

# **Extreme Conditioning Programs**

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## **INTRODUCTION**

Extreme conditioning programs (ECP) are a growing exercise regimen portrayed by depending on aerobic, plyometrics, and resistance training exercises, which involve short intervals of high levels of intensity exercise bouts (1). These workouts typically include Olympic lifting (snatch, clean, and jerk), powerlifting (squat, deadlift, press/push press, bench press), and gymnastic movements (pull-ups, toes-to-bar, knees-to-elbows, lunges, muscle-ups, burpees, dips, push-ups, rope climbs) (2). As well as functional movements (squats and lunges) performed at high-intensity intervals and continually fluctuating movements (3). Programs such as CrossFit, Insanity, Gym Jones, and P90X are all considered these types of programs and have recently become popularized due to their common practices and family feeling (4). In a study done by Bailey et al. (2017), researchers looked into the overall culture of ECPs. Embraced beliefs and values celebrated were “pride in the gym and their workouts, inclusivity, and a strong sense of community that extended beyond the gym and a shared goal of improving their health and well-being.” (Bailey et al, 2017, p.1). As the popularity of ECPs has continued to increase over the last decade, there has been an uptick in the dispute between what is being observed in scientific literature versus anecdotal reports. Athletes, coaches, and physicians have raised concerns related to the frequency of ECP-related injuries as well as the mental and physical health of people participating in this type of exercise program (3). Previous research indicates that the ECP-related injury rate is comparable to injuries incurred is comparable to that of weightlifting and other recreational activities (3). Communication between coaches and athletes is vital to the understanding of the limits and risks of new and experienced athletes to be able to talk about the important factors that make up ECPs (1). This article review will investigate the common rumors of ECPs as well as injury prevalence and potential, their effects on mood, quality of life, muscle power, and gender.

## **OVERALL QUALITY OF LIFE**

According to a study by Pereira et al. (2019) ECPs lead to an overall better mood. The volunteers for this study were divided into two groups (n=10), with one group regularly practicing ECPs and the second being running athletes who have never practiced ECPs. (5). Each group then did a single extreme exercise session for nine minutes, and the mood was analyzed at

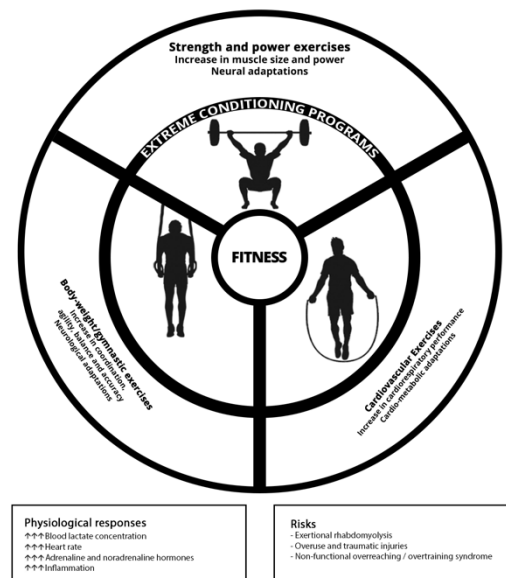
the beginning of the study, immediately after, and 30-minutes after using the Brunel's mood states scale (BRUMS) (5). It was found that anger ( $p > 0.05$ ), confusion ( $p > 0.05$ ), and tension ( $p > 0.05$ ) were notably reduced in both groups immediately and after the 30-minutes (5). While the mood changes were minute to modest these ECPs were able to induce improved mood in both trained and untrained individuals (5).

Not only can ECPs lead to a better mood, but they can also lead to a better quality of life (6). During the late 1800s and early 1900s, epidemiological studies found that inactive people were more likely to have coronary heart disease than those who lead active regimes (6). Since these studies were done, the research has continued to produce evidence showing that physical fitness and regular exercise present pliability of muscles and serve as a fighting resource in countless ways, including blunting stress reactions to both physical and psychological stressors, bestowing multiple physiologic and psychological benefits including serving as a safeguard against stress, and defending against stress-related disorders and many chronic illnesses (6). The two main neuroendocrine systems that arbitrate the stress responses in the body are the hypothalamic-pituitary-adrenal axis (cortisol) and the sympathetic nervous system (epinephrine and norepinephrine) (6). When initiated, these systems facilitate the fight or flight response, which permits the prompt recruitment of energy from storage sites to essential muscles and the brain provoking them to get ready for "action" while increasing alertness and arousal (6). In a study done by Rimmele et al. (2009) trained men versus untrained men displayed significantly lower cortisol and heart rate responses to psychosocial stress (6). By reducing these frequent stressors through exercise, it can sanction a better quality of life.

### **EXTREME CONDITIONING PROGRAMS: MUSCULAR POWER, METABOLIC RESPONSES, AND INFLAMMATION**

Being aware of the physiological effects of ECPs on the body is vital to understanding the effects on muscular power. In a study done by Tibana et al. (2016), researchers investigated the effects of ECPs on the immune and metabolic systems after two consecutive ECP sessions. IL-6, IL-10, osteoprotegerin, muscle power, blood lactate, and glucose were assessed in trained men ( $n=9$ ) (ages  $26.7 \pm 6.6$  years) (2). Each subject completed two training sessions 24-hours apart that consisted of two different workouts. For the 1<sup>st</sup> workout, blood-serum was collected before, immediately, and 24-hr post-first workout, and for the 2<sup>nd</sup> workout, serum was collected immediately post, 24, and 48 h post-workout. Scientists determined that both the 1<sup>st</sup> and 2<sup>nd</sup>

workouts lead to an increase in blood lactate and glucose concentrations, but the 1<sup>st</sup> workout stimulated a considerably higher increase than the 2<sup>nd</sup> workout (2). Mean power considerably decreased after each training session; however, 24-hours post-second workout, the mean power was not statistically significant ( $p < 0.05$ ) different than pre-intervention, but Peak power was statistically significant higher ( $p < 0.05$ ) 24 h after the workout of the day (WOD) 2 than pre-intervention. (2). The training sessions significantly increased IL-6 (WOD 1:  $197 \pm 109\%$  and WOD 2:  $99 \pm 58\%$ ), and IL-10 displayed an increase immediately after workout one ( $44 \pm 52\%$ ) and decreased at 24 and 48 hours following the second workout, while osteoprotegerin (OPG) decreased 48 hours after workout two. The increase in pro/anti-inflammatory cytokines following ECPs was not accompanied by a deterioration in muscle power 24 hours after the second workout (2). The results of this study follow the trend of other research regarding metabolic and inflammatory stress following ECPs and the finds in this study show that even with two consecutive bouts of ECPs, there are no negative effects on muscle power. Recent research studies have determined that high-intensity short rest interval training causes a significant increase in muscle damage, inflammation, and abnormal responsiveness in metabolic and adrenal function in both men and women in resistance training but not in ECPs (Heavens et al., 2014; Szivak et al., 2013; Tibana et al, 2016). While it has been continually observed that ECPs have no negative effect on muscle power (2), it is still suggested to be careful when doing two consecutive days of ECPs due to the effects it has on the immune system (2).



## INJURY POTENTIAL IN ADULTS AND CHILDREN

As extreme conditioning programs rapidly rise in popularity, there is continually a lack of scientific evidence backing up the safety of these programs (7). In a cross-sectional study by Aune and colleagues (2017), researchers provided an injury survey to athletes who participated in ECPs across five locations in Birmingham, Alabama. The results from this study established that the injury rate among athletes partaking in ECPs (2.71 per 1000 hours) was comparable to

the rate of injury in weightlifting (2.78-5.5 per 1,000 hours) and most other recreation activities (1). The areas that were found to be the most vulnerable to injury were the shoulder and upper arms (1). Athletes who were newer to ECP were found to be 2.5 times more likely to sustain an injury compared to someone more experienced with ECPs and the overall injury rate was found to be 2.71 per 1,000 hours (1). As well as those with the previous injury were 8.1 times more likely to sustain an additional should or upper arm injury during ECPs than athletes without (1). This study also found that overexertion and fatigue were commonly reported, and these may be an absolute effect of improper technique as seen in table 4 (1). A majority of injuries sustained were performed with weights/barbells during Olympic-style lifts (1).

**Table 1. Athlete Reported Cause of Injury**

	<b>% (N/Total)</b>
<b>Overexertion</b>	46 (48/105)
<b>Improper Technique</b>	23 (24/105)
<b>Prior injury that predisposed</b>	14 (15/105)
<b>Inadequate warmup</b>	8 (8/105)
<b>Fatigue</b>	5 (5/105)
<b>Lack of supervision</b>	3 (3/105)
<b>Lack of familiarity with exercise</b>	2 (2/105)

In a study done by Moran et al., (2017), 117 CrossFit athletes were followed for 12-weeks. Participants' characteristics, injury history, and training experience were recorded at baseline as well as a Functional Movement Screen (FMS). Those who participated in CrossFit and had an injury within the past six months had a higher risk of injury when compared to those without a previous injury (7). This may be due to muscle strength imbalance, impairment, lacking flexibility, functions or mechanical instability, or the presence of scar tissue (7). Overall, it was found that the incidence rate was 2.10 per 1,000 training hours (7). In other studies (Hak et al., 2013; Weisenthal et al., 2014) the incidence rates were found to be 3.1 per 1,000 hours and 2.4 per 1,000 hours respectively. When compared to the incidence rates of recreational tennis players (1.6-3.0 per 1,000 hours), triathletes (1.6-3.0 per 1,000 hours), runners (33-79 per 1,000

hours), cyclists (6.0 per 1,000 hours), and weightlifters (2.78-5.5 per 1,000 hours) (1). This shows that ECPs such as CrossFit is comparable with that of other fitness activities such as running, triathlon, cycling, weightlifting, and lower than many team sports (7). With all of these thoughts in mind, it is important for both the athlete and coach to pay close attention to signs of fatigue as well as be aware of the technique, form, and overexertion, especially in new and previously injured athletes.

In contrast to adults who participate in ECPs especially CrossFit, youths who participate in CrossFit tend to become injured in different areas of the body compared to adults (8). In youths, a majority of the injuries occurred in the head/spine region as compared to adults where the shoulder was the leading injury (8). While injury rate has seemed to be more prevalent within youth compared to adults participating in ECPs, the solutions seem relatively simple. Stracciolini et al. (2020) states that the majority of these injuries surrounding resistance training in youth are avoidable with appropriate supervision, sensible training progression, and a safe training environment. Weisenthal et al. (2014) showed that frequent coach supervision was associated with a lower injury rate. Summitt et al. (2016) reported that less coach supervision is related to a higher injury risk among CrossFit athletes. Injury prevention surrounding lack of supervision and technique in youth CrossFit might serve to prevent future injury (8).

## **GENDER DIFFERENCES**

Weisenthal et al. (2014) found that male athletes were much more likely to sustain an injury during participation in CrossFit when compared to females (Morena et al., 2017). In this study, females were prone to use applicable loads and/or correct movement patterns, which may have resulted in a reduced risk of injury compared to males (Morena et al, 2017). Females are more likely to prioritize mastery of technique as opposed to performance over mastery which may also equate to the higher rate of injury observed in males (Morena et al, 2017). Poderoso et al. (2019) compared gender differences in hormonal and immunological responses to CrossFit. In both men and women, CrossFit had a significant effect on the testosterone/cortisol ratio (TC) at different measurement time points (9). Cortisol and immunological responses within each did not change, due to the same type of training stressors being placed on both genders (9). Additionally, there were no significant changes over six months in CD4 lymphocytes in those that participated in ECPs/CrossFit (9). CrossFit® training led to changes in the basal levels of testosterone and cortisol in men, which included the testosterone levels increasing, and cortisol levels decreasing

(9). Kraemer and Ratamess (2005), found that testosterone increased in both men and women due to the distinctive neuromuscular, morphologic, and metabolic actions, in which men experience the action of testosterone and women that of estrogen when participating in weight training exercises (9).

## **CONCLUSION**

In conclusion, there are so many benefits to extreme exercise programs and the communities they have created. The positive effects of ECPs lead to a better quality of life and everyday mood while abstaining from detriments to muscle power. Being conscious of fatigue levels that can lead to overexertion and injury is important when participating in ECPs. Learning the correct form and proper execution of exercises is vital to success it adds to the challenges and exhilaration of this type of exercise. Making sure to properly warm up and warm down out of a workout is important in all types of exercise but especially ECPs. ECPs can be an enjoyable exercise for all ages and types of people while being beneficial on all spectrums.

## **ELEMENTS**

### **Apply It**

- Extreme conditioning programs (ECPs) will allow for a better overall quality of life and lead to a reduced risk of coronary heart disease.
- ECPs are great activities for both youth and adults but maintain communication between the athlete and coach is key to overall success and safety.
- It is important for coaches and athletes to be in constant communication and be diligent with technique and form as well as be careful not to overexert an athlete.

### **Bridging the Gap**

- ECPs have the potential to improve everyday mood and overall quality of life. This type of training has shown to have comparable injury rates to weightlifting and other recreational activities.

### **Summary Statement**

- ECPs are something that has become more popular in the fitness world due to their sense of pride, inclusivity, community, and shared goal of improving health and well-being. ECPs allow for a challenge and as well as a great workout that if executed correctly and in communication with the coaches can lead to an improved quality of life and fitness.

### **Pulled Text**

- “ECPs such as CrossFit are comparable with that of other fitness activities such as running, triathlon, cycling, weightlifting, and lower than many team sports (Morena et al, 2017)”
- “Physical fitness and regular exercise present pliability of muscles and serve as a fighting resource in countless ways, including blunting stress reactions to both physical and psychological stressors, bestowing multiple physiologic and psychological benefits including serving as a safeguard against stress, and defending against stress-related disorders and many chronic illnesses (6).”

### **Bio**

Brooke Zukowski is currently pursuing her Bachelor of Science in Exercise Science at the University of New Mexico where she is also a member of the Women’s Swimming and Diving team. She is set to graduate in May of 2021 and will be continuing to pursue her Doctor of Physical Therapy degree.

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