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Assisted jumping: A possible method of incorporating high-velocity exercise in older populations

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A B S T R A C T

In the past, older adults were traditionally deemed too weak or fragile to participate in high-intensity exercise, but more recent research indicates that not only is high-intensity exercise not dangerous in this population, but it may in fact be a preferable form of exercise over other, less-intense alternatives. However, many seniors still do not participate in high-intensity exercise despite the mounting evidence that it can improve a number of physiological functions and ultimately increase quality of life. As health, sport, and medical professionals, we must continuously ask ourselves how we can apply our lab-based findings in real-life scenarios, and in the case of older adults, we must find a way to circumvent some of their most common reasons for not exercising, which can include a lack of time, a lack of know-how, a lack of motivation, a fear that high-intensity exercise is unsafe, and a perception that high-intensity exercise is too difficult. Therefore, introducing quick, simple, safe, and perceptually easy exercises may result in immediate health and functional benefits and may serve as a gateway exercise to usher older adults into the realm of high-intensity training. Specifically, assisted jumping could serve this purpose. In this article, the ideas behind the theory and practice of assisted jumping are set forth, providing an evidence-based hypothesis from which future researchers can build on to implement high-speed, high-power, high-intensity exercise in older populations in both research and practical settings.

Introduction

Despite numerous revisions to physical activity guidelines that have been set forth by local and world-wide health organizations, the percentage of adults who exercise continues to remain relatively low and unchanged [1–5]. As these reports are often virally disseminated among various media outlets, it would be assumed that a lack of awareness or a lack of information is not to blame for the stagnation of exercise habits in the general population. Therefore, it is the responsibility of researchers, doctors, coaches, and practitioners to continually encourage healthy exercise habits not only in the workplace, but also in the public sphere. Furthermore, it is important for workers in these professions to continuously educate themselves with the most up-to-date findings: a task that is becoming increasingly difficult with a seemingly exponential number of scientific studies being published every day.

One example of such a rapidly evolving field is the field of high-intensity exercise, which encompasses a wide range of exercises from high-velocity low-load exercise to low-velocity high-load exercise, which are often performed with maximal effort. Throughout history, one of the most common exercise myths that continues to circulate today is that high-intensity exercise should only be recommended for those who can withstand the large amounts of internal and external stress that are associated with these maximal effort exercise methods. As such, it was believed that children should not lift weights as it was thought to stunt growth [6,7], and senior populations were supposedly too weak and fragile to handle high-intensity exercise [8,9]. However, those ideas have essentially been put to rest in the scientific community, largely thanks to a growing body of evidence supporting the use of high-intensity exercise not only in athletic populations but also in what used to be considered “at-risk” populations [10–13]. Specifically, the notion of older adults performing high-intensity exercise is becoming more popular as research continues to show the benefits of high-intensity exercise on bone health, muscular strength, balance, fall prevention, brain function, and quality of life among various other physical and mental qualities [14–20]. Despite this information being widespread in the scientific community, translating this information into practice in order to encourage older adults to partake in high-intensity exercise can still be a challenge.

Although non-exercisers can provide a multitude of justifications for their (lack of) exercise habits, some of the most common anecdotal reasons for not participating in high-intensity exercise often include a lack of time, a lack of know-how, a lack of motivation, a fear that high-intensity exercise is unsafe, and a perception that high-intensity exercise is too difficult [21]. Therefore, perhaps more time and effort should be spent on determining how to address these barriers while simultaneously introducing high-intensity exercise to older adults who may not be immediately receptive to the idea of traditional high-intensity exercise methods.

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One strategy could be to introduce quick, simple, and safe exercises that could possibly be done in the convenience of the home or at a local park. Additionally, if these exercises could be perceived as easier and more enjoyable than other forms of high-intensity exercise, they may serve as a gateway exercise to usher seniors into the realm of high-intensity training, possibly increasing the likelihood of successfully introducing, enjoying, and maintaining high-intensity exercise habits. One example of such an exercise is assisted jumping.

Assisted jumping: Why?

Often, the aim of high-intensity exercise is to increase the neuromuscular capabilities of muscles, ultimately translating into functional adaptations. Among these adaptations is an increase in muscular power output, and since power output is the product of force output and movement velocity, a positive change in either variable can increase power. Perhaps oversimplified but generally true, when aiming to increase the maximal force capabilities of a muscle, resistance training is the most appropriate form of exercise; but to increase the maximal shortening velocity of a muscle, it is vital to perform rapid movements [22]. In science and in practice, resistance training usually implements "overload" stimuli, as the muscles are exposed to external loads that are greater than normal, resulting in slower movement speeds. Similarly, but on the opposite end of the spectrum, assisted exercises can be classified as "overspeed", as exercisers must move faster than they normally would but at the expense of maximal force production. Although it is well-known that resistance training is important for all individuals and that a base level of strength is necessary as strength underpins power development [23], one could argue that the maximum force requirements of daily life remain fairly low and stable since bodyweight remains relatively constant in most people throughout adulthood. Thus, it could be logical to focus more on the velocity aspect of power development than on the force aspect, which can be done without the need for heavy or specialized equipment in the form of jump training.

Normal jumping, also known as bodyweight jumping, is often used as a plyometric exercise in strength and conditioning programs to help athletes run faster and jump higher. Although increasing running and jumping performance is paramount for athletes, older adults likely do not need to increase their running speed or jumping height. However, the physiological underpinnings of increased performance, in the case of jump training, relate to increasing power output via neuromuscular adaptations of rapid force development, which could be very useful for older populations [17,24,25]. In any case, both overload and overspeed exercises are meant to be performed with maximal voluntary intent in order for maximal adaptations to occur [26–30]. Although shown to be safe in older adults [14,15,31], the notion of exerting maximal effort against a heavy resistance may act as a psychological block that can initially inhibit an older person from partaking in high-intensity overload exercise. In these instances, it may be sensible to introduce assisted jumping, which has been shown to be perceptually easier than what is common during heavy resistance training [32–34] and even easier than bodyweight jumping in young healthy individuals [35].

In young and athletic populations, assisted jumping serves as a form of overspeed training, allowing athletes to jump at supramaximal velocities (i.e. peak velocity about 4–5% faster with 30% bodyweight reduction and about 8% faster with 40% bodyweight reduction [36,37], whereas some studies have shown 30% bodyweight reduction to increase peak jumping velocity by over 50%, which can be attributed to a different set-up [38,39]). By jumping at supramaximal velocities, the muscles must operate at faster-than-normal speeds [35,40–42], resulting in increased jumping and power generating abilities both acutely and chronically [35,37,40,43,44]. Considering the age-related decline in speed and power output [45–48], increasing power output and movement velocity of the lower limbs would be advantageous for older adults. Furthermore, according to the principle of training specificity, chronic adaptations occur at and around the velocities [49,50], range of motion [51,52], and loads [39,53] that are used during training. Therefore, if someone, whether it be an athlete or an older adult, trains with assisted jumping, they would theoretically improve their performance at similar velocities, joint angles, and forces that occur during training. As walking, climbing stairs, sitting down, and standing up all involve near end range of motion movements in the hips, knees, and ankles (i.e. similar to the mechanics of jumping), it could be hypothesized that assisted jumping would increase the power and velocity of these daily movements. Additionally, plyometric training is already commonplace in fall prevention programs, as increasing lower body power output has been correlated with decreased fall risk [17]. However, it is unknown whether overspeed plyometrics could further improve power output of the lower limbs, increasing the positive adaptations associated with jump training. Therefore, although assisted jumping has not been tested in the elderly, we can hypothesize that the mechanisms that underpin the adaptations seen in young athletic populations would also be evident in the elderly. As a result, it is possible that performing assisted jumping in the elderly could increase lower body speed and lower body power output, increasing their quality of life and decreasing the risk of falls, as described above.

Assisted jumping: How?

Assisted jumping is exactly what it sounds like: jumping, but with a bit of upward assistance. In the majority of research studies, this assistance has usually been provided via a system of ropes, pulleys, and elastic bands [39,40,54,55]. In these laboratory-based systems, a member of the research team often pulls down on a rope which runs upward, through a pulley system, and continues downward to where it is attached to a harness that is worn by a participant (Fig. 1). By pulling down on the rope, the elastic bands above the participant are stretched and the participant essentially weighs less, becoming unloaded, or assisted until the ropes and elastic bands are returned to their resting position. With these assisted configurations, the degree of assistance can be adjusted depending on how much the ropes and elastic bands are pulled and stretched, but this setting is not practical in everyday life, as it requires specialized equipment and multiple people [40,41]. To revamp this successful but impractical design, others have reported on a much simpler system to provide assistance that only requires a horizontal bar above the head and commercially available elastic bands (Fig. 2) [35,56].

Using what some researchers called a "field-based" system, they were able to mimic the kinetic and kinematic output of their "lab-based" system like the ones described above [35]. In short, the participants stood under two elastic bands that were hanging down, reached up, grabbed the bands, and pulled the bands and their hands down towards their chest. As a result of the increased stretch of the bands, the participants were pulled upwards towards the horizontal bar. By grabbing higher or lower on the bands, the amount of assistance could be increased or decreased, respectively, resulting in the same levels of assistance as the more complicated laboratory set-up. Therefore, the only equipment that is needed are resistance bands, which can be purchased at nearly every sporting goods store, and an over-head attachment point.

Considering the minimal equipment needed using the set-up described above, it would be possible to quickly perform assisted jumping at home or in a local park. Also, since jumping is a relatively simple task that most people are likely familiar with, the learning curve may be less than what it could be for other forms of high-intensity or high-velocity exercises. Lastly, as bodyweight is decreased during assisted jumping, the participant feels lighter and the exercise is perceived to be easier [35], all while training with an overspeed stimulus that would likely benefit the velocity-aspect of power production: an adaptation that would be highly beneficial for older adults.

Fig. 1. Laboratory-based assisted jumping set-up with a series of ropes, pulleys, and elastic bands.

Other considerations

This article sets forth the hypothesis that assisted jumping may serve as a mode of high-intensity exercise that can result in positive physiological and functional adaptations in older adults. However, it is important to state that assisted jumping would not the "be all end all" in terms of high-intensity training. Without a sufficient amount of muscle mass, the strength required to perform high-velocity movements (e.g. assisted jumping) would likely be insufficient in older, sarcopenic adults, highlighting the importance of resistance training in older populations. Additionally, low-intensity exercise also serves a purpose in overall health and should not be abandoned. Furthermore, assisted jumping may or may not affect impact forces during landing in young individuals, as the research is inconclusive [35,36], and no study has yet investigated the effect of assisted jumping in the elderly. Nevertheless, it is possible that assisted jumping may help increase the quality of the already available muscle by increasing tendon compliance [57–61] or by increasing the recruitment of previously dormant motor units [62–64].

Fig. 2. Practical, field-based assisted jumping set-up with only two resistance bands and a single attachment point overhead.

Therefore, although it could be hypothesized that this milieu of benefits from assisted jumping could have an immediate and positive effect on physical and functional performance, it is important to note that the ideas proposed in this article account for only a small fraction of the overall benefits that can occur as a result of a well-rounded exercise program. In fact, the long-term result of this hypothetical model of implementing assisted jumping in older adults could be to overcome the physical and mental barriers that prevent certain individuals from performing high-velocity exercise, eventually ushering them into a well-rounded strength and conditioning program inclusive of heavy resistance training, bodyweight plyometrics, and assisted overspeed movements (i.e. training across the entire force–velocity spectrum).

Conclusions

In conclusion, bodyweight jumping is beneficial for improving power output in athletes and seniors, and assisted jumping is beneficial in athletes while also being perceived as easier than bodyweight jumping. Although assisted jumping has not been investigated in older adults, the mechanisms underpinning its success in athletes should carry over into older adults as well. Therefore, it can be hypothesized that assisted jumping could serve as a safe, easy, enjoyable, and time-efficient exercise modality in older adults, eventually improving their lower-body power output, maintaining their independence, decreasing their risk of falls, and increasing their quality of life.

Conflicts of interest

The author of the manuscript declares no conflicts of interest.

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