Viruses are the most common infectious agents affecting humans. Some investigators contend that viral upper respiratory illness (URI), or the common cold, causes more frequent acute disability among athletes than all other diseases combined (Ryan et al., 1975).

Disease patterns among Summer and Winter Olympic athletes are remarkably consistent. Respiratory infections head the list, followed by gastrointestinal disorders and skin infections (Hanley, 1976). During the 1992 Winter Olympics some of the world’s greatest athletes were unable to compete or did not perform well because of a URI (Nieman, 1992).

Upper respiratory illnesses are associated with major socioeconomic expense in the U.S., due to missing work or school and to medical expenses. The cost is said to be $5 billion a year (Turner, 1990).

Although heavy exercise may increase the risk of acquiring an upper respiratory infection (Nieman, 1992), athletes and exercise enthusiasts tend to continue participating in competitive and recreational sports during a URI. Therefore it is important to understand the essential changes in cardiac, pulmonary, and skeletal muscle functions during a URI.

The implications for continued sport and exercise participation relative to illness complications and susceptibility need to be considered. Protracted courses of URI, performance levels, and subsequent participation guidelines during illness also warrant discussion.

**Physiological Effects of URI**

Three studies on the effects of URI on the pulmonary function of subjects at rest were completed in the 1970s, and all three suggested that peripheral airway abnormalities are associated with URI. One study concluded that large airways were involved during URI (O’Connor et al., 1979). The other two investigations found no dysfunction in the large airways (Blair et al., 1976; Cate et al., 1973).

Respiratory muscle strength was studied in 12 subjects who had developed an upper respiratory infection (Mier-Jedrzyowicz et al., 1988). Maximum static respiratory and expiratory pressures fell significantly during these infections. The investigators concluded that weakness of the inspiratory muscles may contribute to breathlessness during exertion. To make matters worse, weakness of the expiratory muscles might affect the cough mechanism and subsequent clearing of pulmonary secretions.

Mier-Jedrzyowicz et al. suggest that those who suffer from either lower respiratory tract infections or from exercise-induced asthma should also refrain from sports during URIs or episodes of exercise-induced asthma.

Reduced functional capacity of skeletal and cardiac muscle has been demonstrated during URI. Astrom et al. (1976) examined tissue from patients recovering from recent viral or mycoplasma illnesses and found significantly reduced muscle enzyme activity in infected patients. Moreover, electron microscopy revealed abnormalities in muscle ultrastructure.

Roberts (1986) suggests that during URI there is a decrease in muscle glycogen utilization. Ardawi and Newsholme (1985) report that a decrease in muscle glutamine release occurs with URI during prolonged physical training. Other researchers have also reported that myositis ossificans may be the result of hematoma infection following a respiratory tract infection (Zarins & Ciullo, 1983).

**Fever and Muscle Soreness**

The effects of myalgia and fever on muscle and circulatory function have also been examined.
Friman et al. (1985) found that during a fever, subjects exhibited decreased isometric and dynamic strength and endurance. Severity of myalgia (muscle pain), as rated by each subject, correlated significantly with reduced muscle function. Cardiac stroke volume was lower during and after fever. During fever, an increase in heart rate maintained cardiac output at preinfection values, whereas cardiac output fell during early recovery. This decrease in cardiac output correlated significantly with the severity of fever.

The actual influence of fever and myalgia from a URI has not been determined. A variety of complications may be associated with URI, including prolonged courses of infection and even sudden death. The predilection of the Coxsackie cold virus to produce myocarditis or pericarditis may increase the risk of acute arrhythmias leading to sudden death (Roberts, 1986). In a study of 78 sudden deaths during or immediately after exercise, Jokl and McClellan (1971) found a history of URI in 5 of the victims; cardiovascular problems accounted for most of the rest.

Roberts (1986) comments that there are numerous anecdotal reports of death in healthy young people who undertake vigorous exercise during a viral illness. He also reports that numerous case studies have identified viral infections as a cause of sudden death.

Impact of URI on Sport Performance

The impact of URI on sport performance has not been clearly identified. In related work by Friman et al. (1985), a decrease in muscle performance correlated to the subjects' own ratings of the intensity of myalgia and fever. Friman et al. concluded that a person's perception or experience of a febrile illness seems to influence his or her ability and/or willingness to perform exercise.

Roberts (1986) presented 4 case reports of athletes who experienced a loss of stamina and ability to manage a normal training schedule during subclinical episodes of URI. All had laboratory evidence of recent viral infections. Roberts concluded that inquiry about minor illness should be standard practice in athletes who have an unexplained loss of stamina. Infections that are subclinical in the population at large may greatly affect maximum performance in athletes.

In a study on the self-reported behaviors and activity levels of intercollegiate athletes with URI, Weidner (1994) attempted to discern which URI symptoms are the most problematic for athletes. Distinctions among symptoms were assessed by examining which ones the athletes reported first to their athletic trainers, team physicians, or coaches.

Also examined were those cold symptoms that prevented athletes from participating in a practice or game or that affected perceptions of physical performance. Athletes who experienced symptoms of cough, fever, laryngitis, aching joints or muscles, and nasal discharge were more likely to report their illness. These symptoms also caused athletes to reduce their activity levels, and their own perceived physical performance dropped.

Weidner et al. (1995b) found changes in running gait during a URI. In particular, stride length increased and stride frequency decreased significantly between illness and convalescent running trials. The perception of fever was an important indicator for changes in running performance.

However, in an investigation completed by Anderson et al. (1995), it appears that a URI does not necessarily limit one's ability to perform exercise on a treadmill. That is, changes may be seen in physiological responses to exercise during longer submaximal exercise bouts as opposed to acute maximal bouts of exercise. For example, in a submaximal exercise bout of 45 min, a URI may have an impact on performance.

The impact of URI on sport performance has not been clearly identified. Certainly, alterations in cardiac, respiratory, and skeletal muscle functions as discussed above may individually or collectively alter performance. Further research is needed.
Participation and Clinical Management

There has been no research on the disposition of an athlete with an upper respiratory illness. Roberts (1986) recommends that if the athlete has symptoms of a common cold with no constitutional upset, he or she may safely resume training a few days after the symptoms have resolved. However, if there are signs of extreme fatigue, myalgia, or swollen lymph glands, the athlete should wait a month before resuming a full training load.

For very competitive athletes who cannot afford to miss any training days even when ill, Eichner (1992) recommends that they do a "neck check." If the symptoms are located above the neck (e.g., stuffy nose, sneezing, scratchy throat) and there are no constitutional symptoms, the athlete should be allowed to proceed cautiously through his or her scheduled workout at half-speed. After a few minutes, if the congestion clears and the athlete feels better, the intensity can be gradually increased. If the athlete feels worse, rest is recommended.

The athlete with "below the neck" symptoms such as fever, aching muscles, hacking or productive cough, vomiting, or diarrhea should not train. Fitzgerald points out that exercising during the incubation period of an infection may worsen the illness. Certain, athletes who feel they might be getting ill should reduce their training schedule for a day or two.

If exercise can compromise the immune response in healthy subjects, it seems logical to assume that exercise would certainly do so during an illness. If this is the case, both the severity of the symptoms and their duration may be increased. In addition, training techniques should consider the body's need to restore host resistance by including lower intensity training interposed between higher intensity training bouts (Heath et al., 1992).

In contrast, unprecedented research by Weidner (1995a) found no difference in the severity and duration of symptoms between subjects who continued to exercise and those who abstained from exercise during a URI. However, these symptoms were restricted to above the neck. There is a need for more research in this area.

According to comments in various medical magazines and newsletters, the heart rate and oxygen consumption changes that accompany a fever during some URIs may be reason enough to decrease training. Heart rate increases by 2.44 bpm with every 1.5 °C rise in temperature in febrile subjects (Mackowiak, 1992). As noted earlier, cardiac output correlates significantly with the severity of fever (Friman et al., 1985).

Fever also increases the demand for oxygen (Friman et al., 1985). For every increase of 1 °C over 37 °C, there is a 13% increase in oxygen consumption. In addition, overtraining, fatigue, or illness may increase the resting heart rate. A difference of 10 to 20 bpm upon arising in the morning may signal the onset of illness or lack of adequate rest between workouts (Peters & Bateman, 1983).

Preventive Measures

Nieman (1992) advocates several precautions that can help athletes reduce their risk of URI:

- Eating a well-balanced diet;
- Keeping other life stresses to a minimum;
- Avoiding overtraining;
- Guarding against chronic fatigue;
- Before and after important events, staying away from persons who are ill;
- Getting enough sleep;
- Spacing vigorous workouts and competitive events as far apart as possible;
- For athletes competing during the winter months, flu shots are highly recommended.

Conditions that may increase the transmission of URI among athletes warrant the attention of sports medicine practitioners. Especially during the winter, athletes are exposed to the cold virus in crowded dorms, classrooms, and gyms, and this perhaps accounts for the higher incidence of colds during the winter (Casey & Dick, 1990).

Because there is some evidence that strenuous exercise may increase the incidence of URI (Douglas & Hanson, 1978; Heath et al., 1992), athletes should be advised to try to stay healthy through proper nutrition, adequate rest, and stress management especially during winter.

Facial tissues should be used with care when blowing the nose so as to guard against spreading a cold or other virus infection (Dick
et al., 1986). Casey and Dick (1990) recommend careful hand washing, avoiding direct skin-to-skin contact, and avoiding contact with contaminated tissues, sporting equipment, and appliances. Athletes should not share towels and water bottles. Paper tissues and cups should be used and disposed of in closed plastic bags. Commonly used washing facilities should be cleaned with disinfectants or tincture of iodine before and after each use.

**Treatment**

For the most part, treatment for URIs consists of rest, fluids, analgesics, and over-the-counter cold remedies. Acetaminophen is recommended for fever, headache, and muscle pain. Throat lozenges, saltwater gargles, or viscous lidocaine are recommended for sore throat.

If the athlete is to continue training, he or she must be cautious about using cold medications that contain antihistamines, due to their anticholinergic side effects which can have a negative effect on thermoregulation. Also, some decongestants still contain ephedrine, a substance that has been banned by several sports governing boards. Athletes must be careful to avoid potential disqualification by testing positive for an illegal substance from a seemingly innocent over-the-counter medication.

**Conclusion**

An athlete's performance levels may decline during a URI. More research is needed in this area. Through early intervention and education programs, and some common sense, complications from illness and protracted courses of upper respiratory tract infection may be prevented.

**References**


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