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Research Article

The Importance of the Posterior Chain in CrossFit Programming

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Abstract

CrossFit has become a very popular form of exercise and evolving into its own sport with regional, national, and international competitions. Since its creation by Greg Glassman in 2000, its methods as a constantly variable form of exercise which stresses the importance of being good at multiple skill sets and stimuli have become very popular. The sport has grown beyond the United States to many other countries around the world. Through the inclusion of multiple movements and skills of the sport, it has come into scrutiny due to high injury rates and high load programming. It has been shown that high amounts of external workload are potent risk factors for injury in athletes. Furthermore, the lack of posterior chain exercises in programming methodology may play a role in injury rates across many sports including CrossFit. This paper performed a literature review until September 2020 to find pertinent research on the topic of posterior chain exercises and how they could be used to reduce injury risk in CrossFit. The authors found that inclusion of posterior chain exercises may reduce the risk of lumbar spine and lower extremity injuries when can be included into existing programming. The addition of posterior chain exercises either as accessory work or into the actual work out of the day [WOD] may be beneficial into reducing injury risk in CrossFit.

Keywords: Posterior Chain; cross fit; low back injuries; lower extremity injuries

Introduction

What is CrossFit?

CrossFit is defined as a constantly varied functional movements performed at high intensity [1,2]. It was created by Greg Glassman in 2000 with the first affiliate in Santa Cruz, CA with the idea of becoming proficient at a variety of movements and skills1,2. CrossFit draws programming ideas from powerlifting, bodybuilding, gymnastics, and Olympic Weightlifting [3,4]. CrossFit is unique because it performs movements at a high intensity with the element of time or rounds. Through the rising of its popularity CrossFit has spread from one box to now being present in 142 countries with more than 10,00 affiliates [5]. Within the sport, programming is geared toward improving in the ten fitness domains: [1] cardiovascular/ respiratory endurance, [2] stamina, [3] strength, [4] flexibility, [5] power, [6] speed, [7] coordination, [8] agility, [9] balance, and [10] accuracy (6. A CrossFit class usually involves a WOD (workout of the day) which is performed in a high-intensity manner for a certain number of rounds or a time limit. Due to the high intensity of the sport along with the complex movements performed [handstands, barbell squats, and presses), injury rates may occur similar to other sports [7,8]. Injuries rates are multi-factorial and can't be narrowed into one cause. However, recent literature has investigated the role of the posterior chain musculature into low back [lumbar spine] and lower extremity injury risk [9–11]. While many papers have investigated injury risk in CrossFit, none have investigated how to begin correcting and mitigating this risk [8,12–14]. The purpose of this literature review was to investigate if incorporation of posterior chain exercises could be implemented into CrossFit programming and play a role in injury reduction.

B. The Basics of CrossFit Programming

All CrossFit Coaches are required to be certified at least a Level 1 certification [CF-L1] before independently leading a class. The CrossFit educational and certification department has evolved from two levels [CF-L1 and CF-L2] to now having 4 levels of coaching and various other supplemental courses for specialty purposes which include programming, anatomy, and running. The curriculum of the CF-L1 course is spread over two days and is meant to introduce potential coaches into among other things, the basic of CrossFit programming. A traditional CrossFit class is scheduled for 60 minutes and consists of a warm-up, skill or strength, workout of the day [WOD], and cooldown. The skill may consist of gymnastics movements or Olympic Weightlifting while a strength exercise may be specific workloads in deadlift, back squats, etc. The WOD may consists of a plethora of skills, movements, and variations of the Olympic lifts. It is performed at a high intensity pace paired with a certain timeframe, repetitions performed, or rounds completed. Within this limited time frame, it may be difficult for the coach to find the time within the time constraints to program for performance, longevity, and injury risk prevention.

Methods

A literature review was performed in October 2020 with the use of PubMed, Cochrane, EBSCOhost, and Google Scholar to gather all pertinent research. Search terms included CrossFit, CrossFit Injuries, CrossFit Low back injury, CrossFit lower extremity injury, and posterior chain. Exclusion criteria included studies that were not published in English, the original protocol was to include only studies from peer-reviewed journals. However, in order to include all data, specifically data from the CrossFit journal and other epidemiological information this exclusion criteria were revoked by all three authors. Instead, all relevant articles were collected and screened as part of the secondary process. There seemed to be multiple studies on the topic of CrossFit in Italian and Portuguese. The authors attempted to get an English translation or contact the original authors for more pertinent research if possible, through contacting the corresponding author. Inclusion criteria included any article or research paper that discussed the sport of CrossFit, its programming methodologies, injury rates, and injury types. Once the initial articles were gathered, two of the authors further screened the full article as opposed to the abstract only. Research was not limited to date publication since CrossFit is a relatively new sport (2001) and this paper seems to be the first to explore any relationship between posterior chain strengthening and injury rate/ risk prevention.

Results

The initial search revealed 3,529 potentially relevant, and 30 were chosen after careful screening by the authors using the predetermined criteria. Of the studies found, 2 reported on what exactly CrossFit was and how the sport was defined. 10 studies explored injury epidemiology primarily in the low back and lower extremities. 10 studies described CrossFit programming methods, education, and the layout of a typical class. 5 studies introduced the posterior chain and research into its effect into injury rate/ risk reduction. However, no studies were found to establish a relationship between CrossFit and the posterior chain musculature which the authors sought to explore and provide evidence for.

Discussion

Epidemiology of CrossFit Injuries.

CrossFit has come under scrutiny due to the perceived heightened risk of injury and injury rates [7,15]. performed an epidemiological study among Dutch CrossFit Athletes and found an injury rate of 56.1% [7]. The most common injured areas were the shoulder, lower back, and knee [13,16]. A limitation of this study is the lack of comparison across sports which could be done using Athletic Exposures as defined by [12,17,18]. An athletic exposure [AE] was defined as 1 athlete participating in 1 practice or competition. In CrossFit, 1 AE could be 1 athlete participating in one class or training session. performed a descriptive survey study investigating injuries within recreational CrossFit participants to the shoulder [19. The authors found shoulder injuries occurred at a rate of 1.94 per 1000 hours of training [P=.03] which does not differ from other overhead sports [19]. Similarly, found 30.5% of CrossFit participants suffered an injury within a 12-month period to the shoulder (39%), back (36%), or knees (12%) (X2=12.51; P=.0019) [8,12]. Depending on the frequency of sessions [classes] performed the injury rate varied from 0.27-0.74 per 1000 hours. A unique aspect of the sport is its large recruitment and involvement of both the lower extremity, upper extremity, and core [4,20,21]. This is opposed to many sports and activities which are upper or lower extremity dominant [22–25]. This discrepancy may be one factor in the higher perceived or reported injury rates [26,27]. However, found comparable rates of injury between CrossFit and other recreational and competitive sports (31% vs 57-61.8% in soccer P=.023) [26]. Also, there seems to be a stigma in the ability of CrossFit Coaches to teach the complex movements performed in a short amount of time in large groups [28]. This perceived stigma may negatively affect how injuries are reported compared to other sports or activities. The literature shows injuries suffered during CrossFit occur primarily in the shoulder, low back, and knees [8,12,17,18,26,29]. In the shoulder, these injuries include rotator cuff pathology, labrum injuries, and biceps tendinopathy [30]. In the low back it includes sprains/strains and disc herniations with or without radiculopathy [13]. Lastly, hip pathology in CrossFit may include femoroacetabular impingement syndrome [FAIS] and labral injuries [16]. In correlation with injury prevention programs seen in the rotator cuff and ACL, there have been increase in the inclusion of these programs into organized athletics that have trickled down into high school sports and youth sports [31]. Unfortunately, there is no evidence as to how specific injury prevention programs could decrease risk of injury in CrossFit. This paper investigates potential ways of implementing posterior chain programming into CrossFit methodologies.

Introduce the Posterior Chain

The idea of the posterior chain has been named and termed many different names depending in the field and point of view [32–35]. For example, in the strength and conditioning world knows this group of muscles as such [35] while the manual therapy world knows it as the posterior fascial sling [36] Either way, the posterior chain consists of a group of muscle, fascial, connective tissue, and other supporting structures that runs on the posterior aspect of the human body from the arch of the foot to the top of the cranium to anatomical connections [34,36]. For the purposes of this paper, we will focus on the muscles traversing from the SI joint down to the arch of the foot. The major groups of muscles in this region include the hip extensors, hip stabilizers [rotary and abductors], knee flexors, and ankle plantar flexors [37,38]. In sports that involve extensive use of the hip such as basketball, track and field, and basketball there is a plethora of research into the importance of hip extension and strength of the posterior chain [39–41]. From a sprinting and jumping vantage point, the ability to produce triple extension is paramount is producing power, acceleration, and achieving top-end speed [41–43]. Previous research by Serrano and find that being able to translate horizontal force (through the posterior chain musculature) is a key indicator in sprinting performance. Furthermore, in Olympic Weightlifting, having a strong posterior chain would not only produce optimal pulls (3 pulls in each lift) but also allows the lifter to maintain a better position over the barbell resulting in a more successful lift [39,44,45]. Even in overhead sport that involve throwing such as baseball, the hips and lumbo-pelvic-hip complex contribute about 50% of the power of a pitch [22,23,46–48]. This highlights the importance of a strong posterior chain in sport performance. From a sports medicine standpoint, a strong posterior chain may serve as a potent injury deterrent [11,49].

Connect the Posterior Chain to injuries

As discussed in the previous section, the posterior chain musculature plays an important role in athletic performance through explored concepts such as triple extension and power production through use of the hips [35,50]. However, the role of this musculature in preventing injuries specific to the sport of CrossFit does not exist to the knowledge of the authors. There is literature in other sports and activities to support this concept. For example, previous research by N [51,52] demonstrates how strong hips lead to a reduction in low back pain and low back [lumbar spine] injuries. In occupational medicine, there is evidence that hip strength as part of an all-encompassing core strengthening program leads to decreased sick days and workers compensation claims [53,54]. Occupational medicine includes studies done on manual intensive employees like plumbers, construction workers, and welders [55]. Just as interesting, occupations that involve large amounts of inactivity such as sitting [heavy computer use] jobs also have a high rate of low back pain and injuries [56]. Inclusive programs which include strengthening of the posterior chain leads to decrease in pain levels and improved function. In sports such as track and soccer where sprinting occurs frequently, there is a high incidence of hamstring and adductor strains [57,58]. Programs are focused on the eccentric strength of these muscles which is a direct application of working the posterior chain [59]. Similarly, a weakness or lack of neural control of the gluteal muscles may require the hamstrings or lumbar spine erector spinae muscle (iliocostalis, longissimus, and spinalis) to be overworked leading to injury [10,60,61]. Thus, evidence seems to support that focused programming of the posterior chain could extend directly into preventing injury in CrossFit, a sport with high rates of low back and hip pathology.

Extrapolate how focusing work on the posterior chain may reduce injuries

The Posterior Chain musculature seems to have a protective effect in reducing the risk of injury both in sport and occupational activities [62–64]. CrossFit is a unique sport because it uses the major muscle groups of the body from the lower extremity, core, and upper extremity [65]. The frequent use of the shoulder in gymnastics and Olympic Weightlifting also allow classification as an overhead sport [19]. The most common injuries in the sport occur to the low back, shoulders, hips, and knees as previously discussed [19]. Of these injuries, it would seem a stronger posterior chain through a dedicated strength and conditioning program could reduce their prevalence. More interesting findings lie in Baseball Research where strengthening of the posterior chain leads to reduction in shoulder and elbow injuries [66–68]. Specifically, strengthening of the posterior chain has shown to reduce the rate of injuries to the UCL, Glenoid labrum, and Rotator Cuff [69,70]. These findings show promise into the sport of CrossFit which can be a combination of many other sport movements and activities. By incorporating posterior chain exercises, the rate of commonly seen injuries can be decreased. The challenge then becomes how to best incorporate these types of exercises into a 60minute class and the overall programming in the CrossFit box [gym].

Conclusion

Within the confines of a 60-minute CrossFit class, challenges arise when trying to address the needs of sport performance, movement proficiency, and injury risk mitigation. Sport Performance in this context can be directly applied to qualities like strength, power, and cardiovascular improvement. These are achieved during the first portion of the class using a combination of the strength/skill portion. The cardiovascular improvement [aerobic, anaerobic, or combination] is meant to be achieved during the WOD. The injury prevention portion should ideally be performed as part of the warm-up lasting the first 10-15 minutes of the class. After the cooldown has been achieved to normalize heartrate and breathing rate, there may be time for accessory work in the class. This accessory work should not take more then 10-15 minutes in order for all athletes to be able to complete it within the confines of the class. Similarly, the Head Coach[es] may program a specific day that is biased toward strengthening the posterior chain and other injury prevention factors as time allows. Strengthening of the posterior chain should become an integral part of CrossFit programming for the purpose of movement proficiency and injury risk reduction. This can be done in a time efficient manner on a daily or weekly bases within the programming methodology of each individual affiliate.

Limitations

This paper is limited by its nature as a literature review article. Due to the scarcity of research into the posterior chain as it related to CrossFit injury prevention, the authors were only able to perform a literature review. As a first step in laying the foundation for future research, a literature review is necessary which is the case here. In the future however, hopefully this paper sparks the interest of other researchers in higher quality research. The authors were also limited be their search queries and ability to access the literature. There could have been higher quality data in other databases or published into other languages which could not be translated into English. There could also be ongoing research exploring this specific topic that has not been published yet, further limiting our findings. Lastly, two of the three authors [A.H., B.S.] are avid Cross Fitters which could have led to a confirmation bias in interpreting the available data into a positive light regarding the connections between posterior chain exercises and reducing injury risk in the sport.

Practical Application

The authors decided to include 6 exercises for practical recommendations that could be incorporated into CrossFit programming. These exercises are meant to be done with equipment found in a traditional box and into the confines of a 60-minute class. The GHD [Glute-Ham Developer] is a popular machine in CrossFit due its variability in being used as a posterior chain developer or core developer [29,71]. For the purposes of this paper, the GHD will be used for development of the posterior chain due to the ability to recruit and build the gluteal muscles and hamstrings. The RDL [Romanian Deadlift] is used as a more specific version of the conventional deadlift because it makes athlete hinge at the hips while keeping the knees extended which puts more load on the hamstrings [72–74]. Good mornings are put into this program for the purpose of hip hinging and subsequently working on the key posterior chain musculature [75,76]. Nordic curls are a hamstring focused exercise meant to capture the eccentric strength of the hamstrings which has been found to be a predictive factor for hamstring strains and low back pain [40,77]. The chair deadlift is taken from Louis Simmons and his Westside Barbell method. It is meant to teach athlete how to use their hips properly in a sumo style deadlift which uses a more aggressive hip extension method as opposed to a conventional deadlift. Lastly, if the gym has access to a reverse hyper machine, it may be used to perform reverse hyper-extension exercise. This exercise stabilizes the top half of the body and then the low back goes into extension, hip extension, and knee extension in order to further target the posterior chain [78].

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