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# Effect of Warming Up and Cooling-Down on Sports Performance

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## Abstract

Focus of the present investigation was to evaluate the results of the available literature in connection with the effect of warming up and cool down in the overall fitness and performance of the players. According to the physiological chemistry of the human organism, prompt physical performance is always subject to the state of readiness of the person for the action. Prior to participation in sports, physical, mental, psychological, physiological, preparedness is the primary condition for showing optimum performance. Alongside warming up, acclimatization of the player to heat and cold is also a basic factor for showing better performance. The story of the readiness and preparedness revolves round the state of warm-up. Similarly, after active participation in the activity, cooling down performs the job of gradual normalization of the core body temperature, pace of heart beating and respiration. Literature has revealed scarcity of the consensus about a specific type of warming up protocol that may serve well in all types of activities. It is therefore, concluded that additional information based on scientific research is required to resolve this issue. The present research study evaluated various innovations in connection with different types warming up and cooling down protocols, their duration and effectiveness in the field of sports.

**Keywords:** Warming up, Cooling down, Protocol, Temperature, Sports, Player.

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## Introduction

While at rest and not doing any strenuous activity, human organism functions normally and the state of resting homeostats prevails. However, as soon as, any physical activity or strenuous action takes place, different systems and organs of the body begin to work more than normal. Behind execution of all types of movements and actions of the body, stimulation of the combination of different systems of the body what is popularly known as the tripod of life i.e respiratory, neuro-muscular and cardio-skeletal is required. To switch over from the state of homeostats to the active functional state, cardiorespiratory and cardiovascular systems speed up their functioning and the process of metabolism also begins to function more promptly (Gołaś et al., 2017). Prior to starting any strenuous physical activity, getting the organs warmed-up for the forthcomings is the physiological preference of proper functioning of the different organs of the body. The term warmup/warming-up is commonly understood as a brief session of the preparatory physical activities before starting hard physical exertion.

Warmup renders cardiorespiratory and cardiovascular systems ready for hard physical activities in terms of rapid respiration, speeding up blood circulation, increasing blood flow to the muscles and increasing body temperature (Racinais et al., 2017). It is, in fact, getting the body ready for the active physical engagement though preliminary light activities like skipping, jogging, jumping, leaping, exercising etc. In the field of sports, warming up the body is the initial task on part of the player to get optimum functional state of the muscular and cardiovascular systems prior to undertaking the routine activities of related sport (Bishop, 2003; Fradkin et al., 2010). Stimulation of the cardiovascular and musculoskeletal systems and getting them ready for harder physical activities is the ultimate purpose of warming up session (Martens, 2004). Readiness and increase in the $T_{muscle}$ have close relationship, Racinais and Oksa (2010) have concluded that increase of 1 $^{o}$C in the $T_{muscle}$ improves muscular performance from 2-5%.

In normal conditions, different systems of the body function normally however, as and when need for any action or activity arises, nature of functioning of different systems of the body changes accordingly. Warming up is the intervening phase between the normal resting state and active functional condition of the different systems of the body (Bogdanis et al., 2017). Warming up improves the range of motion by following stretching and shortening cycle. To promptly and

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safely meet the additional requirement of the situation, warming up increases intensity of the functioning of various organs progressively from easier to harder. Gradual increase in terms of intensity from easier to harder and slower to faster is the basic principle of warming up protocol. There is common consensus among the coaches and practitioners that warmup renders the muscles ready for the vigorous physical activities and avert muscular sprain likely to occur as a result of overexertion Daneshjoo et al., 2012).

This review study was primarily focused on evaluating the existing body literature in connection with the different studies conducted in perspectives of the role of warming up in improving sports performance and preventing sports injuries. In this context the research work of Baxter et al., 2017; Bishop, 2003; Faulkner et al., 2013; Febbraio et al., 1994; Ferguson et al., 2002; Flouris & Schlader, 2015; Fradkin et al., 2007; Grooms et al., 2013; Koch et al., 2003; Labella et al., 2011; Martens, 2004; McCrary et al., 2015; McMillian et al., 2006; Neiva et al., 2015; Needham et al., 2009; Sawka et al., 2011; Woods et al., 2007; was thoroughly examined and it was found that the role of warming up activities has been well endorsed in the literature.

**Duration of the Warming Up session**

Warming up is the session of preparatory physical activities undertaken before the proper start of the actual activity. There is no specific timing of warming up, however its duration varies from weather to weather, game to game, gender to gender and person to person. In addition to common factors there are a few other factors that also affect the time duration of the warm up like time of warming up, physical status, age and psychological level of the participant. It requires more time in cold as compared to hot areas and similarly the sports activity involving greater amount of strength, speed, flexibility required extended period of time for proper warming the different systems of the body in comparison to the ordinary activities. Similarly, warming up the body takes more time during morning as compared to evening time. Normally, warmup sessions take 10 to 20 minutes before start of the actual activity. Holcomb (2000); Ribeiro et al. (2020) have found that warmup reduces the chances of occurrence of injury and improves physical performance. Acknowledging the significance of warmup, National Association for Sport and Physical Education [NASPE] (2005) and endorses cardiovascular activities tailed by the stretching activities for 5 to 10 minutes before start of competition.

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Experts further recommends that the intervening time between the end of warm up session and start of the actual competition should be between 3 to 5 minutes.

**The Physiology of Warming Up**

Temperature is the core factor between warming up and performance, increase in the muscles temperature leads to enhanced performance. Research has confirmed that increase in the body temperature has positive effect upon high intensity muscular performance between a few seconds up to five minutes (Faulkner et al., 2013). In another study Chiesa et al. (2015) have concluded that increase in the muscles temperature improves muscle force and power production, enhanced blood flow to the muscles. Increased metabolic rate and prompt supply of energy to the working muscles are also associated with the increased internal temperature of the body (Gray et al., 2006). In addition to the above, a few studies have emphasized upon the metabolic significance of warming up activities in terms of improving sports performance (Baxter et al., 2017). Literature also confirms that warming up like activity has been intact with the sports since ancient days Racinais et al., 2017).

**Types of Warming Up**

The nature and type of warming up exercises differ from person to person and situation to situation. Simple swinging arms and slightly twisting the body is a type of warming up activity for a common sedentary person, brisk walking and jogging is a type of warming up activity for partially active one and walking, running, doing stretching exercises and jumping are the warming up activities for an active player (Fradkin et al., 2010). Technically, warming up activities are divided into two distinct methods, Active and Passive types of warming up activities. Active method is further subdivided into three types which are detailed as follows:

The first type of warming up activities comprises of the stretching exercises to render the big muscles of the body ready for the strenuous exertion. It is also called general warm up.

Aerobic exercises of light to moderate intensity causing increase in the body temperature and cardiorespiratory functioning is the next type of warming up exercises. This type of warming up activities are called dynamic warming up. The third type of warming up exercises is activity-specific and more exactly skill-specific rather than doing general warming up exercises. Activation of the neuromuscular coordination focusing the main skills of the activity is the basic

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purpose of this type of warm up and it is commonly preferred in the sporting fraternity. In this type, a Javelin-thrower, for example, tries to stimulate arm and thigh muscles rather than practicing running or jumping activities.

Passive warming up is the second method of warming up which has nothing to do with the active physical activities or engagement of the person. To increase temperature of the body and get the person ready for the activity, external heating sources of different types are used for this purpose Rössler et al., 2018). This method is basically associated with the employment of the external means like massage, steam-bath "sauna", hot showers and heating pads. The method of passive warming up is not an ideal one for the healthy players however, if a is player is having physical limitation, they may use this method.

**The concept of "RAMP" protocol**

In technical perspectives, the sequence and execution format of RAMP serve the purpose of warming up the person for the vigorous proceedings. Research has confirmed the validity and utility of the RAMP protocol in terms of getting the players ready for the active competition (Jeffreys, 2006). The term RAMP is an umbrella term which stands for Raise, Activate, Mobilize and Potentiate or Performance

**R** stands for **Raise**, which stands for raising the core temperature ($T_{core}$), muscles temperature ($T_m$), heart rate, blood flow, respiration and increase the range of motion at main joints of the body.

**A** stands for **Activation**, which means getting ready for the proceeding strenuous activities.

**M** stands for **Mobilization**, which refers to the stimulation of different organs regarding skill related movements.

**P** means to **Potentiate**, which refers to put progressive load upon different organs and parts of the body to make it ready for the actual activity.

**Benefits of Warming Up**

In general, light cardiovascular workouts and stretching activities are included in the warmup sessions. These two types of exercises serve different purposes; cardiovascular, also called aerobics, increase pace of heart, body temperature and speed up blood circulation whereas stretching activities prepare the muscles for the forthcoming hard activities and prevent possible injuries. The primary objective of all activities included in the warming up regimen is to

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increase the body temperature and tune it in line with the main activities intended to be performed in the proceedings. All types of strenuous, explosive and activities of heavy nature can only be performed safely only if muscles are properly warmed up and ready for it. Besides physical preparation of the player, it also renders the person psychologically ready for the active competition. Bishop (2003); Fermino et al. (2005); Racinais and Oksa (2010) have concluded that the main function of warming up activities is to raise the body's temperature, increase mobility of joints, metabolism process and speed up blood flow to the working muscles of the body. Literature has documented a number of performance related potential benefits of warming up including avoiding injuries by increasing muscles temperature ($T_m$) and flexibility of joints (Rodrigues et al. (2020); Sawka et al., 2011). Referring to the potential role of warming up in enhancing sports performance it was concluded in a meta-analyses of the literature in 2010 that prompt and safe performance was associated with proper warm ups (Aj, Fradkin et al., 2010).

Quin et al. (2015); Subasi et al. (2008) have concluded that the first and foremost effect of warming up reflects in shape of increased heart rate resulting in increased oxygen exchange enabling the muscles to perform efficiently. Increase reaction time and efficient energy production and exchange as a result of prompt metabolism facilitate activities of different nature and intensity. It has been well established that, on account of increased muscles temperature, increased cardiac output, prompt blood supply, there is increased joints mobility, greater range of motion and there is minimal chances of injury and muscle stiffness (Baechle & Earle, 2008; Brunner-Ziegler et al., 2011; Malliou et al., 2007; Racinais & Oksa, 2010). Notwithstanding, the most positive role of warming up in sports performance there still gap of proper investigation in perspectives of designing a composite warming up protocol, determining the factors contributing to strength and force production (Fradkin et al., 2010; McGowan et al., 2015).

**Nature and Concept of Cooling Down**

Apart from the nature and types of the cooling down modalities, refueling the body with water or any other suitable liquid supplement or sports-drink after the activity has paramount significance in recovering and refreshing the body (Coso et al., 2008). Hydration is the most vital element in terms of restoration of the normal hemostats of the person after physical exertion.

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Warming up, main training activities and cool down are the three basic phases of training Powers and Howley (2007). It has always been advisable not to start the activity without warming up the body and similarly not to apply abrupt pause to the activity rather keeping the activity in progress in lighter mode and bringing gradual decrease in the functional intensity of the different systems of the body. Moving, walking or jogging on the spot are ideal activities for cooling down the active functional status of the body (Frey, 2018). While performing any vigorous physical activity, functional intensity of the respiratory, neuro-muscular and cardio-skeletal systems of the body increases many fold. After completing the activity, physiology of the human organism requires to gradually bring the systems back to normal mode of functioning (Cook & Beaven, 2013; Van Hooren & Peake, 2018). Cooling down does this important job by normalizing the internal working environment of the body. A cool down after active physical engagement brings about gradual decrease at the end of the activity (Olsen et al., 2012). Commonly it is called cool down or warm-down.

Literature has confirmed that after hard physical exertion or competition, doing physical activity of light to moderate intensity from 10-15 minutes plays significant role in the recovery and normalizing the mode of functioning of various systems of the body (Crowther et al., 2017; Popp et al., 2017; Tavares et al., 2017). With reference to cooling down, one thing is decided that its story revolves round normalizing the heart rate, decreasing the body temperature and relaxing the state of muscular stress (Brooks et al., 2000). Normally, after participation in exhausting physical engagement, body feels tightness, pains and cramps after a day or two. However, this type of painful situation can be minimized if proper active cooling down activities are performed after active engagement (Rössler et al., 2018).

**Types of Cooling Down**

Active and passive are the two main types of cooling down followed in sports. Generally, during active cooling down, player follows different light exercises of low to moderate intensity within one hour of the termination of the main activity like competition or a training session. Duration of the cooling down activities varies from person to person and activity to activity however, 4-10 minutes is considered as sufficient for majority of the cases. On the other hand, passive cooling down comprises of the indirect external modalities and application of additional outer sources

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that lower the core body temperature and heart beat without active physical involvement of the player. (Bogdanis et al., 2017). have concluded that, in comparison to the passive cooling down, it is commonly believed that active cooling down has a number of more physiological benefits like quick restoration of the heart rate, promoting post-exercise recovery, faster muscles relaxation and prompt elimination of metabolic wastes.

Common modalities followed in passive cooling down are as follow:

1. Steam bath
2. Massage
3. Hot-water therapy
4. Cold-water immersion
5. Compression garments
6. Static stretching
7. Body vibration therapy

**DISCUSSION**

Literature has confirmed the vibrant and positive role of warming up in safe and affective physical activities either it is the field of sports or everyday life. Similarly, bulk of literature also supports the role of cooling down in normalizing the functional state of different systems of the body (Krzysztofik & Wilk 2020). Focus of the present investigation was to evaluate the results of the available literature in connection with the effect of warming up and cool down in the overall fitness and performance of the players. Research has confirmed that warming up boosts performance, ensures safety of the player by avoiding injuries and improves quality of fitness (Ribeiro et al., 2020). One thing noticed in the studies evaluated during this investigation revealed that the nature, type, duration and intensity of the warming up activities differ from study to study therefore their outcomes also vary from study to study. The most commonly followed types of warming up include specific warm-up, general warm-up, and stretching warm-up. Rodrigues et al. (2020) have concluded that activity focused specific warm-up is likely to produce comparatively positive results in comparison to other forms of warming up activities.

Ribeiro and Romanzini (2014) also conducted a study evaluating the effect of different types of warning up on the performance during the resistance activities. The study confirmed two things; first, no significant difference was observed in the effect of the three different types of warming up activities in perspectives of performance during the resistance activities; secondly,

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it was also confirmed that none of three types of warming up protocols contributes to the development of strength among the participants. Literature has confirmed a number of positive effects and performance related benefits of warming up prior to resistance training (McGowan et al., 2015). Another study conducted by Abad et al. (2011) has concluded that in comparison to specific warming up, a combined warming up has more benefits in the field of action sports.

**Conclusion**

Alongside sports, both warm-up and cool down have got vital role particularly in all activities involving physical exertions. The principal advantage of warming up is associated with the increase in the muscular temperature which is alternately linked with the increased heart rate and rapid respiration; they all demonstrate the state of readiness for the coming exertions. However, in addition to raising body core temperature, a sound warming up protocol pay due consideration to the non-temperature aspects of performance including mental and psychological readiness of the participant. Research has confirmed the benefits of warming up irrespective of the weather condition either it is cold or hot; during cold environment warming up increases core body temperature and renders the body ready for performance while in hot environment, it adds to the adaptation capacity of the muscles to acclimatize with the hot environment before performance. After completing the activity, physiology of the human organism requires to gradually bring the systems back to normal mode of functioning. Cooling down does this important job by normalizing the internal working environment of the body. A cool down after active physical engagement brings about gradual decrease at the end of the activity. Further in-depth investigation is required to enhance the understanding with reference to the type, nature, duration and effectiveness of the warming up as well as cooling down in the field of sports.

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