

# Green Exposure: Gardening as a Healthy Physical Activity

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Gardening activities may improve muscle strength and physical functional ability because various muscles are used for gardening.

**G**ardening is a popular leisure activity, offering a variety of benefits like physical activity, edible harvests of fruits and vegetables, exposure to a green environment and ecosystem, as well as psychological well-being. Health benefits of gardening reportedly include improvement in blood pressure, total cholesterol, and muscle strength; as well as physical functional ability, hand function ability, and bone mineral density.<sup>1, 2, 3</sup> To clarify these health benefits, research-based evidence for the therapeutic mechanisms of gardening is needed. This article will address the research-based scientific evidence for gardening as a healthy physical activity.

## Benefits of physical activity

Physical activity is “any bodily movement produced by the contraction of skeletal muscle that results in energy expenditure”.<sup>4</sup> Extensive research has found that regular physical activity may lead to health benefits such as a reduction in chronic disease and improvements in fitness levels, aerobic capacity, balance, etc.<sup>5, 6, 7, 8</sup> Therefore, the Centers for Disease Control and Prevention and the American College of Sports Medicine recommend at least 30 minutes of moderate-intensity physical activity during most days of the week for good health in adults.<sup>9, 10</sup>

## Exercise intensity of gardening activities

The unit metabolic equivalent (MET) represents the exercise intensity of physical activity and is expressed by oxygen consumption and body weight (1 MET equals 3.5 ml O<sub>2</sub>/kg/minute). MET can be categorised into light intensity (less than 3 METs), moderate intensity (3 to 6 METs), and high intensity (above 6 METs).<sup>10</sup> For example, a resting state, such as lying down or sitting quietly, represents 1 MET.<sup>11</sup> Walking corresponds to 3.5 METs and jogging equals 7 METs.<sup>12</sup>

Previous studies that determined MET values for various gardening activities were based on oxygen consumption data while subjects were performing gardening activities, and described a variety of gardening activities of low to high intensity for various populations such as children, adults in their 20s, and the elderly aged over 65 years (see Image 1).

A previous study determined the exercise intensity of various common gardening activities in adults aged over 65 years.<sup>13</sup> The 15 common gardening activities performed by older adults were of low to moderate intensity (1.7 – 4.5 METs). Gardening activities that simultaneously used both the upper and lower body included digging, fertilizing, weeding, raking, and tying plants to stakes: these were moderate-intensity activities. Gardening activities that used the upper body while standing or squatting included pruning, mixing soil, planting seedlings, sowing, watering with a watering can or hose, and harvesting: these were low-intensity physical activities.

Activity	Mean ± SD		
	Children	Adults	Elderly
Digging	6.6 ± 1.6	6.3 ± 1.2	4.5 ± 1.2
Raking	6.2 ± 1.5	5.4 ± 1.0	3.4 ± 0.8
Weeding	5.8 ± 1.1	5.0 ± 0.8	3.4 ± 0.6
Mulching	5.5 ± 1.3	4.5 ± 0.6	3.3 ± 0.8
Sowing	5.0 ± 1.1	4.3 ± 0.8	2.7 ± 0.6
Harvesting	4.9 ± 0.6	4.2 ± 0.6	2.7 ± 0.6
Watering	4.6 ± 1.1	3.9 ± 0.4	2.4 ± 0.8
Mixing soil	4.4 ± 0.6	3.6 ± 0.5	2.4 ± 0.7
Planting transplants	4.3 ± 0.5	3.5 ± 0.5	2.9 ± 0.9

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In another study, common gardening activities performed by adults in their 20s were of moderate to high intensity (3.5 – 6.3 METs).<sup>14</sup> Most of the gardening activities such as transplanting, mixing growing medium, watering, harvesting, sowing, hoeing, mulching, weeding, and raking were of moderate intensity. Activities such as watering, mixing growing medium, and transplanting were of lower intensity. Digging was a high-intensity physical activity and the most intense activity tested.

Common gardening activities performed by children aged 11 to 13 years were of moderate to high intensity (4.3 – 6.6 METs).<sup>15</sup> Digging and raking were high-intensity physical activities for children; digging was the most demanding activity among the gardening activities performed. Weeding, mulching, hoeing, sowing seeds, harvesting, watering, mixing growing medium, and transplanting were of moderate intensity.

Information on METs for various gardening activities in different age groups is useful when gardening is prescribed as a physical activity intervention. Moreover, gardening activities can be applied as an exercise prescription or as horticultural therapy intervention for clients with special needs. In this case, data on METs will be useful for developing a suitable programme tailored to the physical capacity of the client.

### Muscle activation by gardening activity

Weight-bearing exercises improve muscle strength and physical functional ability,<sup>16</sup> as external stress from a high-intensity physical activity stimulates new bone formation.<sup>17</sup> Gardening activities involving weight-bearing body movements work against gravity by using upper and lower limb muscles.<sup>18, 19</sup> Weight-bearing gardening activities such as digging or weeding can improve muscle strength and bone mineral density.<sup>20</sup>

Electromyography (EMG) measures muscle activity while a subject performs an activity.<sup>21</sup> A previous study used EMG to investigate specific upper limb and hand muscle activation while subjects were performing 15 common gardening activities.<sup>18</sup> The subjects used eight muscles (e.g. upper trapezius, triceps—long head, biceps brachialis, flexor carpi ulnaris, flexor carpi radialis, brachioradialis, thenar eminence and hypothenar eminence) during gardening activities, although the degree of usage varied among the muscles. The main muscle used in gardening activities was the upper trapezius, because most gardening activities use the shoulder and arms. The trapezius is generally more activated during activities in the sitting position than in the standing position.<sup>22</sup> In addition, hand muscles such as thenar eminence and hypothenar eminence were also actively used for gardening activities.

1. Metabolic equivalents (METs) data of various gardening activities in children, adults, and the elderly.



Gardening activities can be applied as an exercise prescription or as horticultural therapy intervention for clients with special needs.

Another study analysed upper and lower limb muscle activation during five common gardening activities by using EMG.<sup>19</sup> In the five gardening activities of digging, raking, hoeing, weeding, and trowelling, activation of the upper limb muscles (e.g. bilateral anterior deltoid, biceps brachialis, brachioradialis, and flexor carpi ulnaris) was higher than that of the lower limb muscles (e.g. bilateral vastus lateralis, vastus medialis, biceps femoris, and gastrocnemius). The reason is that the upper limb muscles were mostly used during gardening activities and the lower limb muscles played a role in supporting the body. Moreover, the right brachioradialis and flexor carpi ulnaris of the upper limb showed higher muscle activation than the other upper limb muscles tested.

In addition, a horticultural therapy programme for rehabilitation has been shown to improve muscle strength and range of motion in the upper limbs in stroke patients.<sup>23</sup> Gardening activities may improve muscle strength and physical functional ability because various muscles are used for gardening.<sup>2</sup>

### Health benefits of gardening intervention

Gardening intervention reportedly offers various health benefits through enhanced cardiovascular endurance, muscle strength, physical functional ability, hand function, and bone mineral density, as well as reduced high-density lipoprotein (HDL) cholesterol, blood pressure, and waist circumference.<sup>1, 2, 3</sup>


A recent study reported that a 15-session gardening intervention programme significantly improved hand function ability, physical functional abilities, cognitive ability, and HDL cholesterol, and reduced waist size, blood pressure, inflammatory marker levels in blood, and oxidative stress in elderly women aged over 70 years.<sup>2, 3</sup> In contrast, elderly women in the control group had significantly increased depression symptoms, and decreased agility and muscle mass. Therefore, this study showed that a 15-session gardening programme as a physical activity intervention had positive effects on the physical and psychological health of women aged over 70 years.

Meanwhile, horticultural therapy is used as an intervention for clients with special needs who are treated by a professional therapist.<sup>24, 25</sup> A recent review paper of 509 published research articles showed that horticultural therapy and horticultural activity programmes have positive physical, psychological, emotional, social, cognitive, behavioral, and educational effects in various populations.<sup>26</sup>

### Additional benefits of gardening

Gardening has great potential for therapeutic use. Gardening motivates continuous participation in therapeutic intervention because of the need to care for living plants. Moreover, taking care of plants is an enjoyable activity.<sup>27, 28</sup> Working with green plants induces physiological and psychological relaxation.<sup>12</sup> In addition, gardening intervention provides a variety of goal- and task-oriented activities using various plant materials.

### Future directions

Studies on the effects of gardening as a physical activity intervention or treatment for various populations are needed. In addition, gardening activities need to be analysed for their various physical, psychological, cognitive, and social aspects, to enable use as an intervention for health benefits and well-being, requiring more studies to determine the therapeutic mechanisms of gardening activities. 

## References

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