Older Adults and One-Repetition Maximum Testing: What About Injuries?

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THERE IS LITTLE ARGUMENT that aging imposes significant changes in the musculoskeletal system and functional ability of older adults. Although variability exists in defining an older population, many of the physiologic changes due to aging reported in the literature are observable by the middle of the sixth decade. Declines in gross muscular strength and muscle mass are 2 of the most noted changes. Only in the last few decades has strength training become recognized and widely accepted as an efficacious means of lessening the effects of aging on the neuromuscular system while increasing functional ability (6). The unique characteristics of aging and exercise tolerance in older adults warrant special attention from strength training professionals.

Although strength training has slowly gained popularity among older adults, much discussion has surfaced regarding the safety of one-repetition maximum (1RM) testing within this population. The use of 1RM testing serves at least 2 purposes: (a) to establish a base-level quantification of strength, and (b) to provide feedback for progression and modification of an exercise program. Much data on the safety and efficacy of 1RM testing exists in younger populations; however, the literature is incomplete on data specifically addressing the safety and injury rates of 1RM testing in older adults. Much of the information on injuries with 1RM testing in older adults is rooted in a sparse number of studies or has been extrapolated from studies using 1RM testing but not specifically addressing injuries.

Two primary studies are often cited in regard to injuries with 1RM testing in older adults. Pollock et al. (5) examined 49 subjects 70–79 years of age using Nautilus leg extension and dual decline press tests. The authors recorded an injury “if training had to be stopped or significantly altered for at least 1 week.” The study further added that “minor muscle soreness was not included.” Pollock et al. (5) reported a 19.3% injury rate among their subjects. Of 11 injuries, 5 were localized to the knee as a result of leg extension testing. The remaining 6 injuries were related to the chest press and included 5 of the shoulder and 1 of the back. However, further details showed that 4 of the 5 knee injuries were related to prior injuries or problems. The remaining injuries were not related to previous injury and thus were presumed to be caused by the testing. The authors did state, however, that only 1 subject dropped out of the study because of a 1RM testing–related injury. The remaining subjects were able to complete the study.

Shaw et al. (8) also examined injuries during 1RM testing in older adults. Their study examined 83 subjects 55–80 years of age stratified into 3 levels of weight-lifting experience: no experience, 1–6 months of experience, and greater than 6 months of experience. Strength was assessed on 5 different variable resistance machines: chest press, leg extension, abdominal curl, arm curl, and seated calf raise. Injury, defined as an event “when a subject had to either significantly change or stop their physical activities,” was reported in 2 of the 83 subjects (2.4%). The 2 injuries, both...
In subjects with no lifting experience, included a muscular back injury and a rib fracture sustained while exerting force at or near the subject’s maximum. The back injury occurred in a man with a previous history of joint problems during leg extension, whereas the rib fracture, sustained during the chest press, was in a woman without known orthopedic or osteoporotic pathology. After 2 and 5 weeks, respectively, each subject was able to resume training.

Although the injury rates reported by Pollock et al. (5) and Shaw et al. (8) are used by those who question the use of 1RM testing in older adults, much more data exist that support the safety of 1RM testing in clinical and older populations. The data of Frontera et al. (3) offer support for the use of 1RM testing in older adults. Following weekly 1RM tests on 12 subjects 60–72 years of age over 12 weeks (144 individual tests), the authors reported no injuries. Additional data were presented by Rooks et al. (7) involving pre- and poststudy 1RM tests on 131 community-dwelling older men and women 65–95 years of age. Of 262 1RM tests administered, none of the subjects reported an injury.

The use of 1RM testing has not been confined to only healthy, community-dwelling older adults. Fiatarone et al. (2) used 1RM tests with institutionalized, frail, elderly persons 86–96 years of age. Forty 1RM tests were performed over 8 weeks with only 1 subject leaving the study at the investigators’ suggestion because of reports of strain at the site of a previous inguinal hernia repair. When considered collectively, these 3 studies reported only 1 injury in 446 1RM tests in men and women 60–96 years of age, which equates to a 0.2% rate of injury. Furthermore, the single injury was an aggravation of a previous injury.

Traditionally, cardiovascular exercise programs have emphasized aerobic activities. More recently, however, the addition of resistance training exercises has become popularized as evidenced by the inclusion of resistance training in many cardiac rehabilitation programs. Because the acute cardiovascular responses to high load resistance exercise differs from that of aerobic exercise (i.e., a marked pressor response with heavy resistance), the use of 1RM testing in older adults warrants consideration. Gordon et al. (4) were the first to specifically address cardiovascular safety in subjects with “substantial risk factors for cardiovascular disease.” Gordon et al. (4) examined 6,653 subjects 20–69 years of age during maximal isokinetic and isotonic knee extension and isotonic chest press strength tests. Of all subjects tested, there was not a single incidence of a cardiovascular event and no reports of musculoskeletal injury were made. More recent data by Barnard et al. (1) further support the use of 1RM testing in patients involved in cardiac rehabilitation. Seventy-four patients 39–76 years old and currently enrolled in cardiac rehabilitation performed 1RM tests, including the seated shoulder press, leg extension, latisimus dorsi pull-down, bilateral arm curl, and leg press. All subjects underwent a prior medical examination including a graded exercise test. After nearly 400 individual tests, no injuries were reported and no abnormalities in blood pressure or heart rhythm were reported by a cardiologist monitoring each subject. Interestingly, average blood pressures immediately following maximal strength testing were no different than those measured during the aerobic cycling portion of their cardiac rehabilitation program (150/82 mmHg).

The preponderance of recent data suggests that 1RM testing in older adults can be safely performed. Despite only a limited number of studies specifically addressing injuries in older adults, this conclusion appears to be substantiated when examining the current literature. Safety in 1RM testing is undoubtedly influenced by 2 key concerns that may often be overlooked: proper medical screening and subject supervision. Associated with all studies presented in this column is the use of preparticipation histories and physical examinations to identify individuals for whom maximal strength testing may be contraindicated or for whom injury risk may be increased. Pre-screening may or may not include graded exercise testing but, based on the injury data of others (6, 8), identification of pre-existing joint pathology prior to testing should be requisite and can reduce the rate of injury. The experience of test administrators and injury rates during 1RM testing in older adults have not been studied, but knowledge and experience of the tester is likely to affect the safety of maximal strength testing. Supervision of participants by knowledgeable strength training professionals and adherence to a proper testing format cannot be underestimated if injury during maximal testing is to be minimized.

The use of 1RM testing provides several benefits in regard to exercise training. Concerns about the use of 1RM testing in older adults in terms of musculoskeletal and cardiovascular problems are warranted considering the stress of such testing and the unique changes throughout the
aging neuromuscular system. However, recent data appear to support the safety and thus support the use of 1RM testing in older adults. Although the safety of 1RM testing in these subgroups appears reasonably established in the scientific literature, the strength and conditioning professional should follow standard screening procedures and require appropriate medical clearance where indicated before administering 1RM tests in clinical and older populations. ▲

References