PREVENTION & REHABILITATION: PILOT STUDY

One repetition maximum bench press performance: A new approach for its evaluation in inexperienced males and females: A pilot study

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Summary The aim of this study was to evaluate a new method to perform the one repetition maximum (1RM) bench press test, by combining previously validated predictive and practical procedures. Eight young male and 7 females participants, with no previous experience of resistance training, performed a first set of repetitions to fatigue (RTF) with a workload corresponding to $1/3$ of their body mass (BM) for a maximum of 25 repetitions. Following a 5-min recovery period, a second set of RTF was performed with a workload corresponding to $1/2$ of participants' BM. The number of repetitions performed in this set was then used to predict the workload to be used for the 1RM bench press test using Mayhew's equation. Oxygen consumption, heart rate and blood lactate were monitored before, during and after each 1RM attempt. A significant effect of gender was found on the maximum number of repetitions achieved during the RTF set performed with $1/2$ of participants' BM (males: 25.0 ± 6.3; females: $11.0x \pm 10.6$; $t = 6.2$; $p < 0.001$). The 1RM attempt performed with the workload predicted by Mayhew's equation resulted in females performing 1.2 ± 0.7 repetitions, while males performed 4.8 ± 1.9 repetitions. All participants reached their 1RM performance within 3 attempts, thus resulting in a maximum of 5 sets required to successfully perform the 1RM bench press test. We conclude that, by combining previously validated predictive equations with practical procedures (i.e. using a fraction of participants' BM to determine the workload for

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an RTF set), the new method we tested appeared safe, accurate (particularly in females) and time-effective in the practical evaluation of 1RM performance in inexperienced individuals.

Introduction

The one repetition maximum (1RM) technique is largely acknowledged as one of the most valid measurements of maximal strength and it is defined as the maximal weight that can be lifted with a single repetition (Mayhew et al., 2004; LeSuer et al., 1997; Amarante Do Nascimento et al., 2013; Padulo et al., 2012). The 1RM test has been shown to be a reliable strength indicator in various athletic populations (LeSuer et al., 1997; Benton et al., 2013; Seo et al., 2012), and percentages of 1RM are used in sport and exercise to define training loads for conditioning programs (Amarante Do Nascimento et al., 2013; Arazi and Asadi, 2013; Padulo et al., 2014). Apart from being tested directly, the 1RM performance can also be estimated through validated predictive equations when repetition-to-fatigue (RTF) performances are known (LeSuer et al., 1997; Taylor and Fletcher, 2012; Amarante Do Nascimento et al., 2013).

Despite the importance of 1RM testing in evaluating effectively strength performance, the technique of absolute muscle endurance (defined as the maximal number of repetitions that can be performed with a sub-maximal workload) has been increasingly adopted in many sport and exercise contexts as an alternative measure of upper body muscular performance (Mann et al., 2012). Indeed, prescribing fixed sub-maximal intensities has been recently considered as a potentially safer method than 1RM testing to assess muscular performance within resistance training contexts (Ehrman et al., 2010; Paoli and Bianco, 2012). This trend is particularly apparent within the context of recreational resistance training as performed by individuals in commercial gyms. Resistance training practitioners dealing with inexperienced individuals generally consider the 1RM bench press test a time-demanding and risky procedure. Therefore muscular endurance tests based on fixed sub-maximal intensities have been proposed as an alternative to evaluate 1RM performance within fitness contexts (Reynolds et al., 2006). However, it has to be acknowledged that these procedures have been repeatedly shown to under or overestimate both upper and lower body maximal strength (Castillo et al., 2012; LeSuer et al., 1997; Julio et al., 2012). Most of these methods base their 1RM predictions on the number of repetitions to fatigue (RTF) that can be performed with a self-selected weight to lift. Self-selecting a weight to lift can represent a practical issue when tests are performed by inexperienced individuals, such as those attending commercial gyms. Nevertheless, assessing maximal strength accurately and precisely is critical to evaluate current training state and formulate new training programs not only for experienced, but also for inexperienced individuals.

In order to overcome these practical issues, and in order to provide strength and conditioning professionals with practical guidelines for the evaluation of muscular strength of inexperienced individuals, here we designed and tested the effectiveness of a new method to perform the 1RM-bench press test. This method was designed based on previously validated theoretical predictive and practical procedures. Furthermore, we evaluated the physiological demand induced by the 1RM-bench press method we developed, with regards to its effects on oxygen consumption (VO_2), heart rate (HR), blood lactate (BLa) and perceived exertion (RPE). Physiological changes induced by the 1RM test have been poorly studied Scott et al. (2009) and further clarification is needed to understand how maximal efforts affect human performance. Numerous studies have examined the effects of different type of exercises on muscle soreness and damage (e.g. creatine kinase [CK] and lactate dehydrogenase [LDH]) and found increases in muscle injury following exercises (Uchida et al., 2009a, 2009b; Calle and Fernandez, 2010). However, still little is known on the acute effect of the tests used for the evaluation of physical qualities such as maximal strength. Increasing the knowledge on the energetic cost of maximal physical exertion, as well as providing accurate and precise information concerning the metabolic intensity of fitness activities is indeed essential to define the characteristics of fitness and exercise activities aimed at improving life quality while minimizing health risks (Ehrman et al., 2010; Nelson et al., 2007).

The aim of this study was therefore to assess the effectiveness of a newly designed 1RM-bench press method specifically targeted to inexperienced young male and females and to investigate the impact of such method on some metabolic and cardiovascular parameters.

Subjects and methods

Subjects

Eight male (age: 23.5 ± 2.3 yrs) and seven female (age: 27.9 ± 10.0 yrs) individuals participated to this study (Table 1). All participants gave their informed consent for participation. The test procedures were explained to each participant. Participants were asked to fill a health screen questionnaire. Inclusion criteria for this study were: 1. no history of cardiovascular disease and muscle-skeletal injuries in the previous 12 months; 2. no previous experience of resistance training. Ethical approval was granted by the University of Palermo Ethical Committee (Department of Sport and Motor Sciences DISMOT).

The principles of the Italian data protection act (196/2003) were observed. All participants provided informed consent. The study was performed in compliance with the Helsinki Declaration.