

*Full Length Research Paper*

# H1N1 virus and sport, risks of transmission and methods of prevention

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Accepted 7 June, 2011

**The relationship between sport-related physical activity and H1N1 virus can be studied from many perspectives including: 1) The high risk of transmission of H1N1 virus in athletes contact and collision sports and also those who live in or travel to endemic regions, and participate in exercise and competition groups; 2) Useful role of exercise and physical activity in high-risk individuals for H1N1 (metabolic diseases such as diabetes, cardiovascular diseases and obesity); 3) Improvement of immune system against infectious diseases by moderate exercise and physical activity. Therefore, prevention should be focused on vaccination, increasing physical fitness and hygiene in sport and non-sport environments especially in high-risk individuals.**

**Key words:** H1N1, sport-related physical activity, immune system, metabolic diseases.

## INTRODUCTION

H1N1 influenza has been known as a major health problem. According to the World Health Organization (WHO), there are 414000 confirmed cases and nearly 5000 deaths reported to WHO in 2009 pandemic and the actual number of cases is estimated even higher due to the issue that public health systems have stopped confirming individual cases and are now monitoring disease trends. However, H1N1 influenza (swine flu) is deemed to cause high morbidity but low mortality rates (1 to 4%) (WHO, 2009; David and Hui, 2010; Pedersen, 1998).

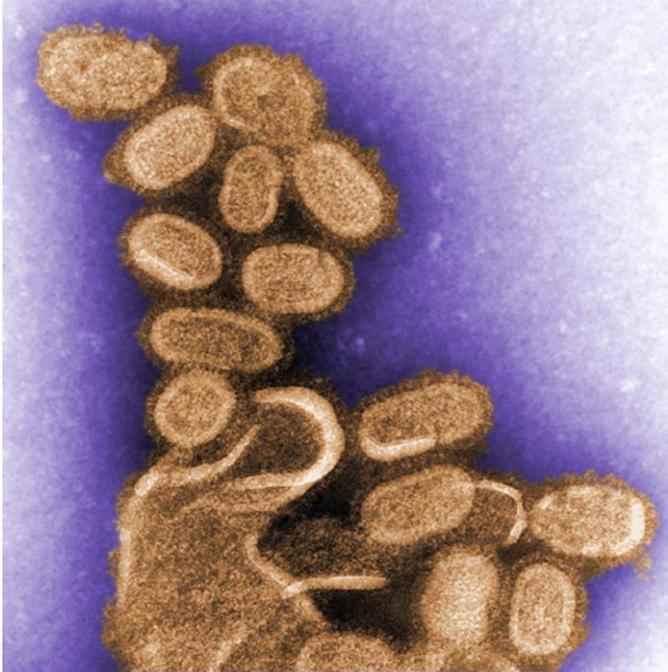
Meanwhile, the influenza virus has caused the bird, swine, and human diseases for many centuries. Pandemics and epidemics have occurred throughout the history and reports of new strains continue to emerge (Marjani, 2010). Two major surface antigenic glycoproteins, hemagglutinin and neuraminidase, have various subtypes, resulting in numerous combinations of these proteins. For example, combinations occur when an influenza strain from a bird mixes with a strain from a human. This mixing occurs in a host, often in pigs,

resulting in a new strain. This new strain can cause pandemics since people have no immunity to the new strain. An H1N1 subtype pandemic which occurred in 1918 led to millions of deaths. Along with this, veterinary reports of "influenza" in pigs also emerged. It is postulated that humans infected the pigs with this H1N1 virus (WHO, 2009). The ability to trace outbreaks of swine flu in humans dates back to investigation of the 1918 Spanish influenza pandemic, which infected one third of the world's population (an estimated 500 million people) and caused approximately 50 million deaths (Figure 1).

Current human cases of H1N1 influenza (formerly called swine influenza) of influenza A (H1N1) have been reported worldwide (Lanari, 2010; Brady, 2010). In 2009, some cases of influenza-like illness (ILI) were first reported in Mexico on March 18; the outbreak was subsequently confirmed as H1N1 influenza A (WHO, 2009). As at May 5th, 2009, nearly 600 H1N1 influenza cases had been confirmed in Mexico, including 25 deaths (CDC, 2009; Cruz-Pacheco, 2009; Eubank, 2004).

Government and public health officials are monitoring this situation worldwide to assess the threat from H1N1 influenza and to provide guidance to health care

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**Figure 1.** Novel H1N1 swine flu.

professionals and the public (GOUYA, 2010). Because the situation is changing rapidly, it is important to check regularly for changes in recommendations as new information becomes available. Online resources for daily guidance include the centers for disease control and prevention (CDC), World Health Organization (WHO), and Medscape's H1N1 Influenza A (swine flu) Alert Center.

This relationship between sport-related physical activity and H1N1 can be studied from a variety of perspectives. Researches have pointed out that moderate exercise and physical activity improve immune system against infectious diseases (Mackinnon, 1999; Ortega, 2008; Klentrou, 2002; Neto, 2011; Agostini, 2010; Verratti, 2009).

The American Medical Society for Sports Medicine has confirmed H1N1 infection among athletes and suggested that the athletes who participate in exercise, competitions, or travel and live together are exposed to H1N1 influenza (Kelsey, 2009). Also, the American Orthopedic Society for Sports Medicine has suggested that these infections are increasing among athletes, and create important and complex problems for sport-medicine practitioners (AMSSM, 2009).

There are few data on risk factors to predict severe cases and deaths associated with this pandemic. The presence of metabolic conditions (such as diabetes and obesity), respiratory diseases, heart disease, infections, immune suppression as well as kidney and liver diseases has been shown to be associated with higher mortality

(Vaillant, 2009). Overweight probably is one of the predisposing factors for H1N1 infection (Christensen, 2009).

Theoretically, there is a high risk of transmission of H1N1 in athletes through participating in competitions (especially in contact sports), exercise, sport environments, traveling and overtraining). Therefore, the present review addressed the following questions:

- 1) What are the overall effects of sport-related physical activity on immune system?
- 2) What are possible ways of H1N1 transmission in sport-related physical activities?
- 3) What are general and special recommendations for prevention of H1N1 in sport-related physical activities?

## METHODS

This research was performed using Medline (1980 to 2009), Iranian National Medical Digital Library and SPORTDiscus (1960 to 2009). The research parameters comprised H1N1, influenza A, swine influenza, sport, athlete, and immune system. The reference lists of all relevant articles and reviews were back searched for additional studies. The World Wide Web, using the Google search engine, was applied for searching the same key words. Studies with data on possible ways of transmitting H1N1 in sport and related methods of prevention were reviewed. There was not any study with a qualified methodology such as randomized clinical trial or cohort. Studies were mainly case reports, the opinion of experts, and consensus statements. Review of these studies suggests that H1N1 may be transmitted in different situations and in different sports, all of which will be discussed in the following parts.

## RESULTS

The included 53 studies yielded a total of 120. These studies have been published between 1980 and 2009. Most of the studies have been conducted in the US, while the rest of them were from different countries such as: Mexico, Spain, Iran, South Africa, Switzerland, the UK, China, Canada, and Australia. Majority of these studies discussed possible ways of transmission and recommendations of H1N1 or the effects of moderate exercise and physical activity on immune system against infectious diseases.

## POSSIBLE WAYS OF TRANSMISSION IN SPORT

Transmission of swine influenza viruses to humans is uncommon. However, the swine influenza virus can be transmitted to humans via contact with infected pigs or environments which are contaminated with swine influenza viruses. Once a human becomes infected, he or she can then spread the virus to other humans, presumably in the same way as seasonal influenza is spread (that is, via coughing or sneezing). Also, outbreak of the H1N1 virus is thought to occur in the same way as

seasonal flu spreads. Flu viruses are spread mainly from person to person through coughing or sneezing of people with influenza. Sometimes people may become infected by touching something – such as a surface or object – with flu viruses on it and then touching their mouth or nose. The basic reproduction number (the average number of other individuals that each infected individual will infect, in a population that has no immunity to the disease) for the 2009 novel H1N1 is estimated to be 1.75 (Balcan, 2009; Eubank, 2004; Leonid, 1985). In other words, H1N1 flu spreads like any other flu virus, mainly from one person to another through coughing or sneezing. In sport areas, athletes may become infected by touching objects or surfaces with flu viruses on them and then touching their mouth or nose. Team staff should educate players and parents of the need for a total cooperation in all aspects of hygiene, and most specifically the need for the prevention of transmission of the H1N1 virus. The staff should create awareness to the players and parents that they may be infected with the virus due to the following issues:

1. The presence of the disease in the stadium or hall due to presence of infected individuals with H1N1;
2. Nonobservance of washing hands routinely before and after handling sport equipment;
3. Nonobservance of covering mouth and nose when coughing and sneezing;
4. Touching their mouth or nose in the sport environment.
5. Overtraining;
6. Participating in contact sports (wrestling, box ...);
7. Lack of attention to assist student-athletes in protecting their immune system by stressing them to get sufficient sleep and proper nutrition;
8. Lack of concern or indifference for getting flu vaccine.
9. Type of sport (contact sports);
10. Weakness in athlete's physical fitness.

## Symptoms

Manifestations of H1N1 influenza (swine flu) are similar to those of seasonal influenza. Patients with symptoms of acute respiratory illnesses including at least two of the following are recommended to consult their health care provider promptly:

1. Fever
2. Cough
3. Sore throat
4. Body aches
5. Headache
6. Chills and fatigue
7. Diarrhea and vomiting (possible).

If an antiviral agent is necessary, it should ideally be

initiated within 48 h from the onset of the symptoms. The duration of illness is typically 4 to 6 days. The infectious period for a confirmed case is defined as 1 day prior to the onset of symptoms to 7 days after the onset. Meanwhile, in children, signs of severe diseases include apnea, tachypnea, dyspnea, cyanosis, dehydration, altered mental status, and extreme irritability (CDC, 2009).

## The differences between H1N1 flu and cold symptoms

### *General recommended steps in a team environment*

The CDC has issued interim recommendations for controlling the spread of H1N1 influenza in health care settings (CDC, 2009; Matin, 2011). Recommended measures for care of patients with suspected or confirmed H1N1 influenza include the following:

The influenza A (H1N1) monovalent vaccine was produced in 2009. The immunization series for this vaccine consist of 2 doses for athletes younger than 10 years, including an initial dose and a booster to be administered for several weeks. Adults and athletes who are at the age of 10 years or older should receive a single dose.

Also, the following target populations are recommended to receive the 2009 H1N1 vaccine: pregnant women, household contacts and caregivers of children younger than 6 months, healthcare and emergency medical services personnel, children aged 6 months to 18 years, young adults aged 19 to 24 years, and people aged 25 to 64 years with high risk of medical complications due to influenza virus. The subsequent suggestions should be taken into account as well:

1. A separate seasonal influenza vaccine may be deemed necessary to be administered for the 2009/2010 influenza season (CDC, 2009);
2. Care should be taken to place the patients in a single-patient room with the door kept closed. An airborne-infection isolation room with negative-pressure air handling, if available, may also be used. Air can be exhausted directly outside or recirculated after filtration by a high efficiency particulate air (HEPA) filter;
3. Suctioning, bronchoscopy, or intubation should be performed in a procedure room with negative-pressure air handling;
4. Patients should wear a surgical mask when outside their room;
5. Patients should be encouraged to wash their hands frequently and to follow respiratory hygiene practices. Cups and other utensils used by the infected should be washed with soap and water prior to the use of other

persons;

6. Routine cleaning and disinfection strategies should be used during influenza seasons;

7. Standard, droplet, and contact precautions should be used in all care-related activities and maintained for 7 days after the onset of illness or until fading of the symptoms;

8. Health care personnel should wash their hands with soap and water or use hand sanitizer immediately after removing gloves and other equipment or after any contact with respiratory secretions;

9. The personnel who provide care to or collect clinical specimens from the patients should wear disposable non-sterile gloves, gowns, and eye protection (for example, goggles) to prevent conjunctiva exposure;

10. Regarding the importance of using masks and respirators during influenza pandemics, it is recommended that the personnel engaged in aerosol-generating activities (that is, collection of clinical specimens, endotracheal intubation, nebulizer treatment, and bronchoscopy) and resuscitation involving emergency intubation or cardiac pulmonary resuscitation wear disposable N95 respirators;

11. Until enlightenment of transmission patterns for the 2009 H1N1 influenza A (swine flu) virus, personnel providing direct patient care for suspected or confirmed individuals should wear a fit-tested disposable N95 respirator when entering patients' room.

### **Steps in a sport environment (specially recommended)**

Team staff should emphasize the need for all the players and their parents to cooperate in all aspects of hygiene and more specifically making an effort to prevent transmission of the H1N1 virus (AMSSM, 2009) (Ehresmann, 1995; Lim, 2010; David, 2010), by doing the following:

1. Players should be urged to report all illnesses to their parents, coach or managers. Parents are urged to keep their children away from a sport environment if it is found with any signs of infectious diseases or viruses. Sick players should be encouraged to see their physician if they show signs or symptoms of the H1N1 virus, and to be fully recovered prior to returning to play;

2. Players should be encouraged to wash their hands with soap and water routinely prior to and after handling sporting equipment. Frequent hand washing with soap and water is one of the best preventions. Teams are encouraged to carry extra hand soaps or hand sanitizers as not all gym and community centers have this readily available;

3. The staff and coaches should talk to their players to cover their mouth and nose when coughing or sneezing using their arm as opposed to their hands;

4. Players should be advised to try and not touch their own mouth or nose when in a sporting environment to reduce the chance of passing an infection onto themselves;

5. All the players and staff should make sure to have their own water bottles name and number on them. Sport drink bottles should be avoided as a direct lip contact may happen when drinking;

6. Officials and coaches should avoid drinking from players water bottles and have water readily available to them on their side;

7. Towels should be removed from all benches. Players should not share towels, clothing, bar soap or other personal items;

8. Athletes should be assisted in protecting their immune system by stressing them to get sufficient sleep and proper nutrition;

9. Players with flu-like symptoms should not participate in sport club gatherings such as practice games or team meetings;

10. Holiday sport clubs should be avoided;

11. Temperature in the sport environment should be standard;

12. Teams and athletes who travel should monitor their health and avoid contact with sick people while traveling.

If a team member or an athlete develops a fever and coughs while travelling, the following steps should be taken:

1. Isolate the person, if possible, from travelling companions;

2. Offer practicing respiratory hygiene by all the individuals, that is, using and throwing away tissues, coughing into a sleeve, washing hands, etc;

3. Inform a health care provider of his or her own symptoms.

Athletes are advised to protect themselves from the Flu by paying an adequate amount of attention to the following issues:

1. They should carry a bottle of hand sanitizer with themselves and use it when soap and water is not available;

2. They should not share water bottles, even with members of their own team. Also, it is suggested that they wash their water bottle often with soap and water;

3. They should keep their team uniforms clean and let their uniform and equipment dry out as best as possible;

4. They should not share other personal items such as pillows, headphones, towels, and other toiletries;

5. They are supposed to bring sandals to wear in the shower and around the residence and pool decks and also avoid walking around in bare feet;

6. The athletes should make sure they are eating properly and getting enough sleep and keeping themselves strong;

7. If they are experiencing symptoms such as shortness of breath, sore throat, fever, cough, muscle pain, and weakness, they ought to let the others know.

There are a number of steps that the supervisors of teams and organizations can undertake to protect their members and help prevent the spread of the H1N1 flu virus. They have frequently been proposed to:

1. Teach athletes and others involved in their team or organization to wash their hands with soap and water for 20 s;
2. Ask athletes to carry hand sanitizer in their sports bags and to use it frequently;
3. Request team members and athletes not to share water or juice bottles, cups or glasses. Ask each athlete or team member to try to use a personal water bottle;
4. Urge them to cough and sneeze into a tissue or into their sleeve or the inside of their elbow;
5. Encourage them to stay at least 2 m (6 feet) away from people who are sick.

## DISCUSSION

There are few data on risk factors to predict severe cases and deaths associated with this pandemic. The presence of metabolic conditions (such as diabetes and obesity), respiratory and heart diseases, immunologic depression, kidney and liver diseases and other infections has been shown to be associated with higher mortality (Vaillant, 2009; Louie, 2011). During an evaluation period which was carried out in the United States, April to June 2009, 73% of the patients had at least one underlying medical condition such as asthma, diabetes, heart, lung and neurologic diseases, and pregnancy (Walker, 2009; CDC, 2010; Mahmoud, 2008; Mahmoud, 2009). During epidemics of seasonal influenza, around 90% of deaths have occurred in the feeble elderly, that is, those who have been suffering from one or more chronic medical conditions. Although influenza can worsen such conditions and contribute to death, testing for influenza viruses is not done in most cases, and deaths are usually attributed to an underlying medical condition (WHO, 2009).

Various data reported that sufferers from heart diseases, diabetes and obese people have largely been at risk of H1N1. About 19% of American adults who had been hospitalized with the H1N1 virus had diabetes, and one in four of them were in need of ICU care (Splete, 2009). Prior to this analysis, CDC had not considered obesity to be an independent risk factor for complications of H1N1 infection. However, the organization is now considering whether obese individuals should be treated differently when they acquire H1N1 and whether immunization protocols ought to differ for obese persons. A study revealed that among 30 H1N1 cases admitted to California hospitals in April and May, 37% had underlying

lung problems and 20% took medications or had other complications that suppressed their immune system.

In this study, four patients had diabetes mellitus which is another condition that predisposes the situation for complications and four of them were obese (CDC, 2009). It is claimed that overweight has probably been one of the predisposing factors for H1N1 infection (Christensen, 2009). Presently, CDC is investigating a number of theories about why obesity may play a role in the severity of influenza infection. Schuchat proposed the mechanism of hypoventilation due to "Pickwickian syndrome" that may increase the pulmonary complications of a respiratory infection (CDC, 2009). Research on animals shows that obesity prevents the body from properly turning on its immune system in response to an infection. For example, when infected with influenza, obese mice are 50% less capable of killing the virus when compared to lean mice.

Moreover, obese mice are ten times more likely to die from influenza infection than mice of normal weight. Obese animals have an impaired ability to express genes and proteins that control several antiviral and pro-inflammatory cytokines, which are essential for dealing with infections in their early stages. Also, they demonstrate deficiencies in the activity of natural killer cells, which are T lymphocytes that limit viral spread by killing infected cells (Smith, 2007). Leptin modulates several parameters of the immune response, including T cell activity, proliferation of white blood cells, and inflammatory activity. Obesity decreases the sensitivity of peripheral tissues to leptin signals and contributes to impaired immunity (Claycombe, 2008).

People with heart diseases, cardiovascular diseases, or with a history of stroke are at increased risk of having medical complications of flu. This idea has arisen special instructions for cardiovascular patients (CDC, 2010). In conjunction with this, there is a lot of information about the effective role of exercise and physical activity on metabolic diseases such as diabetes, cardio respiratory diseases and obesity (Sato, 2005, 2007; Donahoe, 2007).

In sum, numerous other researches have shown that moderate exercise and physical activity improve immune system against infectious diseases (Pedersen, 1998; Gunnar, 2007; Lowder, 2005; Marian, 2004; Kohut, 2002). Along with this, the theory indicates that having physical fitness and proper protection of body with H1N1 vaccination in old age is very useful in the prevention, treatment and management of H1N1 flu (Plasencia, 1992; Smith, 2006; Patricia, 2011).

## Conclusion

Sport-related physical activity has a dual relationship with the H1N1 virus. There is a high risk of transmission of H1N1 in athletes through their involvement in competitions (specialty in contact sports), exercises, sport



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