



The Pre-Participation Examination for Activity/Sports

Dr. W. E. Kelsick B.Sc., FCCSS(c), FCCRS(C)

The popularity of team sport has mushroomed in the last two decades at the Amateur and professional level. The increased popularity has led to increased sport participation and varied physical activity of the general population. Physical activity is now recognized as an essential component of healthy living and well-being. Regular physical activity is known to increase physical capacity, decrease body fat, increase lean body tissue and bone density, and lowers rates of coronary heart disease, type II diabetes, hypertension, and cancer (Lee et al 1991). However, one of the consequences of this dramatic surge in physical activity and sports participation is the increasing incidence of injuries with no discrimination as to activity or sports type. *(A recent British Columbia study estimated that people who do not exercise or engage in some type of physical activity cost the BC tax payers between \$347-647 million in health care and lost productivity) (CPI Atlantic Canada)*

In the last decade or so the drive to decrease the incidence and severity of sport injury has been given much attention in the medical field. Health Care Providers have implemented or suggested many strategies (i.e. proper conditioning, improved skills, techniques, equipment and environment; pre-participation examination) to help achieve the goal of lowering the incidence of injuries. The literature evidence has shown that if such strategies are implemented, there can be a drastic decrease in the incidence and severity of sports injuries. The sports participant can improve performance, hence making the sport more enjoyable.

Of the above mentioned injury prevention strategies, the pre-participation examination (PPE) should be the front line of defense. Implementation of the pre-participation exam concept into the sporting team program is a prudent, initial and effective step in the drive to decrease injuries and improve performance. It should be noted that in addition to injury prevention, the PPE has several other benefits, namely: identification of strengths and deficiencies in athletic abilities i.e. fitness conditioning, biomechanical faults and asymmetries, and congenital disorders; increases the confidence athletes have in their sport medicine team and allows for better interaction with the medical support staff; it gives the sports medicine doctor a good grasp of the athletes' level of fitness, flexibility and health prior to onset of the season hence allowing for the evaluation of the off-season conditioning programs; its an excellent starting point to implement an educational platform about fitness conditioning, injury prevention and general health and wellness for athletes and coaches; and it allows the opportunity to satisfy the legal requirements for preseason screening required by insurance companies depending on the sport.

Overall, this type of athletic profiling can help determine whether the athlete is fit to participate or allow limited participation in a selected sport. In addition, by correcting the deficiencies discovered in the examination, athletic performance can be improved and the frustration level decreased when the etiology of poor performance is unclear.



The Principles and Goal of the PPE

The keystone to having an effective PPE is to have a well design protocol. This can be achieved if certain principles and goals are taken into consideration.

Several basic principles help govern the PPE (Kibler) namely:

- The PPE should have definite goal
- A reproducible method should be used to obtain the proper information
- The information should be as objective as possible to allow for measuring or quantifying by easy testing methods
- The examination should be as specific for the intended sport as possible. Hence the testing procedures should be flexible enough to measure the different aspects of the musculoskeletal (MSK) performance that are dominant in that sport
- The exam should be completed in most opportune time in the season. Ideally testing should be completed 6 to 8 weeks before the start of the practice season. This allows the athlete time to implement any conditioning that may be required if musculoskeletal deficits are indicated.

There are five goals, which should be emphasized when designing the protocol for a PPE for athletes. Like the principles these goals will help make the PPE sports specific. The goals are as follows:

1. Provide an objective sport-specific musculoskeletal profile of athletic fitness
2. Delineate negative information that prohibits, modifies or delays participation
3. Delineate positive information to decrease injury risk and increase performance
4. Provide a reproducible record for subsequent exams
5. Provide a base for sport-specific fitness conditioning

Components of the Pre-participation Examination

The pre-participation exam has several components most of which must be address if the outcome is to be successful. However this paper will focus on the musculoskeletal (MSK) examination for track and field. With this in mind I will offer specific guidelines for the PPE of a track and field athlete. Listed below are the key components of the PPE.

- The Evaluation Protocol
- Medical history
- Physical examination
- Musculoskeletal examination
 - Muscle balance – intra and extra regional
 - Muscle firing/excitation patterns
 - Flexibility, Strength, Speed, Power and Endurance
 - Agility
 - Joint dysfunction
 - Core/trunk stability
- Orthopedic and neurological examination
- Gait assessment
- Physiological Profile
 - Aerobic and anaerobic capacity
 - Isokenetic Testing



The Sport Specific MSK Pre-participation Examination: A look at Track and Field

In the following discussion I have chosen the sports of track and field as the reference sport. My choice is based on the fact that track and field is a very physical demanding sport and the skills required are actually that of sprinting, running, walking, pushing, jumping, hopping and throwing. Consequently, Track and field athletes should place emphasis on the power, speed, quickness, agility, relative strength, anaerobic, aerobic and flexibility components of fitness. In addition, the nature of the sport depicts the body part where majority of the injuries will occur, namely the lower extremity, core/trunk, low back and pelvis. Most of these injuries (some 60% - Kibler) are of the tensile overload stress type (e.g. tendonitis, strain, muscle tear or stress fracture) or traumatic in nature (e.g. ankle and knee sprains or severe ligament tears).

Poor flexibility, muscle strength imbalances and muscle weaknesses in the core/trunk, pelvis, shoulder complex, and hamstring/quad complex are common findings in Track and field injuries. For example, in running the action of the lower extremity is responsible for moving the upper body from point "A" to point "B" in the shortest time (maximum speed). This is achieved by the transfer of forces from the lower to body to the upper body, which depends on how well they are connected. In this case, it is known that proper balance in the abdominal for flexion and obliques for rotation, back and pelvic muscles are crucial in maintaining trunk stability. Accurate synchronization of the thigh and lower leg power, strength, and flexibility is especially important in determining proper balance during sprinting movements. For instance, if there are weaknesses or muscle imbalance in the hamstring, knee stabilization capacity can be severely compromise in movements such as running and jumping, predisposing the athlete to severe ligament (ACL, MCL) tears and sprain. In such a case conditioning programs can be prescribed to "pre-habilitate" the tissues to allow them to obtain the appropriate strength and flexibility to withstand the forces.

Test Selection for the PPE

When designing the protocol for the PPE selecting the test depends on the sport's profile. As already mentioned attention should be given to the types of injuries common to track and field in this case and common anatomic locations. This allows for more detail data collection and in-depth study of the supporting tissues of the region. In addition, track and field includes two major movements: Power generation – toeing/pushing off and Power absorption – landing.

Power generation (acceleration movements) involves concentric muscular activity where as power absorption (deceleration movements) - landing consists of eccentric muscular activity.

Track and field like other sports can be characterized by the common denominator of the all-athletic activity: the muscle. On a macroscopic level there are five identifiable parameters which can be use to measure muscular activity in athletic activity:

1. Flexibility
2. Strength
3. Power
4. Anaerobic endurance
5. Aerobic endurance
6. Balance



Most muscular activities such as running, jumping throwing (events in track and field) are a combination of the basic parameters. Let's look at important parameters of distance running and sprinting for example. In order of priority:

Long distance running: 1. Aerobic endurance, 2. flexibility, 3. Strength, power and anaerobic endurance. Distance running stresses different anatomic regions than sprinting. Lower leg, knees and ankles seem to most affected with injuries. Most distance runners demonstrates lower extremity weakness I strength and power.

Sprints: 1. Anaerobic endurance, 2. Power, strength, flexibility, 3. Aerobic endurance. Sprinting is an explosive sport hence it places tremendous tensile loads on the lower extremity muscles. The Hamstring and lower leg injury are most common. Therefore the MSK PPE would focus on those key areas and the accessory areas, which complements its function.

Sports Specific Functional MSK Testing for Track and Field

The MSK examination may vary according to the history of the athlete and the preference of the examiner. More in-depth examination may be required depending on the information collected on a particular problem area during history taking. A complete foot, ankle, lower leg, knee, pelvis, trunk, shoulder complex and spinal evaluation are absolutely necessary. Based on the information presented in previous sections the parameters most practical to the sports chiropractor for testing are flexibility, strength, power and muscle balance. I develop a testing protocol for track and field on the principle that muscles, as a functional unit, do not work in isolation. They work as groups, either as agonist, co-contractors, synergist or stabilizers. In addition I try to carry out all my functional testing in the upright posture base on the fact that people do not run in a prone or supine position/posture. It is my opinion that in order to get the true functional ability of a muscle or group of muscle is to test them as close as possible in the position they perform the work/activity. I therefore, recommend testing of all prime movers (i.e. muscle) be conducted in an upright posture. The following is a battery of test, which I recommend for track and field athletes.

1. Assessment of symmetry and deformities of the bony structures of the trunk, pelvis, and upper and lower extremities
2. Evaluation of the shoulder complex (scapular thoracic mechanism). Observe for pectoralis muscle group tightness which can hinder gleno-humeral extension; and scapular motion
3. Observation of spine in its entirety (cervical, thoracic and Lumbar) for symmetry in all ranges of motion (ROM) and segmental dysfunction
4. Assessment of symmetry of the trunk, pelvis and upper and lower extremity from behind. Paid attention to scapular asymmetry, pelvic un-leveling, hamstrings and calf atrophy. (Figure 1)
5. Observe the athlete's back and spine with trunk in a forward flexed position with knees extended to detect scoliosis and hamstring flexibility. Hamstring flexibility determined in the standing posture is more functional than in supine posture for runners. (Figure 2)
6. Observation of the lower extremity from the front, which could reveal excessive pronation or supination of the feet, excessive tibial torsion, knees for genu valgum or varum, and quadriceps(including vastus medialis obliquus-VMO) symmetry during contraction and relaxation. (Figure 3)
7. Observation of knee position (Medial or lateral deviation from center) over foot during single leg squats test. (Figure 4)
8. Observation of during double leg squatting and duck walking allows for functional evaluation of hip, knee and ankle function.



9. Observation during toe and heel in both walking and standing position to evaluate strength of plantar and dorsiflexion respectively.(Figure 5)
10. Observe static standing pelvis and trunk posture. Look for pelvic tilts/shifts in all planes of motion.
11. Functional standing hip flexion testing (active and passive ROM and muscle testing) instead of supine testing. This can be class as a modify Thomas test. In this position, you should also assess for pelvic stiffing/tilt. (figure 6)
12. Functional standing hip extension testing (active and passive ROM and muscle testing) instead of prone testing (figure,7)
13. Assessment of core strength and stability. With athlete's standing observe the trunk position in relation to centerline (a plum line can be used) when performing: single leg squat; hip flexion, abduction, adduction, and extension; lateral trunk flexion, extension and rotation.
14. Evaluate for neuromuscular synchronization (proprioceptive) function. Observe for appropriate core and accessory muscle firing (movement) patterns. Use standing posture instead of conventional prone posture. This test assists in check for balance, stability and coordination (i.e. peripheral dysfunction). The following tests can be use to evaluate stability: 2 x 4 Plank walk, in-line lunge plank walk, and hurdle step. (Fig 8,9,10)
15. Evaluate gait by doing a functional dynamic Gait and treadmill analysis

Conclusion

The pre-participation examination can be of exceptional benefits to a Track and field athlete's as well as other sports base on facts mentioned above. The information collected from the PPE is crucial in making decisions pertaining to safe and optimal athletic participation. The information will also help improve all aspects of the sports program by: identify weaknesses and imbalances in the musculoskeletal system; determining body adaptation, which would have taken place from participating in other sports in the off-season; decreasing the risk of injury; developing more effective (i.e. functional/sports specific) conditioning programs; developing more effective rehabilitation programs; and by creating a better environment for communication between athletes, coaches, and sport medicine professionals. The PPE will also aid in making recommendations for reconditioning required for the new season. The overall goals of sports program are to: to minimize injuries, optimize performance and fun. To achieve these goals there must be a starting point. The PPE is the strategic starting line to attain such goals. The examination protocol must be simple, comprehensive and easy to implement and undertaken by personnel with the appropriate clinical skills.

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