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Impact of Smartphone-Induced Mental Fatigue on Resistance Training Performance and Efficiency - The Role of Smartphone Use During Workout

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Abstract

Introduction

Resistance training volume is a key determinant of muscle hypertrophy and strength development. However, mental fatigue can significantly impact this volume, ultimately affecting performance. One prominent source of mental fatigue in modern gym environments is smartphone use, which has become pervasive and may reduce workout efficiency and overall training volume.

Purpose

This review examines the dual effects of smartphone use on resistance training outcomes and offers strategies to balance these impacts effectively.

Conclusions

Smartphone-induced mental fatigue increases perceived exertion, leading to reduced performance during resistance training by lowering volume-load and endurance, particularly in low- and moderate-intensity exercises. Despite this, maximal strength appears to remain unaffected. Additionally, smartphone use diverts cognitive resources, resulting in mental fatigue and impairing both physical and technical performance due to distractions during workouts. It can also unintentionally prolong rest periods, which disrupts the balance between muscle recovery and mental readiness, further decreasing training efficiency. However, smartphones also offer valuable benefits, such as access to fitness apps, progress tracking, and motivational music, which can help maintain or even enhance performance by improving focus and motivation. To minimize distractions and optimize training outcomes, strategies such as using airplane mode or scheduling specific times for phone use are recommended.

While excessive smartphone use can impair training efficiency, careful management and strategic use can enable athletes to capitalize on its benefits and improve resistance training results. Future research should focus on developing best practices for incorporating smartphone use in fitness settings to balance its advantages while minimizing its downsides.

Key words: physical performance; strength training; cognitive effort; mental fatigue; training load; neuroperformance;

1. Introduction

Resistance training volume is a key determinant of the effectiveness of strength training programs, typically calculated as the total weight lifted during a session—derived from the number of sets, repetitions, and the weight used [1, 2]. Mental fatigue, characterized by cognitive exhaustion due to extended mental effort, leads to diminished cognitive performance and increased subjective feelings of fatigue [3, 4]. It can significantly impair physical performance, not by affecting cardiorespiratory or musculoenergetic systems, but by

elevating the perceived effort required during exercise [5]. Mental fatigue, whether induced by cognitive tasks or social media use, can negatively impact performance in resistance training and other sports. For instance, studies have demonstrated that mental fatigue increases the rate of perceived exertion (RPE) during weightlifting and reduces cycling performance [6, 7]. It also adversely affects endurance, motor skills, and decision-making across various sports [8], leading to a decrease in the number of repetitions and movement velocity in resistance exercises, even though maximal force production remains unaffected [7, 8].

Smartphones are now omnipresent in numerous environments, including gyms, classrooms, and healthcare settings. While they can enhance learning and provide convenient access to information [9], they also introduce challenges such as distraction and dependency. In fitness contexts, smartphone apps can effectively encourage physical activity by tracking progress, setting goals, and offering user-friendly interfaces [10, 11]. These apps utilize smartphone features like GPS and accelerometers to monitor health and fitness parameters, providing personalized coaching and motivation [11]. However, smartphone use in gyms presents a dual-edged sword: while it may help filter out intimidating environmental stimuli, it can also detrimentally affect performance outcomes [12]. Therefore, it is essential to establish guidelines for smartphone use in various settings to maximize benefits and minimize distractions [9].

Research suggests that smartphone use in gyms can significantly impact workout performance. Prolonged smartphone use before exercise can induce mental fatigue, resulting in a reduced volume-load in resistance training [13]. Moreover, excessive smartphone use has been linked to both mental and physical health issues, with higher levels of smartphone addiction correlating with increased mental fatigue and reduced cognitive flexibility [14]. Prolonged use, particularly of social media apps, can cause mental fatigue that diminishes physical performance. For example, studies have shown that resistance training participants exhibited a lower volume-load after using social media apps [13], and young footballers demonstrated reduced physical and technical performance following smartphone use [15].

2. The Impact of Mental Fatigue on Brain Acivity

Mental fatigue, caused by prolonged cognitive activity, can significantly impact physical performance, particularly in endurance tasks [16]. It leads to increased perceived exertion and

decreased time to exhaustion, although physiological variables remain unaffected [16]. Mental fatigue interferes with prefrontal cortex activation during physical tasks, potentially influencing motor output [17]. EEG studies show increased frontal theta and parietal alpha rhythms associated with mental fatigue, allowing for accurate classification and tracking of fatigue development [18]. The onset of EEG-detectable fatigue can occur within 15-30 minutes of task performance [18]. Recovery from mental fatigue varies, with alpha power remaining elevated up to 60 minutes post-task, while motor skills recover within 40-47 minutes [19]. These findings highlight the complex interplay between mental fatigue, brain activity, and motor function.

3. The Impact of Mental Fatigue on Physical Performance and Resistance Training Volume

Mental fatigue, induced by prolonged cognitive engagement such as smartphone use, can significantly impact physical performance by reducing endurance and volume-load in resistance training, primarily due to increased perceived exertion rather than physiological changes [5, 13, 16]. The impact of mental fatigue appears to be psychological rather than physiological, as evidenced by unchanged physiological variables like blood lactate concentrations and heart rate [6,13]. Even the mere presence of smartphones can occupy cognitive resources, potentially affecting performance [20]. In a gym setting, 30 minutes of smartphone social media use led to increased mental fatigue and decreased volume-load during strength exercises compared to a control condition [13]. While mental fatigue does not appear to affect maximal strength, power, or anaerobic work, it consistently impairs endurance performance [16]. Studies have shown that mental fatigue reduces total training volume and the number of repetitions to failure in exercises like the half-back squat [13, 21, 22], with this effect being particularly pronounced in low- and mid-intensity resistance exercises but not in high-intensity exercises [22].

4. The Role of Smartphone Use in Inducing Cognitive Load and Distraction

Smartphones require continuous cognitive engagement, whether through social media, messaging, or other apps. Even their mere presence can reduce available cognitive capacity, particularly for individuals who are highly dependent on their devices [20]. This constant connectivity may have cognitive costs, impacting attention, memory, and the ability to delay gratification, potentially leading to mental fatigue during workouts as the brain must divide its focus between training and smartphone use [23]. Research has shown that prolonged smartphone use can negatively affect physical and technical performance in young athletes,

such as footballers [15], and that repeated smartphone use before training can impair decision-making abilities in sports like volleyball over time [13].

5. Impact of Smartphone Use on Rest Periods and Training Efficiency

Research indicates that mental fatigue can significantly reduce endurance performance, resulting in shorter time to exhaustion and lower self-selected power output [16]. In resistance training, mental fatigue impairs strength endurance, leading to a reduction in the number of repetitions performed in both upper and lower body exercises [24]. This detrimental effect extends to other activities, such as weightlifting and cycling, where mental fatigue raises perceived exertion and lowers both power output and distance covered [6]. However, while some studies report considerable effects of mental fatigue on resistance exercise performance, others have found no significant differences in the total number of repetitions completed or in muscle activation patterns [6].

The duration of rest periods between sets is a critical factor in resistance training performance. Longer rest periods (3-5 minutes) enable better maintenance of repetitions and total work volume compared to shorter rest intervals (1 minute) [25, 26]. However, one of the most significant effects of smartphone use during workouts is the unintended extension of these rest periods. Smartphone notifications have been shown to increase symptoms of inattention and hyperactivity. Experimental studies demonstrate that keeping notification alerts on and having phones within reach leads to higher levels of inattention and hyperactivity compared to minimizing interruptions. These increased levels of inattention are associated with lower productivity and reduced psychological well-being [27].

While adequate rest is essential, excessive rest due to smartphone distractions can induce mental fatigue and disrupt the workout rhythm. Inconsistent rest periods caused by smartphone use can create an imbalance between muscle recovery and mental readiness, potentially decreasing workout effectiveness and reducing overall training volume.

5. Leveraging Smartphone Use for Training Benefits

While smartphones can contribute to mental fatigue, they also offer several advantages that can enhance training outcomes. Access to apps that track progress, suggest personalized

workouts, and monitor vital statistics can help maintain or even boost training volume by providing structure and real-time feedback. Additionally, smartphone apps have been developed to improve mental health literacy and reduce barriers to care, further supporting overall well-being [30]. Listening to music on smartphones can help mitigate some effects of mental fatigue by enhancing mood and motivation [28]. Research shows that music, especially when self-selected and motivational, can lower perceived exertion and improve performance, particularly during repetitive or endurance-based activities [29].

6. Mitigating Mental Fatigue to Maximize Training Efficiency

To reduce the impact of smartphone-induced mental fatigue, athletes can adopt strategies such as using airplane mode, setting designated times for phone use, or relying on less distracting wearable technology. These approaches help maintain mental focus and optimize training volume by minimizing unnecessary interruptions [31]. By strategically utilizing smartphones—prioritizing beneficial apps and music while reducing distractions—gym-goers can harness technology to support, rather than detract from, their resistance training efforts.

7. Conclusion

Smartphone-induced mental fatigue increases perceived exertion, leading to reduced performance during resistance training by lowering volume-load and endurance, particularly in low- and moderate-intensity exercises. Despite this, maximal strength appears to remain unaffected. Additionally, smartphone use diverts cognitive resources, resulting in mental fatigue and impairing both physical and technical performance due to distractions during workouts. It can also unintentionally prolong rest periods, which disrupts the balance between muscle recovery and mental readiness, further decreasing training efficiency. However, smartphones also offer valuable benefits, such as access to fitness apps, progress tracking, and motivational music, which can help maintain or even enhance performance by improving focus and motivation. To minimize distractions and optimize training outcomes, strategies such as using airplane mode or scheduling specific times for phone use are recommended.

While excessive smartphone use can impair training efficiency, careful management and strategic use can enable athletes to capitalize on its benefits and improve resistance training

results. Future research should focus on developing best practices for incorporating smartphone use in fitness settings to balance its advantages while minimizing its downsides.

Disclosure:

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