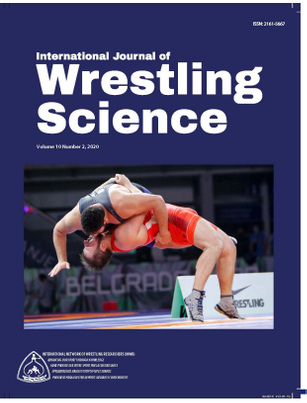

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Commentary

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Commentary

PREVENTION OF HEAT EXHAUSTION: FOCUS ON WRESTLING

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INTRODUCTION

Of the several sports in which competitors are grouped according to body weight (wrestling, judo, weightlifting, boxing) wrestling is the most popular. Not only is the number of participants greater in wrestling, but the number and frequency of matches is far greater during each season for wrestlers. Wrestlers often adopt dangerous weight loss practices at a young age (Gibbs, 2009). It has been estimated that outstanding wrestlers will "make weight" 20 to 30 times each season and will likely repeat this process 200 times during their careers. Medical researchers, sports medicine physicians, athletic trainers, coaches and parents have raised concerns about not only the immediate and short-term effects of repeated occurrences of making weight, but the possible long-term effects of repeated episodes of food and water deprivation.

THE SCOPE OF THE PROBLEM

Of particular concern are the immediate and short-term consequences of food and water deprivation in wrestlers during the off-season summer matches. Whereas scholastic and collegiate wrestling is a fall-winter sport with environmental conditions of temperature and humidity less hostile, the environmental conditions during off-season tournaments are often difficult if not dangerous. Ambient temperatures not infrequently approach or exceed normal body temperatures and relative humidities in the gym are often 50 to 90%. Since dehydration is the quickest and by far the most frequent method used by wrestlers to "make weight", thermal regulation and control in a dehydrated, glycogen depleted wrestler in unfriendly environmental conditions is often compromised and should be of concern.

To better understand the problem of temperature regulation, a brief review the normal physiology and the pathophysiology of heat related injury is necessary. The human body has a magnificent thermal regulatory system capable of maintaining thermal balance throughout a wide range of conditions. The system can compensate for an extremely wide range of external temperature (skiers at less than 0 degrees Celsius and runners at greater than 37 degrees Celsius) but the system can fail to maintain the core temperature within a normal range when the body's ability to either conserve or dissipate heat has been compromised.

Heat Production

At rest, the average heat production resulting from normal body function is approximately 72 Kcal per hour. During strenuous exercise (since even the best athletes work at only 30% efficiency) heat production can reach 600 Kcal per hour.

Heat Loss

The heat production must be balanced by an equal amount of heat loss. Four mechanisms are available for dissipating heat – radiation, conduction, convection, and evaporation (Armstrong 2007). Loss through radiation in the form of infra-red rays accounts for 60 percent of total heat loss at rest. Conduction, the transfer of heat directly to an object (such as a chair or wrestling mat) accounts for 3 percent at rest. Convection, the transfer of heat to air or water is responsible for 12 percent at rest and is improved with the movement of air. Evaporation (sweating) accounts for 25 percent of heat loss at rest.

During exercise, however, evaporation becomes the major mechanism for heat loss. Sweating can be effective only if the sweat evaporates on the skin. Dripping drenching sweat serves only to increase water loss and does little to dissipate heat. To evaporate, the ambient temperature must be lower than the body temperature and the humidity must be lower than the humidity at the skin surface. Finally, the movement of air across the surface of the skin will aid evaporation.

Training and acclimation will improve the efficiency if sweating is a mechanism for heat loss.

Thermal Regulation

The temperature regulatory center is located in the hypothalamus. The responses to heat are controlled primarily by heat sensitive neurons in the anterior hypothalamus, while responses to cold are controlled by the posterior thalamus. Overheating of the anterior hypothalamus will stimulate the heat loss mechanisms primarily by increasing the production of sweat resulting in increased evaporative heat loss. Additionally, the vasomotor

center is inhibited, removing the normal constriction of the skin vessels allowing an increase in heat loss through the skin.

The hypothalamus functions as the body hemostat and initiates heat production or heat loss whenever the core temperature goes above or below the “set point”. Peripheral sensors play a minor role in the problems of heat loss and a more important role in heat conservation.

Environmental Factors
The effective heat dissipation process depends not only on internal regulation but, as mentioned earlier, on ambient temperature, humidity, air movement, and radiation. Measurement of ambient dry bulb temperature alone is inadequate to fully evaluate the effect of environment.

The measurement of wet bulb temperature has been accepted as the standard for estimating the environmental effect on thermal regulation (Budd, 2008). A system of color-coded flags used to indicate the risk of thermal stress has been adopted by the American College of Sports Medicine (Armstrong 2007). The W.B.G.T. index is calculated by ensuring the ambient temperature with a dry bulb thermometer, a wet bulb temperature with a water saturated thermometer and a black globe temperature with a thermometer encased within a black painted globe.

W.B.G.T. = 0.7 wet bulb temperature + 0.2 black globe temperature + 0.1 dry bulb temperature.
The importance of the wet bulb temperature (indicating the effect of humidity) can be appreciated since it accounts for 70 percent of the index.

Table 1. W.B.G.T. Index for Physical Activities

W.B.G.T. above 76 degrees F.	Utilize discretion (**Yellow** signal flag)
W.B.G.T. above 82 degrees F.	Avoid strenuous activity (**Red** signal flag)
W.B.G.T. above 86 degrees F.	Cease physical activity (**Black** signal flag)

* Adapted from American College of Sports Medicine

FOCUS ON WRESTLING
The importance of hydration can be implied from the understanding that the major mechanism for heat dissipation during exercise is the production of sweat with a resulting loss of body fluid. Adequate hydration thus, is critical to effective thermal regulation. In wrestling, however, adequate hydration is problematical. Unfortunately, many wrestlers do not understand body composition, lean body mass and body fat and in their attempts to lose weight opt for the “quick fix” (Walker, 2020). Rather than utilize the caloric reduction/ exercise approach, they utilize the dehydration approach – a combination of fluid restriction and sweat loss accelerated by exercise in a hot environment. Most weight is loss the day before competition and several studies have shown the average loss to be approximately 7 pounds. Clearly weight loss of this amount in a short period of time is strictly fluid loss. But, completely replenishing body fluids may take 24 to 48 hours (Case, 2016).

It has been shown that the body fat of wrestlers did not change during the week that they lost five percent of body weight. So, wrestlers who need to make weight usually do so through dehydration (Walker, 2020). At the time of weigh-in they are dehydrated. Can adequate replenishment of body fluids be accomplished between the weigh-in and competition? Every study published indicates that the answer to this question is NO (Convertino, 1996).

Klinzing and Karpowicz (1986) at Cleveland State University studied the effect of a 50-hour 5 percent weight loss on performance as measured by a test requiring many of the same performance factors as wrestling. Seven subjects were administered the test four times including: after no weight loss, immediately, one hour and four hours after making the 5 percent weight loss. The subjects regained 22 and 44 percent of their lost weight in one and in five hours respectively. Performance was significantly less when the test was taken immediately after making weight, somewhat improved at one hour but still significantly less than at the five-hour performance test. Performance scores retuned to baseline levels after adlib fluid and food consumption.

RECOMMENDATIONS
The question of long- term effects of repeated episodes of acute and chronic dehydration aside, since the data are not clear on this subject, we have legitimate concerns about the acute effects in wrestlers particularly during the off-season summer tournaments. Are there any recommendations that could be adopted to decrease the potential of thermal stress and injury?

A. Clearly the adoption of the W.B.G.T. index is a readily available recommendations with precautions taken in the event of yellow (76-82 degrees F.), red (82-85.9 degrees F.), and black (86 degrees F. or higher). For example, when the W.B.G.T. index is greater than 86 degrees F. all physical activity should be stopped.

B. Should the time of weigh-ins be changed? Presently, weigh-in 2 hours prior to competition may not be long enough to allow rehydration – perhaps 5 hours should be allowed.
C. Should wrestlers be required to make weight for the second consecutive day of wrestling or should an initial single weigh-in be adequate?

Our primary goal is the prevention of injury through education (Hudson 2003). There is no legitimate reason for our young men to risk heat exhaustion or heat stroke and our own efforts in education and regulation should be directed to their welfare. All administrative policies should be directed to their welfare. All administrative policies should be directed toward decreasing the risk of injury to our athletes, e.g. postponement or delay of tournaments, scheduling of matches in compliance with environmental conditions and flexibility in weigh-in regulations.

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