Fit for the Stage: The Function of a Pre-Performance Warm-up Routine for College Theatre Students

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Abstract

College theatre programs require students to perform in stage productions that demand a high level of stamina, endurance, strength, and flexibility. This level of athleticism makes injury rates more prevalent with one dance study documenting a 74% injury rate among participants (Chmelar et al., 1987, as cited in Malkogeorgos et al., 2011). In sports programs, warm-up protocols are utilized as injury prevention techniques. Due to the physical demands on college performers, a specific warm-up routine should be designed and implemented for each production. A properly conceived warm-up will include aerobic exercise, dynamic stretching, and movement patterns resembling those in the show. Additional details such as timing and length of the warm-up will vary based on the needs of individual performers and productions.

Fit for the Stage: The Function of a Pre-Performance Warm-up Routine for College Theatre Students

The theatre industry is a major source of entertainment across the country. In an attempt to help raise up new generations of theatre performers, many colleges offer theatre degrees. While some are production-based, other available degrees are performance-based with acting or musical theatre concentrations. As a part of the curriculum of these performance programs, students perform in academic productions as preparation for the post-graduation job market. Due to their pre-professional nature, these productions often demand a strong level of athleticism, dancing, agility, and flexibility. When academic performances are repeated numerous times within a few weeks in addition to daily classes, the likelihood of injuries becomes all too possible and probable (Russell, 2013). In order to combat high injury rates, warming up before activity is a beneficial prevention technique. A proper warm-up program should be included before every rehearsal or performance at the college level in order to prevent injuries and prep the performers' bodies for activity.

The Need for a Warm-up

Performers are athletes in that they undergo the same physical stressors and level of fitness as those who play in professional sports (Berardi, 2013; Bird, 2016; Russell, 2013). In the same way that athletes require warming up their bodies, theatre majors must prepare themselves for physical exertion. The degree of strength, endurance, stability, and flexibility needed to execute a performance may tire a student out short-term, but when multiple shows in the course of one or two weekends are expected, a performer may accumulate physical stress and overuse (Bird, 2016; Malkogeorgos et al., 2011; Russell, 2013). Overuse is what Soares Campoy et al. (2011) refer to as "repetitive microtrauma that anatomic structures suffer when the practitioner is

submitted to an excess of repetitive activities" (p. 497). When the body is unable to rest and repair from the overuse, the resultant physical fatigue and tissue damage lead to a higher chance of injury (Berardi, 2013; Fischer et al., 2016; Rosenblatt, 2015).

Although dancing is of primary concern in this study due to its intense athleticism, students that are cast as straight actors and singers should not be disregarded. Theatre deems it necessary for individuals to move freely and be capable of executing a role with intense physical requirements even if dancing is not utilized for a particular production. Today's theatre performers are expected to be "triple threats," versatile individuals skilled in acting, singing, and dancing. Success comes in combining artistry with athleticism. For example, in ballet choreography, gracefulness and fluidity are prized movements. A dancer wants to create beautiful lines and mesmerize the audience with the choreography's storytelling. Without the ability to access one's range of motion and flexibility, however, the long line of the dancer's body is cut short, and the visual impact fails. For an actor, the body must be totally free to move in whichever way they feel an impulse. Physical limitations are a distraction to the actor and can impede their work when their full attention needs to be on their scene partner.

Injuries and Their Consequences

According to Liederbach (2000), an injury is any bodily dysfunction or pain that impedes performance (as cited in Berardi, 2013). Injuries can be major setbacks to athletes of all ages and sports. Activity in general comes with a risk of injury for participating individuals (Jones, 2016; Russell, 2013), so no one is immune. Some injuries will be unpreventable, such as traumatic or contact injuries (Jones, 2016; Peterson & Renström, 2017). However, those cases that involve tendinopathies, strains, and overuse injuries are much easier to prevent and safeguard against (Jones, 2016). Due to the general non-contact nature of theatre, the college performer is fortunate

in that most injuries fall into the latter three categories rather than a contact injury (Jones, 2016).

Depending on the severity of an injury, a lengthy recovery may be in order (Della Villa et al., 2016; Peterson & Renström, 2017). A minor injury is generally a week or less of recovery time, while moderate injuries will last from one to four weeks (Bronner et al., 2006). Severe injuries are any cases that last longer than four weeks (Bronner et al., 2006). These prognoses can be devastating to the performer and production if the artist is forced to sit out of rehearsals or performances. Since many rehearsal processes last around six weeks, the artist may still be able to participate in the show's run if they sustained a minor injury or a moderate injury at the beginning of the rehearsal process. However, severe injuries will most likely prohibit the performer from further participation depending on their role in the cast, the production's demands on the injured body part, and medical advice.

Recovery time is not the only marker of injury severity (Bronner et al., 2006). Grades can be assigned to rate the extent of tissue damage (Bronner et al., 2006; Peterson & Renström, 2017). The three grade levels, with the most minor at I and the most severe at III, aid in diagnosing the injury and providing a timeline for recovery (Peterson & Renström, 2017). In grade III cases where conservative measures are not helping, surgery may be necessary, followed by an "intensive rehabilitation program" (Peterson & Renström, 2017, p. 409). It may take several months to half a year before the patient can gradually build their strength and endurance levels back up to pre-injury levels (Peterson & Renström, 2017). While surgical outcomes may be successful in returning the injured individual back to their desired activity, surgeries come with risks and differing results (Peterson & Renström, 2017). Some individuals may not regain their pre-injury activity levels (Peterson & Renström, 2017). Thus, in order to protect a

performer from minor injuries that only require conservative treatment to severe ones that necessitate surgery, injury prevention is needed (Russell, 2013).

Injuries come with unfortunate consequences outside of a doctor's visit or rehabilitation protocol. Cartilage wear and tear may appear as arthritis later in the athlete's life, leading to painful movement and activity restrictions (Della Villa et al., 2016; Peterson & Renström, 2017). In addition, previously injured areas are more susceptible to re-injury (Lategan & Gouveia, 2018). Not only are injuries physically limiting, but they take a toll on the mental health of an athlete, who is often anxious to get back to their respective sport and activity level (Peterson & Renström, 2017). Especially for theatre majors who are working toward performance careers, the missed opportunity to perform can be upsetting and worrisome. If a halt in activity during recovery is prescribed that prevents students from continuing in the cast (Peterson & Renström, 2017), they may lose any academic credit they were receiving. A warm-up should be high on the performer's priority list in order to decrease the likelihood of injuries and avoid the unwanted effects.

Risk Factors for Performers

Although the length of a production's run may be limited to one or two weekends in the academic setting, rehearsals can last four or more weeks in advance of the show's opening. These nightly rehearsals coupled with any dance or movement classes taken academically during the day can add to the rate of injuries sustained (Malkogeorgos et al., 2011; Russell, 2013; Soares Campoy et al., 2011). Fatigue sets in later at night from the overload as "the majority of ballet injuries occur between 4:00 and 6:00 pm" (Berardi, 2013, p. 37). To make matters worse, dancers will frequently push through their current injuries for the sake of rehearsals and performances before the body is fully recovered (Berardi, 2013; Bird, 2016; Ojofeitimi et al.,

2012). While this is not encouraged and will only risk increasing the damage, a warm-up can aid in preventing further harm and keeping the injured area mobile. While rehearsals require a good deal of athleticism and stamina, performances have been shown to elevate the heart rate more and increase oxygen uptake (Russell, 2013). These findings are plausible due to the high pressure, adrenaline, and all-out effort that dancers give in performances before a paying audience. Thus, performers must have a routine to maintain their health for the entire run of the show.

Extrinsic Risk Factors

At times, the artistic element of theatre can add physical challenges for the performer. Production design varies depending on the show, and the different layouts and visual concepts that result can pose specific challenges. If a raked stage is used, such as in the musical *Matilda*, care must be taken to acclimate the body as balance will be especially tested (Bird, 2016). Another example is the use of staircases on stage. Running up and down or dancing on stairs may be taxing to the quadricep muscles and knees. In some productions, cast members double as the crew and participate in set changes. Depending on the production design, set pieces can range anywhere from doors to entire cabins as in the musical *Bright Star*. When moving large set pieces, a warmed-up body is essential to prevent a muscle strain.

While seemingly unrelated to the performers' activity within a given play, costume design actually has a big influence on which muscles are exercised. Any shoes that are inappropriate to the demands of a sport may strain the body, thus specialized shoes that function as part of the performer's costume can cause added stress if they are not conducive to the required movements (Peterson & Renström, 2017). High heels are worn by most females in theatrical productions, placing a high demand on the calves since the body's weight is

concentrated over the ball of the foot (Berardi, 2013). Dance shoes, such as ballet, jazz, or tap, offer little shock absorption for the feet, yet they are required for most musicals (Russell, 2013). For musicals involving dancing en pointe, such as *The Phantom of the Opera*, injuries have been connected to the use of pointe shoes (Russell, 2013). Dream ballet sequences and other scenes involving barefoot performers pose a challenge as the foot and ankle have no support (Russell, 2013). In both straight plays and musicals, heavy costume pieces increase the physical exertion and challenge of maintaining stability and an ease of movement (Bird, 2016).

In the same way that athletes face different injury risks based on the sport they play, theatre performers are more or less susceptible to certain problems depending on their production's style of movement. Theatre encompasses a wide range of dance styles, which means all dance forms and their related injuries must be acknowledged. The foundation of dance, ballet is a prominent feature in stage musicals, especially those from the "Golden Age" (the first half of the twentieth century). *Carousel*, *Oklahoma!*, and *An American in Paris* are examples of ballet-based musicals that require jumps, turns, and high levels of flexibility (Bird, 2016). One study found that 40% of dancers in a Broadway musical with ballet choreography sustained injuries, adding to the fact that ballet is a highly athletic dance form (Berardi, 2013). The other two leading dance styles, jazz and tap, permeate shows such as *Chicago*, *Thoroughly Modern Millie*, and *42nd Street*. The isolations of jazz and the percussion of the feet and ankles in tap differ from ballet's demands, but all three dance styles need recognition as high-intensity activity.

While a large majority of stage productions feature ballet, jazz, or similar musical theatre styles in the choreography, new forms of 21st century dance styles are making their appearance in the theatre industry. Hip-hop has recently taken to the stage in musicals such as *Hamilton*, and

though it may not seem from a spectator's glance to reach the same level of physical athleticism and demand that other dance styles do, findings show that the injury risk for these forms of dance must be taken as seriously as traditional dance styles. In one study of hip-hop dancers, 62% of injuries were partly caused by a lack of warmup (Ojofeitimi et al., 2012). Whether the hip hop consists of popping, locking, or breaking, lower extremities are the most commonly injured (Ojofeitimi et al., 2012). This research aligns with data for tap dancing, yet it exceeds that of ballet (Ojofeitimi et al., 2012).

A proper warm-up does not and will not single-handedly eliminate the risk of injuries, for numerous other extrinsic factors may predispose dancers to injuries (Lefevre et al., 2016; Rosenblatt, 2015). Previous injury is the biggest factor in muscle injuries (Dönmez et al., 2015; Rosenblatt, 2015). Incorrect technique, such as inadequate turn-out among ballet dancers, is another primary risk factor (Berardi, 2013; Bird, 2016; Lefevre et al., 2016). In a high-pressure environment like stage performances tend to be, adrenaline and energy can take over the body, and performers may worry more about impressing the audience than remaining safe on stage through correct technique. Such a scenario is why muscle memory of proper form for every movement is essential for dancers. If faulty technique is ingrained in the dancer, the inefficient use of muscles and joints will lead to fatigue (Bird, 2016). Theatre performers who primarily describe themselves as actors or singers may lack the dance technique needed for the productions they are cast in. With appropriate training, however, the number of injuries related to this problem can be significantly reduced (Russell, 2013).

Nevertheless, performers of every level, from properly trained dancers to amateur movers, are at risk of injuries, especially musculoskeletal injuries (Hincapié et al., 2008). The risk factor of incorrect technique can be overcome with training, but there will always be a

possibility of injury no matter how experienced the performer is. Therefore, a warm-up is crucial for every single performer to ensure they have the best chance at injury prevention.

Much like other athletes, the surface on which activity is performed is an important consideration as some terrains are risk factors and roots of injury (Peterson & Renström, 2017). One study found that the flooring caused 12.8% of the injuries documented (Wanke et al., 2012). Subfloors that are hard in material and lack elasticity lead to more injury complaints (Berardi, 2013; Wanke et al., 2012). Slipping on an uneven floor or one that lacks grip is a casualty that will not be solved by performing a warm-up no matter how efficient the routine is (Berardi, 2013; Wanke et al., 2012). In particular, the lower leg and foot can be injured from faulty flooring, resulting in shin splints, Achilles tendinitis, or plantar fasciitis (Berardi, 2013). An ideal dance floor will have proper traction to guarantee that dancers have grip and appropriate springiness to dampen impact (Felter & Rietveld, 2009).

Intrinsic Risk Factors

The previous factors are extrinsic, but intrinsic factors will affect injury risk levels as well (Lefevre et al., 2016). These include weight, height, anatomy, and gender (Fischer et al., 2016; Lefevre et al., 2016). One study found that jazz and contemporary dancers who sustained injuries were typically at a higher weight (Soares Campoy et al., 2011). Similarly, the same study discovered that tall ballet dancers were more disposed to injuries, while short dancers were the most affected in tap (Soares Campoy et al., 2011). However, these factors are most likely out of a performer's control. Dancers genetically prone to larger bodies may be unable to lose the weight needed to minimize the risk of injury, while height is an unalterable genetic trait. Anatomical limitations may predispose some dancers to injuries, such as flat foot, leg length variations, and knee malalignment (Fischer et al., 2016; Peterson & Renström, 2017). Women

suffer overuse injuries, such as patellofemoral pain syndrome, more than men do as a result of physical composition and variations in sports (Fischer et al., 2016; Lefevre et al., 2016; Peterson & Renström, 2017). Given that dancing is a female-dominant sport and generally a high-intensity activity, the higher rate of injuries sustained is understandable (Lefevre et al., 2016). Overuse coupled with these traits only increases the risk (Soares Campoy et al., 2011).

Assuming that technique has been cultivated in rehearsals, the warm-up must be seen as a superb form of injury prevention for performances. Tightness and imbalances in the muscles, as well as weakness in the core, can predispose the dancer to injuries (Berardi, 2013). However, a carefully designed warm-up can address these issues. Warm-ups will not erase the risks of these other factors if they are working against the performer during a rehearsal or performance. However, executing a warm-up prior to activity ensures that the performer has done everything in their power to prevent injury – provided their technique is correct – while acknowledging that the other factors affecting injury are out of their control.

Common Injury Locations

Studies have proven that warm-ups prevent injuries, which are prevalent and common among performers, specifically dancers. One study by Chmelar et al. (1987) showed that a wide range of dancers which included university dancers had a 74% minor injury rate (as cited in Malkogeorgos et al., 2011). Broadway and professional theatre companies have specifically been researched with findings revealing that one injury occurred per performer studied (Malkogeorgos et al., 2011). Among all types of injuries, the lower extremities are the most often affected, especially the ankle, feet, and knees, which are injured as much as 80% of the time (Berardi, 2013; Malkogeorgos et al., 2011). The last 20% of injuries are found in the spine (Malkogeorgos et al., 2011). Although the upper body is vulnerable to injuries as well, lower body injuries will

be described in this study due to their prevalence among performers and thus the urgency to prevent them. Injuries to the low back and hip are more commonly seen in younger dancers, whereas older dancers injure the foot, ankle, and leg more (Kelly, 2010). While college students have passed adolescence and reached physical maturity, they are still susceptible to injury in all regions of the lower body.

The uppermost region of the lower body, the hip is subject to multiple syndromes, including piriformis and ischiogluteal syndromes (Malkogeorgos et al., 2011). Excessive hip flexion and range of motion in dance and gymnastics can lead to iliopsoas syndrome and snapping (Allen & Butler, 2010; Anderson, 2016). While snapping hip syndrome results from either the iliopsoas or iliotibial band moving within the body and is often harmless, 58% of dancers have pain in addition to the sensation (Kelly, 2010). Stress fractures in the hip can result from excessive jumping (Malkogeorgos et al., 2011). Near the hip, groin strains can occur as a result of running, attempting the splits, or kicking, all of which are activities frequently required of theatre performers (Allen & Butler, 2010). In dancers, inflammation from osteitis pubis can cause pain in the pelvic and abdominal regions (Peterson & Renström, 2017).

The thigh itself is frequently injured among non-classical dancers, especially those who practice jazz and contemporary styles (Soares Campoy et al., 2011). Muscular strains among the adductors or hip flexors are common in athletics (Nepple & Philippon, 2015). These strains and others may come from movements that take the joints and muscles to an extreme range of motion (Dönmez et al., 2015). The posterior side of the thigh, specifically the hamstring muscle, is the most common site for a muscle strain, and its high prevalence affects athletes especially when jumping, kicking, or sprinting maneuvers are required (Fukutome & Fukubayashi, 2015; Herrington & Comfort, 2010; Lategan & Gouveia, 2018). Studies cite an inadequate warm-up

and fatigue as two contributing factors (Herrington & Comfort, 2010; Lategan & Gouveia, 2018). The flexion of the hip paired with the extension of the knee during a dancer's kick, as well as the intense stretch of the muscle body, is a primary cause of hamstring injuries, especially those near the pelvis bone where the hamstring muscle attaches (Askling & Heiderscheit, 2015; Herrington & Comfort, 2010; Lategan & Gouveia, 2018; Peterson & Renström, 2017). While the dancer is essentially performing her splits mid-air, the movement becomes active as opposed to a passive hamstring stretch on the ground. The splits themselves – side splits, in particular – when performed in a production are a risk factor for hamstring injuries in addition to the eye-high kicks, for the movement takes the dancer's flexibility to an extreme range of motion (Askling & Heiderscheit, 2015).

Moving down the lower limb to the knee and shins, overuse injuries including patellofemoral pain syndrome, patellar tendinopathy, and shin splints are common, but acute injuries are also possible such as meniscus and ligament tears (Berardi, 2013; Brucker & Imhoff, 2015; Malkogeorgos et al., 2011; Peterson & Renström, 2017). Ligament strains within the knee can result from the turn-out required by ballet (Bird, 2016). Risk factors for ACL, or anterior cruciate ligament, injuries are when individuals, especially females, perform pivoting or cutting motions (Meuffels, 2009; Myklebust & Steffen, 2015). Landing from a jump on one leg can also lead to ACL injuries, especially if the leg ends in turn-out with knee valgus, an inward falling of the knee (Meuffels, 2009; Myklebust & Steffen, 2015). Females are up to 20% more likely to sustain a non-contact ACL injury than males (Sugimoto & Myer, 2015). Within the anatomy of the knee, the most frequently injured parts are the menisci (Peterson & Renström, 2017). These can be damaged when the knee is hyperextended, a common issue among dancers (Peterson & Renström, 2017).

The ankle and foot are highly susceptible to dancers, specifically those involved with classical ballet (Bird, 2016; Soares Campoy et al., 2011). Regarding acute injuries, ankle sprains are the most frequently seen (Malkogeorgos et al., 2011). In fact, "49% of all sprains occur during athletic activity," and many happen in the late teen years, around the age of college students (Bettin et al., 2015, p. 1753). Unfortunately, ankle sprains are hard to completely prevent due to their unpredictability as acute traumatic injuries (Jones, 2016). Overuse injuries include multiple types of tendinitis including Achilles, posterior tibial, and peroneal (Malkogeorgos et al., 2011). Achilles tendinopathy can form when overtraining occurs without proper recovery, a danger for performers who pack their schedules with rehearsals, performances, classes, and personal gym workouts (Allen, 2010). Tendinopathy in the flexor hallucis longus is caused by repeated pushing off, such as in ballet pliés (Hodgkins et al., 2008; Ou-Yang & Yoon, 2015). The term "dancer's tendonitis" has been given to injuries surrounding the flexor hallucis longus based on how frequently it is injured (Hodgkins et al., 2008, p. 285). Ankle impingement is a possibility if dorsiflexion or plantarflexion is continuously taken to the extreme by a performer (Joyce, 2010).

Not surprisingly, the foot and ankle are affected most heavily by stress fractures (Malkogeorgos et al., 2011). Mann et al. (2015) explains that "stress fractures comprise the inability of bone to withstand the repeated stress which athletic activity, military service, or even normal daily life exerts on a prior strong, normal, or weakened bone" (p. 2052). Recurring high impact activities are one influencer on stress fractures (Berardi, 2013). Locations of foot and ankle stress fractures vary depending on the activity, but the tibia is a common location (Finestone & Milgrom, 2015). One study of ballet dancers showed that 45% experienced stress fractures, proving the high risk of developing this injury (Malkogeorgos et al., 2011). Other

studies cite higher statistics with 61% of ballet dancers suffering injury (Finestone & Milgrom, 2015). Although ballet is not used within every stage production, it is not the only form of movement to bring with it a risk of stress fractures. A two-year study of female gymnasts revealed a 24% incidence rate for stress fractures (Mann et al., 2015), and in current productions today where tumbling is incorporated, risks still run high.

Finally, the back, a primary component of the dancer's "core," must be addressed. Musculoskeletal pain for the dancer is often in the back with an incidence rate around 70-80% in the dancer's lifetime (Malkogeorgos et al., 2011). A stress fracture in the back, termed spondylolysis, affects dancers four times more than non-dancers (Malkogeorgos et al., 2011). Excessive back bending stresses the lumbar spine, and the famous ballet arabesque can particularly tax the lower back (Bird, 2016). Male dancers sustain more lumbar spine injuries than female dancers, which is a matter of concern for musicals with dance lifts (Wanke et al., 2012). Within modern dance, the forceful movements, jumps, and sharp angles "can pressurize the spinal vertebrae and potentially lead to disc degeneration and back pain" (Bird, 2016, p. 33).

Although these injuries have higher probabilities of occurring in dancers than others, fear or quitting is not the answer to preventing them. Pain and setbacks happen to the most disciplined and careful of dancers, but such individuals are likely to suffer less problems throughout their lifetime than those who throw caution to the wind and dance without adequate rest and recovery measures. Performers must understand the need of a warm-up if they desire to protect themselves against injury. Once the reasons for a warm-up are clear, designing an appropriate routine can begin.

Designing the Warm-up

According to a study by Fradkin et al. (2010), a warm-up is a "period of preparatory

exercise to enhance subsequent competition or training performance" (p. 140). An effective warm-up routine will ideally include aerobic exercise at a low intensity, stretching, and movements resembling the subsequent activity (Fradkin et al., 2010; Zaffagnini et al., 2016). Blood flow, an increased body temperature, elevated heart rate, flexibility, and coordination are all physical benefits of the warm-up (Berardi, 2013; Fradkin et al., 2010). By increasing body temperature, the musculoskeletal, nervous, and cardiorespiratory systems are altered and primed for activity (Berardi, 2013; Lefevre et al., 2016). A warm-up has even been shown to improve athletic performance (Fradkin et al., 2010). Most important, as it regards to this study, are the injury prevention benefits of a proper warm-up (Berardi, 2013; Zaffagnini et al., 2016). Inadequate warm-ups are a risk factor for injuries (Berardi, 2013; Dönmez et al., 2015). Professional athletes run through warm-ups before their games, sometimes with athletic trainers guiding them through the moves. Given the advantages of a warm-up, an individual engaging in athletics or high-intensity exercise should first properly prepare the body.

Since well-structured warm-ups are proven to prevent injuries, the design of any warm-up routine must be effective and thorough. A routine should specifically target the needs of the performers and production itself. The strategy of such a program should first consider the most common injuries that dancers and performers face. For example, hamstring injuries and ankle sprains are highly common. These body parts should be accommodated for in the routine. Next, the unique factors listed above that performers face must be addressed. If heels are a large part of the show, performers should stretch and prime their soleus and gastrocnemius muscles in order to make sure they are ready. In the same way, any splits in a show should first be prepared for by targeting the hamstring and hip muscles. Any specific needs of the individual actor must also be acknowledged, including any rehab exercises that the individual may be undergoing. Each

person's body differs from the next and varies day to day, so every warm-up must answer the demands of the person's physical instrument for that day. A warm-up should ultimately result in blood flow, a higher heart rate, flexible muscles, a stable core, and optimal balance.

Sports injury prevention programs can be helpful models when designing a warm-up program as they are geared towards athletes in high-intensity situations that require a large degree of physical stamina, strength, and coordination (Myklebust & Steffen, 2015). For example, studies have shown that a specific prevention routine can have an effect on reducing ACL injuries in female soccer players, as well as other lower body injuries (Alentorn-Geli et al., 2015; Myklebust & Steffen, 2015). FIFA, or the International Federation of Association Football, utilizes a prevention program for its soccer players termed the "11+" that functions as a pre-training warm-up (Myklebust & Steffen, 2015). Twenty minutes long, the 11+ begins with running. It then moves on to strength, core, and balance exercises and ends with another stint of running (Myklebust & Steffen, 2015). One study by Soligard et al. (2008) proposed that the 11+ had a decreased overuse injury rate of 53% (as cited in Saho, 2015), while another study by Grooms et al. (2013) showed 72% of lower extremity injuries decreased in male soccer players (as cited in Saho, 2015). A warm-up should be specifically relevant to the specific sport (Lefevre et al., 2016). While the 11+ is geared toward soccer players, the general components of the program can function as a model for a dancer's warm-up.

The warm-up should ideally begin with myofascial release to rid the muscles of any knots. Gentle cardio can follow next where the heart rate steadily rises and breathing becomes quicker. Dynamic stretching is performed after the blood is flowing from the cardio. General stretches for both the upper and lower bodies can be done, followed by specific stretches that resemble the moves done in the particular show (Bird, 2016; Lefevre et al., 2016). Balance and

core exercises can be inserted here to target stability and strength as well. If muscle imbalances or previous injuries are currently undergoing rehabilitation, specific exercises aimed at resolving the problems may be inserted here. Eccentric exercises are proven to be preventative measures in sustaining injuries during sport, especially hamstring injuries (Lategan & Gouveia, 2018). Now that the outline of the warm-up is described, each component will be discussed in greater detail for the purpose of clarity.

Foam Rolling

To start, massaging with a foam roller is a good option to decrease stiffness and increase mobility in the muscles (Blazevich, 2015). Foam rolling is a form of self-myofascial release, ideal for breaking up knots within the muscle tissue and lengthening the entire muscle body (Clark et al., 2017). For the purpose of time, foam rolling during a warm-up can be targeted at areas of tension or muscles that will be heavily involved in the activity to come (see Figure 1). It is especially beneficial for college students who may have tension in the hip flexors and upper body from sitting and wearing backpacks throughout the day. As little as five seconds of foam rolling can improve range of motion, according to studies (Button & Behm, 2014). It even rivals the benefits of static stretching by increasing range of motion to a similar extent without impeding performance like the latter has been shown to do (Button & Behm, 2014). In one study, foam rolling increased sit-and-reach flexibility by 16.6%, a higher percentage than static stretching or aerobic activity (Bushong, 2011). Foam rolling then is a beneficial starting point to the theatre performer's warm-up.

Figure 1

Foam Rolling Demonstration

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Note. [Photograph of person foam rolling calf muscle]. (n.d.). Physiosteps. https://www.physiosteps.co.nz/foam-rollers/

The foam rolling portion is an ideal time to address muscle imbalances and deficiencies that can set the dancer up for injury in the activity to come (Behm, 2018; Berardi, 2013; Clark et al., 2017; Fischer et al., 2016; Peterson & Renström, 2017). When muscles that normally work in tandem are not operating at their peak sufficiency, it may be that one muscle is overactive, leading to tightness and inhibiting movement (Berardi, 2013). The other muscle in the synergistic pair is underactive, resulting in weakness (Berardi, 2013). While exercises to strengthen the underactive muscles can be involved in the warm-up, one must be careful not to fatigue the dancer before the rehearsal or performance is conducted. Strengthening exercises are better left to cross-training sessions throughout the week. Instead, a better option for the pre-performance warm-up would be to focus on the tight, overactive muscles and release the tension. As an example, targeting overactive muscles around the knee can reduce the knee falling inward, a condition known as knee valgus that can be a factor in ACL injuries (Myklebust & Steffen, 2015; Rosenblatt, 2015). In such a case, the adductors are usually some of the culprits, but they can easily be accessed with a foam roller (Clark et al., 2017).

Cardiovascular Activity

Although foam rolling may increase flexibility more than aerobic activity, a low-intensity session of cardio is still best performed at the beginning of the warm-up (Berardi, 2013; Bushong, 2011; Zaffagnini et al., 2016). The cardio component will gradually elevate the heart

and breathing rates as well as increase blood flow and body temperature (Berardi, 2013; Zaffagnini et al., 2016). Exercise machines such as a stationary bike or elliptical are excellent cardio options, especially if the college theatre department has access to machines or the school gym (Behm, 2018). However, in many cases, a warm-up will be done in a dance studio, stage, or backstage in dressing rooms. If such is the case, then bodyweight movements would be appropriate (Berardi, 2013). Jogging in place, jumping rope (with or without an actual rope), running (provided there is space), or jumping jacks can all be done quite easily (Behm, 2018). If a dancer is suffering from an injury rendering impact inadvisable, a nonimpact activity can be utilized (Berardi, 2013). Whatever movement is ultimately chosen for cardio, it is important that the entire body is involved and engaged in the movement (Clark et al., 2017). Even if a theatre production makes little use of the upper body, all muscle groups need to be warmed up and activated to tackle any physical demands on them – planned or unplanned – that may arise during the show (Clark et al., 2017). Since cardio movements such as those listed above are universal for all activities and athletics, this section forms the "general" phase of the warm-up (Clark et al., 2017, p. 202). Around five to ten minutes of light cardio would be sufficient for the majority of dancers (Behm, 2018; Berardi, 2013; Clark et al., 2017; Jones, 2016).

Dynamic Stretching

Immediately after the cardio component, dynamic stretching should be performed as the muscles will be warm and more supple (Jones, 2016). Keeping the stretches active and moving through the full range of motion leads to increased flexibility and body temperature as opposed to static stretching, which is best performed after the warm-up or performance takes place (Berardi, 2013; Clark et al., 2017; Jones, 2016). Static stretching can hinder power and performance during activity, as well as potentially cause a drop in body temperature (Blazevich,

2015). Static stretching may even irritate injuries that dancers are currently nursing as one article proposes that hamstring injuries as the result of extreme stretching garner more pain from passive stretching (Askling & Heiderscheit, 2015). Dynamic stretching, also termed functional stretching, will mobilize the joints and increase range of motion as a part of the warm-up (Berardi, 2013; Blazevich, 2015; Clark et al., 2017). Flexibility can be a risk factor for injuries; for example, tightness in the hip flexor is thought to be related to hamstring injuries (Mendiguchía et al., 2015). By reducing stiffness, soft-tissue injuries may be reduced (Blazevich, 2015).

Examples of effective dynamic stretches depend on the activity that is to follow, for the stretches should focus on the relevant muscle groups that are to be used (Blazevich, 2015; Zaffagnini et al., 2016). Because of the nature of the exercises being suited to the particular characteristics of the forthcoming activity, dynamic stretching constitutes the "specific" phase of the warm-up (Clark et al., 2017, p. 202). For dancers in theatre productions, the lower body should be given the most attention due to the predominant kicking, turning, and jumping that takes place in musicals. Ankle circles, bodyweight squats, hip swings, and lunges are appropriate (Berardi, 2013; Clark et al., 2017). Despite its smaller use in production numbers, the upper body should not be neglected; arm circles, torso rotations, and shoulder rolls can increase mobility and reduce stiffness (Berardi, 2013). The cat-cow exercise (see Figure 2) can counteract any stress accumulated from sitting throughout the day, which is ideal for college students who sit in classes for a majority of the day (Berardi, 2013). Anywhere from three to ten exercises can be performed, and ten reps of each is sufficient (Clark et al., 2017).

Figure 2

Cat-cow Exercise

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Note. Wolfe, M. (2013). [Photograph of person demonstrating cat-cow exercise]. POPSUGAR. https://www.popsugar.com/fitness/How-Do-Cat-Cow-Pose-26662589

Movement Patterns

Similar to warming up the same muscle groups, exercises that resemble the same movement patterns to come in the performance or rehearsal can be inserted into the latter half of the warm-up after cardio and dynamic stretching has taken place (Jones, 2016; Zaffagnini et al., 2016). By training the same movement patterns, muscle memory becomes ingrained in the performer, and the exact muscles that are targeted in the performance will be activated. Working on show-specific movements can be done within three minutes (Behm, 2018). An example of this component might be bear crawls on the ground for the ensemble members playing apes in *Tarzan*. Jabs and hooks thrown into the air can serve as preparation for a combat sequence on stage.

The caveat here is that dynamic stretching (muscle group exercises) may overlap in content with the movement pattern exercises; in that case, any dynamic stretches that were performed may suffice for the latter grouping. However, it is important to note that the terms muscle groups and movement patterns are not necessarily interchangeable. Exercises may train the muscles needed, but the specific function and coordination needed for the muscles to work together properly may differ. For example, a dynamic stretch such as a leg swing concentrates on the hip flexors, hamstrings, and glutes. It also mimics the movement pattern of a kick, thus fulfilling the needs of the warm-up. However, an exercise like the arm circle will work on

shoulder rotation, but it may not be directly applicable to any movement in the production.

Additional Considerations

A selection of core activation and balance exercises should be utilized in the warm-up as well. As the body's center, the core aids in stabilizing the dancer and providing a strong base from which to anchor the upper and lower extremities. According to Romita & Romita (2016), "core support is the skeletal, muscular, and myofascial recruitment needed to maintain a balanced center of gravity…in any position" (p. 61). Weakness in the abdominal muscles is a danger for dancers as it can put them at risk for injury (Berardi, 2013). Likewise, balance exercises are ideal for creating stability and coordination in the body. To target both core and balance, a single-limb exercise may be done, such as balancing one-legged on a Bosu ball or performing the bird dog exercise (see Figure 3). In those dancers who are currently undergoing physical therapy, balance exercises may be prescribed by their therapist (Berardi, 2013). In studies that centered around soccer players, prevention programs that contained balance and core exercises had a positive effect on the reduction of knee and other lower extremity injuries (Alentorn-Geli et al., 2015; Burton & Cook, 2015). Specifically, ACL injuries can be effectively reduced with such exercises when combined with other modes of exercise (Myklebust & Steffen, 2015; Sugimoto & Myer, 2015). In addition, lower back pain can stem from core deficiencies, making core exercises an important step in any warm-up routine (Burton & Cook, 2015).

Figure 3

Bird Dog Exercise

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Note. POPSUGAR. (2018). [Photograph of person demonstrating bird dog]. POPSUGAR. https://www.popsugar.com/fitness/photo-gallery/43200628/image/43206801/Instead-Bird-Dog

Rehabilitation Exercises

If a dancer has a previous injury for which she is currently seeking rehabilitation, the stretching and strengthening exercises provided by their physical therapist may be done during the warm-up in an effort to prevent further damaging the site of injury during the rehearsal or performance (Berardi, 2013). Rehab generally includes similar components as the warm-up template described above (Peterson & Renström, 2017). Mobility training that includes stretching surrounding muscles of the injured site is suitable for the dynamic stretching component of the warm-up (Peterson & Renström, 2017). The strengthening exercises that a therapist may issue their patients can be done afterwards (Peterson & Renström, 2017). Preventing further injury to the damaged site is important, so the physical therapist's routine must be adhered to and followed for the specific individual performer. Ideally, the physical therapist should be consulted regarding the warm-up routine of the production and if and how the dancer needs to modify. This is contingent on whether or not the dancer can participate in the production and is not currently prohibited from activity for recovery purposes.

A Sample Warm-up

A sample warm-up that involves all of the previously mentioned components follows. In this example, the performer is a female performer in the dance-heavy musical *A Chorus Line*. She currently has no injuries for which she is seeking rehab, but she struggles with knee valgus. In addition, her hip flexors are tight from sitting in classes all day. The only place she can perform her warm-up is in her small dressing room. Taking all of these factors into account, a warm-up can then be devised. The warm-up would begin with three minutes of foam rolling, massaging the areas of tension and working out any knots in the muscle tissue. For her knees, the adductors could be foam rolled to minimize knee valgus. Her hip flexors and quadriceps can be

isolated afterwards. Next, the performer marches in place for two minutes, then jogs in place for another two minutes, and finishes the cardio section with two minutes of jumping jacks. To stretch and increase range of motion, the performer does slow butt kicks, standing toe touch kicks, and lateral lunges to stretch the adductors (also known as the inner thigh muscles). Bird dogs will target the abdominals and back, coordinating the muscles of the core with stability, and a single leg balance with hip rotation will function both as dynamic stretching and a stability challenge. Finishing the warm-up, the performer moves into leg swings and high knees to mimic the movement pattern of the eye-high kicks to come later in the performance.

Implementing the Warm-up

Location

The location of the warm-up is an important consideration. Utilizing the actual performance space could be highly beneficial. The performers need to get their bodies accustomed to the area, especially if the floor is a specific material or the stage is raked. While on stage would be ideal, this may not be practical for most productions if the stage is pre-set with scenery, occupied by crew members, or otherwise off limits. A rehearsal room or dance studio that is accessible and nearby makes a convenient location. Otherwise, the backstage area may be the most feasible option, perhaps even a dressing room. Space tends to be tight in dressing rooms and backstage areas, somewhat limiting exercise choices for the warm-up. Although running or similar exercises that require distance would be impossible, the warm-up could be simply modified to accommodate a smaller space.

Time

The optimal time to perform the warm-up is shortly before the performance takes place to ensure that the muscles stay warm for activity (Berardi, 2013). Once the heart rate drops and the

muscles contract again, the body is no longer warm and flexible. If actors warm up only to wait for even ten minutes for their scene on stage, their muscles and body temperature return to their pre-warm-up levels (Berardi, 2013; Peterson & Renström, 2017). To further monitor that warm-ups are taking place whether individually or as a cast, a time could be set before the show that is explicitly for warm-up purposes. Thirty minutes before the curtain rises may be an ideal time to ensure that there is plenty of time in case the individual needs 20 minutes to perform a full-body warm-up. Any extra time left between the warm-up and the beginning of the show could either be filled with costume, hair, or makeup needs, or the performer could keep lightly moving to keep their heart rate up. Scheduling any other tasks such as mic check or fight call can be done in the moments leading up to or immediately following the warm-up period. Otherwise, performers may unintentionally miss warming up in favor of making mic check and similar tasks. In addition, having a time reserved would ensure that the stage is available for use by performers, giving adequate room for individuals to spread out and conduct a group warm-up.

Length

The length of the warm-up routine depends on the time available and also the needs of each performer (Berardi, 2013). A good minimum time for a warm-up is around 10 minutes for the majority of athletes (Zaffagnini et al., 2016; Peterson & Renström, 2017). On the other hand, Berardi (2013) states that most dancers will find 20 to 40 minutes ideal for warming up. In general, a longer warm-up can be more beneficial than a short one in order to ensure that each muscle is properly primed for movement. A short warm-up could tire the muscles out by doing too much too fast (Lefevre et al., 2016). However, the warm-up should not last to the point that the performer's energy is spent before performance has even started. Gradually escalating the effort and intensity of the warm-up is advised (Lefevre et al., 2016). External factors play a part

on the length of the warm-up as well, such as the temperature of the performance space. Certain environmental aspects, such as a cold theatre or the winter season, may constitute a longer warm up since they are injury risk factors (Ishikawa et al., 2015; Peterson & Renström, 2017; Zaffagnini et al., 2016).

Group vs. Solo Warm-ups

The leader of the warmup is the next technical question to solve. In general athletics, the coach implements the injury prevention programs for his players (Della Villa et al., 2016). For the theatre, a similar person in charge would suffice. The director, choreographer, or dance captain are all viable options to teach or run the group through the warm-ups, but this of course depends on whether or not the warmup is even conducted as a group. A group warm-up at the beginning of the rehearsal process could help in teaching the performers any essential moves, answering questions, and ensuring they understand the importance of continuing the warm-ups on their own, then allowing them to perform them on their honor throughout the run of the show. While team warm-ups may be more effective in guaranteeing that all performers are warming themselves up, a solo warm-up should be permissible so as to make the warmup conducive to the individual's own needs. If group warm-ups prove to be the best route, a solo component could be added on to the end of a group warm-up, thus both offering the benefits of team motivation and the opportunity to address individual needs. Overall, the most crucial aspect of the warm-up routine is that it is correctly and consistently performed (Della Villa et al., 2016).

Optional Equipment

Since most warm-ups can be bodyweight focused, no equipment needs to be provided by the college itself. If performers wish to foam roll as an optional component of the warm-up, they can purchase and bring their own roller. Fortunately, foam rollers are easily accessible at stores

and online. They come in different sizes and densities to meet individual needs, as well as varying price points. Lacrosse balls, trigger point balls, and massage sticks are useful alternatives to foam rollers that the performer may be interested in. Likewise, if during the dynamic stretching or exercise movement pattern, the performer would like to progress the difficulty, they can bring their own resistance bands or ankle/hand weights. Finally, headphones or earbuds can be encouraged (at least during the warmup) so that performers are able to listen to their favorite songs while warming up. All of these different possibilities will allow college students to ‘customize their warm-up and make it their own.

Educating the Performers

Once a warm-up has been implemented, education on why the warm-up is important for the performer’s safety and stamina during the run of the show should follow. Students may not see the need for a warm-up or why their current warm-up routine is inadequate. Explaining the common injuries and the benefits of a warm-up can provide the performers with a better understanding and desire to take care of their bodies. Injuries can have prolonged recovery times, and, depending on what point of the rehearsal process the injury happens, the student may be unable to perform in the productions. Furthermore, the consequences of an injury do not only affect the individual, but they affect the entire cast. Finding a replacement who can learn the role or moving forward with one less performer puts a strain on the entire production. It should be carefully emphasized that, as performers, taking care of their physical health does not just pertain to the current production they are in, but it prepares them for future careers. A professional theatre company may require company warm-ups, and it will better serve college students if they are familiar with such a routine. Although education may not guarantee that each cast member listens and makes the decision to adequately warm up their body, it is at least a step in the right

direction in informing and producing healthier performers.

Conclusion

Ultimately, a warm-up is a superb method in injury prevention. A theatre student must learn to incorporate a proper warm-up into both their pre-rehearsal and pre-show routines to meet the demands of the stage. Creating a healthy lifestyle is the mark of a professional athlete. As an athlete, a performer must make his or her physical health a main priority for career longevity and success. Of course, it is impossible to eradicate all risk of an injury, especially one that derives from a traumatic incident such as a fall. Some injuries may simply be unavoidable and the results of unfortunate accidents. Luckily, the majority are preventable. Thus, every measure to safeguard against injuries is beneficial. The student performer must remember that it is just as crucial to prevent an injury as it is to treat one (Peterson & Renström, 2017). “Break a leg” should remain a stage adage, not a reality.

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