1-RM vs. M-RM Strength Testing

What are strength testings?

Strength tests are generally used to determine the maximum intensity a person can handle during a particular exercise/movement and thus determine the intensity for a targeted training phase.

There are two test models of strength tests, the **1-RM** and the **M-RM**.
While the 1RM test is often considered as the gold standard for assessing the strength capacity of individuals in non-laboratory environments the M-RM is not yet very popular. Nevertheless, I like this test very much and work with it a lot. In this lecture I would like to explain why and give you a better comparison of the two.

What are the differences?

- 1-RM stands for one repetition maximum and it describes your max intensity
  —> It is tested how much load a person can move one time.
- M-RM stands for multiple rep maximum and it describes your max intensity for X reps
  —> It is tested how much load a person can move for a given number of repetitions (for example 5RM).

Note: Both tests are really to find out the maximum intensity, that means with a RPE @10 - so that no more repetition would be possible and technical failure would occur.

1-RM vs. M-RM Testing

As described above, the 1-RM test is already well researched and there are a wide variety of proven test protocols. The M-RM test, on the other hand, is much less researched and tested for reliability.

The argument in favor of the 1-RM test is often that it has a higher significance in terms of maximum strength. In the meantime, however, studies have shown that, for example, a 5-RM is suitable as an indicator of maximum strength for performance evaluation. In these studies, both the 1-RM and the 5-RM test and the maximum possible number of repetitions at a submaximal intensity of 90% were determined. The result was a very high correlation ($r = 0.97; p < 0.001$) between the 5-RM and the 1-RM.

I always thought that the 1-RM test could be risky for nonprofessional practitioners because it's so intense. However, this idea is contradicted by research showing that various 1RM tests have been shown to be a safe and reliable measure of strength in young children (6-12 years), adolescent athletes (15-17 years), healthy trained and untrained adults (18-36 years), untrained middle-aged individuals (50-52 years), post-menopausal women (54-60 years), patients with cardiovascular disease, and individuals over 75 years of age. The argument is mostly that the biggest risk lies in the quality of movement pattern and not in the „heavy" load.

Nevertheless, I believe that precisely that quality of movement execution under maximum load can lead to overload and injury in inexperienced practitioners. That's why I think **training beginners** should not do a 1RM strength test because lifting maximum weights can cause serious muscle soreness in people who are not used to strength training and increases the risk of a more serious injury.

RELIABILITY & PERFORMANCE EVALUATION

Studies have shown that the M-RM test also has excellent reliability. This means that we have two similarly good test procedures in terms of reliability. But what about the accuracy of performance evaluation?

I think the question should always be **what is being tested for**. To find out what the current intensity limit is, the 1-RM is a good choice without question. Also, if the training phase is planned in a very high intensity range (90-100%) and thus with low repetitions (1-3), the 1-RM test can serve to evaluate performance.
However, if the training is planned at a sub-maximal intensity (80-90%), in a sub-maximal repetition range (3-5), then the 1-RM test becomes very inaccurate.
Studies have shown that the 1-RM is inappropriate for specifying load for strength training (not maximal strength training). For example, the frequently propagated linear 1-RM-repetition relationship is curvilinear and be strongly influenced by confounding factors like strength training experience and type of exercise. Therefore, the classical approach to derive loads for strength training as a certain percentage of the 1-RM often leads to an **overestimated or insufficient load**. This experience I have also made on myself and with students. It often happened that the training intensity derived from the 1-RM for e.g. 5 repetitions was clearly too high and training was not possible. Therefore, I was looking for other test possibilities and have worked predominantly with the M-RM test over the last few years. It turned out that the M-RM test is much more realistic and practicable in terms of actual training intensity.

In further studies it was also shown that there is a significantly lower dispersion in the 5-RM test compared to the 1-RM test regarding the maximum possible number of repetitions (5-RM: CV = 15.8% / 1-RM: CV = 36.2%). This can be seen as evidence of better suitability for determining training intensity in the context of training control.
In addition to the lower load and the lower risk of injury, the determination of the the 5-RM strength test, the determination of the multiple-repetition maximum enables more effective training control than the 1-RM strength test.

Furthermore, the M-RM can be also even used as a predictor for the 1-RM. Here, especially the 5-RM allows a very valid estimation of the 1-RM. Other M-RM have not yet been further investigated.

Here is one of the studies regarding M-RM and performance evaluation linked:
Reliability of a 5-Repetition Maximum Strength Test in Recreational Athletes by Gail S, Künzell S.

Since we rarely train the maximum, but mostly the submaximal strength in the JST and also do a lot of bodyweight training, the M-RM test has proven to be more practical for me.

To conclude this short lecture I present on the following page two well working test protocols, one for the 1-RM and one for the M-RM test. They correspond to the methods used in most recent studies.

1-RM Test Protocol

Beginning of the test:

1) The practitioner should perform a warm-up with a self-selected load that allows him/her to complete at least 6-10 repetitions (approximately 50% of the expected 1RM).

2) 1-5 minute(s) rest.

3) Person will then select a weight based on previous effort that will allow them to perform 3 repetitions (approximately 80% of predicted 1RM).

4) 1-5 minute(s) rest.

5) Person now increases the elevation and begin attempting their 1RM. A series of individual trials should be performed until a 1RM is achieved. This means you test and if the repetition was successfully performed, the load was increased.
Rest periods between trials should be 1-5 minutes, and load increases are typically between 5-10% for upper body and 10-20% for lower body exercises. 1RMs should be achieved within 3-7 trials.

Note: If multiple 1RM tests are performed, it is recommended that all test exercises be separated by a 3-5 minute rest period.

Note: If you go for weighted tests it is important to have a spotter during such a test, who can support you if your muscles or your nervous system fail.

M-RM Test Protocol

Beginning of the test:

Determine the number of repetitions in which you want to test (e.g. 5-RM).

1) Person performs a warm-up with a self-selected load that allows him/her to complete at least 6-10 repetitions (@RPE 5-6).

2) 1-5 minute(s) rest.

3) Person will then select an intensity based on previous effort that will allow them to perform the number of repetitions which will be tested later; for example 5r (@RPE 7).

4) 1-5 minute(s) rest.

5) Person now increases the elevation and begin attempting their M-RM. A series of individual trials should be performed until a M-RM is achieved. This means you test and if the repetitions were successfully performed, the load was increased.
Rest periods between trials should be 1-5 minutes, and load increases are typically between 5-10% for upper body and 10-20% for lower body exercises. M-RMs should be achieved within 5 trials.

Note: If multiple 1RM tests are performed, it is recommended that all test exercises be separated by a 3-5 minute rest period.