on those exercises that require large ranges of motion such as the hip and shoulder. This is evidenced further with overhead exercises (log press), whereby adopting a hand and elbow position anterior to the shoulder, may reduce the degree of shoulder injuries observed (11,12). This is synonymous with traditional based resistance exercises whereby insufficient technique can produce excessive hip extensor torques and high shear lumbar forces (5, 13, 14). It is therefore important that the coaches focus on cueing a neutral lordotic curve, correct shoulder alignment and equal weight distribution during the lifts. Although strongman training has indicated higher incidences of injury, it appears effective coaching relative to technique and postural awareness should increase the safety of these exercises. As with any form of exercise programme there will be undoubtedly some degree of risk involved, utilising a structured exercise programme, with correct coaching and appropriate regressions and progressions where necessary, both the incidence and severity of injuries can be markedly reduced.

Practical Application/Programming:

The current research evidence surrounding strongman training highlights its importance in bringing about positive adaptations in an attempt to improve sporting performance (19). This is largely due to its associated with a termed coined 'imperfection training', which provides a stimulus for training strength in unexpected and suboptimal conditions, that may be encountered within sport (37). As such, it is recommended that where possible, strongman exercises should be amalgamated with traditional resistance based methods to bring about greater functional strength and stability, during the GPP of a periodised programme (see table 2.0 and 3.0). This phase is largely characterised by high volumes of training at varying intensities, ideally adopting whole body exercises, such as the log clean and press. Its adoption within this phase will aid to build a solid physiological foundation of strength, speed, balance, flexibility and an increased working capacity (35). This amalgamation will also aid the principle of variation which could potentially overcome plateau's and prevent stagnation due to an increase in motivation and training adherence (40).

Table 2.0: An example of a training programme incorporating strongman exercises for a rugby player, training lower body strength, during the GPP of a periodised programme.

Exercise	**Sets**	**Repetitions/Distance**	**Total Load**	**Rest Intervals**
Log Clean and Press	4	6	85%	3-4 minutes
Strongman Back Squat	4	6	85%	3-4 minutes
Single Leg RDL’s	4	6	85%	3-4 minutes
Back Extensions	5	5	85%	3-4 minutes
Yolk Walk	3	20 metres	85%	3-4 minutes
Prone Hold’s	3	30 seconds	85%	30sec- 1minute

Table 3.0: An example of a training programme incorporating strongman exercises for a wrestler, training whole-body strength, during the GPP of a periodised programme.

Exercise	**Sets**	**Repetitions/Distance**	**Total Load**	**Rest Intervals**
Atlas Stone	4	5	85%	3-4 minutes
Tyre Flip	3	6	85%	3-4 minutes
TRx Rows	4	5	85%	3-4 minutes
Weighted Chin Ups	3	6	85%	3-4 minutes
Farmers Walk	3	20 metres	85%	3-4 minutes
Barbell Roll Outs	3	8	Bodyweight	2 minutes

It is still acknowledged that some coaches within the industry seem to avoid the use of strongman exercises due to the perceived lack of specific movement patterns within sports (2). A closer analysis of the movement patterns within these exercises identifies strength and power in triple extension and therefore giving pertinence to their use. This is supported by evidence that suggests the likely benefits of their use in sports such as rugby, hockey, football, basketball and wrestling (1, 20).

Its positioning within programme design relative to recovery periods, intensity and volume is largely based on anecdotal evidence, due to the apparent lack of research available. As with any form of exercise regime, insufficient recovery periods could potentially bring about exhaustive effects, which could be detrimental to an athlete's immediate performance (18). The majority of strongman exercises are measured through loads lifted, distances carried, or a combination of both. The manipulation of these variables can be centred around gains in strength, through increase in load, or strength endurance through an increase in distance covered; with the variations in rest periods bringing about adaptations in anaerobic working capacity. In load based strongman exercises, it is recommended that repetitions between four and eight are adopted (36). This is to ensure steady progression, for example if eight repetitions are comfortably achieved, then the load can be increased with a target repetition of four. Using this prescription will allow for correct technique to be maintained, and maximum strength to be improved. Strongman exercises over distance are often carried out over 30 meters, this can be increased if strength endurance is the training goal for the session. The sets can be manipulated for the majority of events to cover desired training volumes, with the exception of the truck pull. Due to the physiological demands and high lactate levels produced in this exercise, this should be carried out as one movement and should not be carried out for a period greater than 60 seconds. Attention to the duration of strongman exercises is a key variable that should be appropriately planned in an attempt to reduce excessive overload on muscle tissue. With human tissue carrying a degree of tolerance to the magnitude of load enforced, a prolonged increase in mechanical loading on the musculoskeletal system could predispose the body to injury (24).

The amalgamation of strongman exercises has also been suggested to be successful during the late ‘specialisation phase’ of a periodised programme, where training becomes more specific (41). This is based on the premise of exercises such as the keg toss and Atlas stone training explosive strength in the triple extension movement pattern. Further to this exercises such as the farmers walk challenge torso stability, grip strength and strength endurance, key components in sports such as wrestling and American football (1, 20). These exercises could be further adapted through walking in lateral motions, or adopting the Zercher position. Although there are many uses and adaptations of the exercises that can be adopted, it is important that the S&C coach takes into consideration the wider aspect of their athlete’s needs, when incorporating these exercises during the late ‘specialisation phase’. Should the athlete be taking part in exercises that require precise kinematic movements, for example sprinting, then the conditioning coach should refrain from using strongman exercises pre-technical movement training.

The monitoring of training programmes is essential relative to both intensity and frequency in order to prevent the build-up of fatigue. Although it is recommended that the most accurate measures are used when including strongman exercises (such as blood lactate values), this can be often problematic where access to these measurement tools are limited. In order to combat this potential issue, coaches should seek to adopt various methods where appropriate. Monitoring session ‘rate of perceived exertion’ (RPE) could adopted post-exercise, to compare traditional weight room sessions to those sessions with strongman exercises amalgamated into them to give an indication of total load. Coaches who have access to data in previous seasons may choose to use this to compare current season loads. Although these methods are largely indirect, they can form a reliable field-based method for monitoring the key variables which have implications on levels of fatigue.

Conclusion:

The evolution of strongman training is largely characterised by its increased popularity and media attention. It was initially adopted within the practice S&C due to its competitive nature and opportunity for variety within exercise programmes. Evidence suggests strongman exercises to compliment traditional resistance exercises during the planning of a periodised programme (2). With increased awareness of technique and familiarity of exercises, coaches will become more skilled in manipulating combinations, and programme variables to continually challenge athletes towards their desired training goals. Although the safety of this genre of exercise is widely debated, largely due to the small number of studies that have been conducted, it is unequivocal that this type of exercise challenges the entire musculoskeletal system. Future research should be directed towards quantifying the amalgamation of strongman exercises and traditional resistance training to promote optimal training prescriptions; this would offer coaches more robust guidelines into the adoption of these exercises.

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