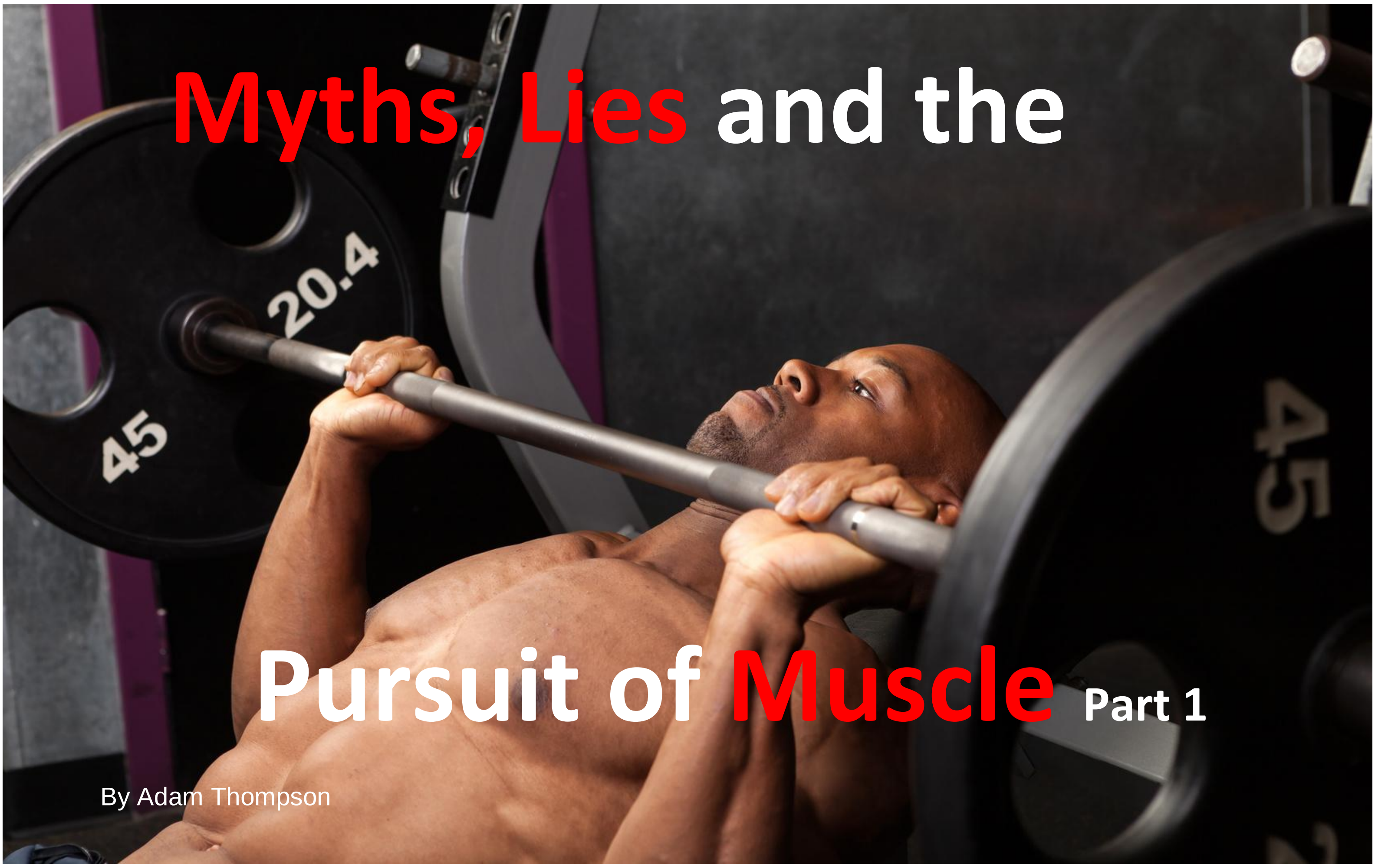

Myths, Lies and the Pursuit of Muscle Part 1

By Adam Thompson

Introduction

Weight training is about trying to force your body to do something it doesn't want to do. Human physiology is designed to maximise our chances of survival and big muscles do not factor into that equation. Developing a body that is big, strong and powerful isn't simply about lifting as much weight as possible. It's about training smart. It's about using techniques and strategies that overcome the human body's natural resistance to building big, strong muscles. To do this you need to have an understanding of the training methods and strategies that work and those that do not.

Most people don't have degrees in human physiology or exercise science and they don't read scientific journals. For the majority of weight training athletes their knowledge comes from the internet, books, magazines and other athletes in the gym. Unfortunately these sources of information, however well intended, are not always reliable. This can result in athletes adopting training practices that are ineffective and possibly even counterproductive at helping them achieve their goals. This *Muscle Building Science Special Report* will show how some common training strategies have a logical basis but the evidence simply does not support their use.

Water, water everywhere

Everyone knows the benefits of water. Drinking lots of it throughout the day flushes toxins from the body, promotes kidney health, enhances mental acuity, improves skin tone, prevents dehydration and maximises physical performance. So important is it to drink lots of water throughout the day that organisations such as the US Institute of Medicine, the European Food Safety Authority and the UK's National Health Service all have their own recommendations. The exact amount we should aim for can vary slightly but the most common recommendations are to drink at least eight 8 ounce glasses or 1.5-2.0 litres of water per day. This message is further promoted by the media, often through health professionals reminding us of the necessity to keep up our water intake. Failure to do so may seriously harm our health.

Given the prevalence of the water message and the professional organisations that promote it you have probably never questioned the need for a high water intake. After all, why would you? With so many people repeating the message it must be backed up by substantial evidence.

This may come as a surprise but there is in fact very little evidence supporting the current water recommendations. An article published in the *British Medical Journal*[1] concluded there is no available compelling evidence which demonstrates the benefits of drinking lots of water. The author further states the need to drink 8 glasses of water per day is more than just nonsense, it is debunked nonsense! This conclusion is supported by other reviews which also failed to find any substantiative evidence that a high water intake is beneficial for health[2] and that current water recommendations cannot be justified based on the existing evidence[3].

How can this be? How is it possible that a message repeated constantly in the media and supported by medical and health authorities has no factual basis? Is it simply because enough people have said it enough times that it becomes an established fact even in the absence of hard evidence? Is it because everybody assumes everybody else has checked the facts that nobody questions it anymore?

By now you are probably wondering where all this is going. What does this have to do with building muscle? The lesson here is that when a message is given by someone we perceive to be an authority we tend to accept it without question. This quirk of human nature can even work its way into the gym and influence our workouts. When was the last time you questioned something you do during your workout? You may use a particular method you read about in a magazine or on a website or it may be a technique recommended to you by the biggest guy in your gym. The information parted by these authorities must be effective in helping you reach your goals otherwise they would not have said it, right?

Just like the advice we need to drink lots of water, some of the strategies and techniques you use during your workouts may also have no factual basis. You may accept them unquestionably because you have heard them many times from many different authoritative sources. This does not necessarily mean they are effective for building muscle however. If you want to build a body that is big, strong and powerful you need to focus on those techniques that work while avoiding those that do not.

Training to failure

The premise behind training to momentary muscular failure is that it ensures the maximum number of muscle fibres are recruited during the exercise. This in turn should lead to optimum strength and hypertrophy adaptations. While this argument has a logical basis the evidence is less than convincing.

Drinkwater et al.[4] put 26 elite junior athletes through 6 weeks of periodized bench press training. Half of the volunteers performed repetitions to failure (4 sets of 6 repetitions) while the other half terminated their sets before failure was reached (8 sets of 3 repetitions). All groups performed the same volume of work in the same time. It was found the group that trained to failure increased their bench press strength by 9.6% and power by 10.6%. The non-failure group increased their bench press strength by 5.1% and power by 6.8%. This would seem to support the idea that training to failure maximises the adaptation response.

A limitation of this study is that it does not accurately reflect real world conditions because the volunteers performed only bench presses in their training. A study that better reflects real world conditions was done by Izquierdo et al.[5] who put 42 volunteers through a 16 week periodized training program. Twice weekly workouts involved squats, bench presses, shoulder presses, lat pulldowns, standing leg curl, crunches and back extensions. The final 5 weeks of training was power orientated and included exercises such as sprints and loaded vertical jumps. All participants performed the same volume of work at the same intensity but half trained to failure while the other half did not. At the conclusion of the study both groups had increased their strength equivalently. The failure group had a greater increase in the number of bench press repetitions they could perform but this was not observed for squats. The non-failure group had a slightly greater increase in lower body muscle power output. Training to failure as part of a structured periodized resistance exercise program may therefore offer some advantages for upper body muscular endurance but has no effect on strength.

Willardson et al.[6] put a group of volunteers through a 6 week non-linear peiodized resistance training program designed to increase lower body muscular endurance. Half trained to failure with 3 sets of 13-15 reps while the other half performed 4 sets of 10-12 repetitions that were not to failure (the extra set was used to equate volume between the two groups). At the conclusion of the training period both groups were found to have increased their muscular endurance equivalently. This supports the findings of Izquierdo et al.[5] where training to failure also had no effect on lower body muscular endurance.

Sanborn et al.[7] put 17 untrained females through 8 weeks of squat training. 9 of the volunteers performed a single set of 8-12 squats until failure. The other 8 volunteers performed 3 sets not to failure using a non-linear periodized training program. At the conclusion the multi-set group had increased their 1 repetition maximum (1RM) squat 34.7% while the single-set group increased theirs by 24.2%. This indicates a single set taken to failure provides a lower stimulus for strength adaptations compared to performing multiple sets not to failure.

Most of the research examining the effects of training to failure has measured quantitative effects such as strength and power. Very little research has looked at the effects on hypertrophy. Ogasawara et al.[8] had 9 untrained males perform 3 sets of 10 repetition bench presses with 75% 1RM. The protocol was performed 3 times per week for 6 weeks and each set was terminated before failure was reached. Following 12 months of de-training where no resistance exercise was performed the same volunteers performed the same training program but utilised 30% 1RM for 4 sets each performed to failure. It was reported that the gains in 1RM bench press strength were greater under the high intensity protocol compared to the lower intensity performed to failure. Increases in triceps and pectoral hypertrophy following the low load protocol were similar to that observed during the initial high-load protocol. This result needs to be treated with caution however. The small number of subjects, short training period and the study design where volunteers performed only bench presses and were training to *regain* lost strength and hypertrophy do not reflect real world conditions. The results do suggest that training to failure with a light resistance *may* be an effective stimulus for regaining lost hypertrophy during the initial stages of a resistance exercise program but they do not indicate whether it is effective for continued gains in experienced athletes.

The principal argument justifying training to failure is that it maximises the number of muscle fibres recruited. This is contradicted by the evidence with research showing maximum muscle fibre recruitment can occur 3-5 repetitions before failure is reached[9]. Training to the point of momentary muscular failure therefore does not recruit more muscle fibres.

Schoenfeld et al.[10] demonstrated that performing leg presses to failure with 30% 1RM recruited fewer quadriceps and hamstring muscles compared to training to failure with 75% 1RM. This is because muscle fibre recruitment is determined by the force requirements of the muscle (the load it is required to contract against) and not fatigue. Forcing your muscles to contract against a large force (>50% 1RM) is required to maximise the number of muscle fibres recruited during an exercise[11].

Despite the lack of supporting data there is some argument that training to failure *might* provide a unique stimulus to allow advanced athletes to break through training plateaus when used short term as part of a periodized training program[12]. Limiting training cycles to 6 weeks of training to failure interspersed with equivalent cycles of non-failure training may maximise any potential benefits while minimising the potential detriments[13]. Training to failure should not be performed repeatedly over long periods due to the potential for overtraining[12]. Training to failure too frequently has also been shown to lead to reductions in resting testosterone levels[13], a possible early indicator of overtraining[14].

The performance benefits of training to failure have not been demonstrated. There is some evidence that when used during short training cycles it can benefit upper body muscular endurance but not strength or power. The effect of training to failure on long-term hypertrophic adaptations has yet to be determined.

Muscle fibre recruitment is determined by the training load and not the level of fatigue, negating one of the key arguments supporting the benefits of training to failure. If an athlete is stuck at a plateau in their training then performing repetitions to failure for short periods *may* provide an additional stimulus that allows them to continue progressing. This needs to be carefully managed however due to the risk of overtraining.

Forced repetitions

Forced repetitions are the next step after training to failure. The argument is that it pushes muscles to work beyond their normal limits by recruiting more muscle fibres than would be possible by training to failure. The greater stimulus provided by forced repetitions should therefore result in an even greater adaptation response.

Drinkwater et al[15] reported that performing forced repetitions during a 6 week training program did not result in greater increases in strength or power compared to performing repetitions until momentary muscular failure.

The increased physical demand by forced repetitions can increase the recovery time required for optimum muscle functioning. Ahtiainen et al.[16] reported strength was significantly lower 3 days post-workout in those who performed forced repetitions compared to those who performed repetitions to failure, indicating a reduced rate of recovery. This was observed after only a single workout. If these individuals were to perform another workout before full recovery was achieved strength and hypertrophy adaptations would be compromised. This means the regular inclusion of forced repetitions will necessitate a reduction in the volume of work and/or an increase in rest periods otherwise the lack of sufficient recovery will compromise subsequent workouts and increase the likelihood of overreaching and eventually overtraining. The reduction in workout volume therefore needs to be carefully considered if forced repetitions are to be a part of an athlete's training.

These two studies are the only ones that can be identified in the scientific literature examining the adaption response to forced repetitions. Given the emphasis that is placed on this technique by weight training athletes and the logic used to validate its use the lack of information is surprising. No definitive conclusions can be drawn from this limited data but combined with the limited benefits observed with training to failure the effectiveness of forced repetitions has to be questioned.

Forced repetitions are promoted as a strategy to help maximise the adaptation response but the limited data does not support this. If an athlete chooses to perform forced repetitions its application should be very limited and additional recovery time may need to be factored in so as to avoid overtraining.

Isolation exercises

Many athletes use a combination of free weights and machines during their workouts. This is particularly true with bodybuilding workouts where the goal is to develop maximum hypertrophy. The justification is that multi-joint (also known as compound) exercises are used to build muscle mass while single-joint (also known as isolation) exercises help 'refine' the muscle. It is argued the two types of exercise combined produce a stimulus that elicits superior adaptations compared to a compound exercise by itself.

Gentil et al.[17] put 29 males through a 10 week upper body training program. One group performed 3 sets of 8-12 repetitions of bench presses and lat pulldowns twice per week. A second group performed 3 sets of 8-12 repetitions of bench presses, triceps extensions, lat pulldowns and seated preacher curls. The second group performed a greater volume of work because the objective of the study was to see how the *addition* of single-joint exercises influenced the adaptation response. It was found biceps size and strength increased equivalently between the two groups with no advantage seen in the group that incorporated the single-joint exercises.

A similar study by Rogers et al.[18] reached the same conclusion. 17 national-level baseball players undertook upper body training. One group performed only multi-joint exercises while a second group performed the same exercises but also included biceps curls and triceps extensions. Increases in arm circumference and upper body strength were reported to have increased equivalently between the two groups. This study needs to be treated with caution as it has not been published in a peer-reviewed journal and was only presented as an abstract during the 2000 National Strength and Conditioning Association Conference[17].

de França et al.[19] put 20 males through an 8 week upper body non-linear periodized training program. All participants performed the same exercises but half performed two additional single-joint exercises (3 sets each) for biceps or triceps during each training session. At the conclusion of the training period upper body strength increased equivalently between the two groups. Arm circumference increased more in the group that included the single-joint exercises but flexed arm circumference increased the same between each group. The reason for this discrepancy is not clear.

These three studies are the only ones that could be identified in the scientific literature specifically examining the effect of adding single-joint exercises to multi-joint exercises as part of a structured resistance exercise program. Just like with forced repetitions the lack of evidence is surprising given the ubiquity of this training strategy among athletes. Based on the limited data the addition of single-joint exercises to a program that includes multi-joint exercises is difficult to justify. The evidence suggests that multi-joint exercises alone provide a sufficient stimulus to trigger strength and hypertrophy adaptations. The addition of single-joint exercises does not seem to enhance the adaptation response.

This is not to say single-joint exercises have no role to play at all. They can be a useful tool to allow an athlete to work around an injury or if there is a weakness in a specific muscle a single-joint exercise may allow for more targeted training in order to strengthen that muscle. The common practice of combining single- and multi-joint exercises when training a muscle group may not be as effective as it is made out to be however.

Conclusion

Training to failure, forced repetitions and adding single-joint exercises to a training program that includes multi-joint exercises are staple techniques used by weight training athletes. These methods are promoted as effective training tools but the evidence does not support their use. Training to failure does not recruit more muscle fibres and does not lead to greater increases in strength or hypertrophy compared to terminating a set before failure is reached. Forced repetitions also do not enhance the adaptation response but do increase the time it takes a muscle to recover. Multi-joint exercises alone appear to offer sufficient stimulus to elicit strength and hypertrophy adaptations. Adding single-joint exercises to a program that includes multi-joint exercises does not appear to enhance the adaptation response beyond that achieved by the multi-joint exercise alone.

In Part 2 of this *Special Report* we will examine three more common training myths: Pre-exhaustion, repetition ranges and fatigue as a stimulus for the adaptation response.

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