

## ORIGINAL RESEARCH PAPER

# AMATEUR AND PROFESSIONAL ICE HOCKEY PLAYER HYDRATION STATUS AND URINE SPECIFIC GRAVITY VALUES BEFORE AND AFTER TRAINING IN WINTER CONDITIONS

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## Abstract

*The aim of our investigation was to determine and compare the pre- and post- training body hydration status in professional and amateur male ice hockey players consumed the drinks according to their thirst sensation in winter conditions. Materials and methods: 11 amateur and 23 professional ice hockey players participated in the investigation. The players were weighted before and after training using precise scales. The body mass composition of every athlete was determined by the body composition analyzer. Every player collected mid-stream urine specimens before and after the training. Urine specific gravity (USG) was measured by urine refractometer. Results: 56% of the professional ice hockey players and 82% of amateur players were hypohydrated before training according to their USG values  $\geq 1.020$ , 5% of professional players were dehydrated their USG values  $\geq 1.030$ . After the training with duration of 1.5 hours the mean body mass decreased for  $0.9 \pm 0.5\%$  of pre-training value in amateur players and for  $1.6 \pm 0.8\%$  in professionals ( $p=0.005$ ). After the training the professional players' hydration status worsened: 66% were hypohydrated and 26% dehydrated according to USG, the mean USG after training was significantly higher than before it ( $p=0.011$ ). USG after training did not change in amateur players: their mean USG values before and after training did not differ significantly ( $p=0.677$ ). Conclusions: Fluid uptake according to thirst sensation in winter conditions cannot compensate the fluid loss at rest and during training especially in professional ice hockey players. The body mass loss exceeded value critical for performance - 2 % in one third part of professionals. The differences between two groups can be explained by higher intensity of exercises during training, the better physical conditioning and greater sweating rate in professional players in*

*comparison with amateurs, which causes close to twice greater uncompensated fluid loss in professionals than in amateurs.*

**Key words:** *hydration status, urine specific gravity, urine refractometry, ice hockey players*

## **Introduction**

Recent research data in team sports, such as soccer, football, and basketball, have shown that a body mass (BM) loss of 2% decreased skill performance (Edwards et al. 2007; Maughan 2003; Shirreffs S. (2010)). The BM loss in hockey players did not reach 2% in the investigations available in literature (Logan-Sprenger H.M., Palmer M.S. and Spriet L.L., 2011). Incomplete replacement of fluid losses during prolonged exercise can lead to exaggerated increases in heart rate, core temperature, and perceived exertion, and decreases in stroke volume and cardiac output with as little as a 1% loss of pre exercise body mass (Montain, S.J. and Coyle, E.F. 1992).

One would speculate that the relatively cool micro-environment of a hockey arena (~10°C) would reduce sweating. However, the equipment worn, which allows only the face to be exposed for sweat evaporation, coupled with the very high intensity of the intermittent exercise elicits high sweat rates and the potential for hypohydration (Godek, S.F., Godek, J.J., McCrossin, J. and Bartolozzi, A.R. 2006; Palmer Matthew S. and Spriet Lawrence L. 2008). The fluid loss during exercises for sport games players depends not only on climatic conditions, but is proportional to many other factors, such as: exercise intensity, the athlete's acclimatization, the athlete's physical conditioning, physiologic individual characteristics and the player's biomechanics (Maughan RJ, Leiper JB., 1994; Monteiro C.R., Guerra I., Barros T.L., 2003). The rate of sweat loss will also depend on genetic differences, the aerobic fitness status of the player, and the player's hydration status (Logan-Sprenger H.M., Palmer M.S., and Spriet L.L. (2011).

Palmer Matthew S., Logan Heather M., and Spriet Lawrence L. (2010) were unaware of any studies that have examined the repeatability of the hydration status measures on different test days in the same population. Recent field research reported that elite junior and professional (Palmer Matthew S. and Spriet Lawrence L. (2008) ice hockey players choose to drink water over a carbohydrate–electrolyte solution (CES) during on-ice practices when left to make their own drink selection. The ingestion of carbohydrate in a drink has been shown to delay fatigue and improve performance, compared with a placebo, when ingested during moderate

intensity endurance exercise (Coyle, E.F. 2004), and as such could be beneficial for hockey players during on-ice practices. When athletes exercise during training or while competing, it is clear that they sometimes benefit by ingesting various mixtures of water, carbohydrate and electrolytes (Casa D.J., Armstrong L.E., Hillman S.K., Montain S.J., Reiff R.V., Rich B.S.E., Roberts W.O., Stone J.A., (2000); Coyle, E.F. 2004). The benefits can be expressed through improved performance and/or reduced physiological stress, on an athlete's cardiovascular, central nervous and muscular systems. Although the scientific evidence exists to support the general theory for encouraging athletes to consume water, carbohydrate and electrolytes during exercise, the practical recommendations for optimally applying these general theories is not simple. This is due to the quite varied nature of the physical stresses encountered during training and competition for a wide range of sports, as well as the unique rules of each sport regarding the allowance for fluid and fuel intake during competition (Coyle, E.F. 2004).

It has been known that when given *ad libitum* access to fluid, and thus drink voluntarily, that these mechanisms compel people to drink at a rate that replaces approximately one-half of their fluid losses and at best two-thirds (Coyle, E.F. 2004). The concept that thirst during exercise does not drive people to take in fluid at the rate of fluid loss is termed 'voluntary dehydration'. In the 1960s, athletes were generally advised 'to drink only a little water during exercise' and to 'ignore their thirst' and to thus replace a small percentage of lost fluid. It is unrealistic to expect that brief guidelines, which are naturally general, can be practically used by all athletes in all sports under all conditions (Coyle, E.F. 2004).

It is important to point out that unrestricted drinking that causes initially euhydrated people to gain large amounts of body weight and body water should be discouraged. Coyle, E.F. (2004) has reported that dehydration without hyperthermia reduces stroke volume by 7–8% and that hyperthermia without dehydration also reduces stroke volume by 7–8%. However, the combination of dehydration and hyperthermia elicits synergistic effects in reducing stroke volume by more than 20%. Competitive athletes exercising at high intensity in sports such as running, cycling and soccer have high rates of heat production that require dissipation to the environment to prevent progressive heat storage and elevation of core temperature to above 39°C (Coyle, E.F. 2004).

The aim of our investigation was to determine and compare the pre- and post- training body hydration status in professional and amateur male

ice hockey players consumed the drinks according to their thirst sensation in winter conditions.

## Material and methods

*Subjects.* 34 male ice hockey players (11 amateur and 23 professional) participated in our research. The anthropometrical data of the amateur player group were: the mean age  $33.27 \pm 9.5$  years, mean height  $1.815 \pm 0.095$ m, mean weight  $92.6 \pm 14.7$ kg and mean BMI  $28.0 \pm 3.7$ kg/m<sup>2</sup>. The one's of the professional player group were: the mean age  $18.0 \pm 0.6$  years, mean height  $1.812 \pm 0.058$ m, mean weight  $78.9 \pm 7.7$ kg and mean BMI  $24.0 \pm 2.0$ kg/m<sup>2</sup>. The investigation was proved by the Ethics Comity of the Latvian Academy of Sports Education.

*Methods.* The anthropometric data were collected before the training. The ice hockey players were weighed using special scales Midrics1 (Sartorius, Germany) with precision 10g and maximal weight of measurement 150kg. The weighing of the athletes was repeated after training with duration of one and half hours. Before the training ice hockey players' body mass composition was tested using the body composition analyzer BC-545 (Tanita, Japan).

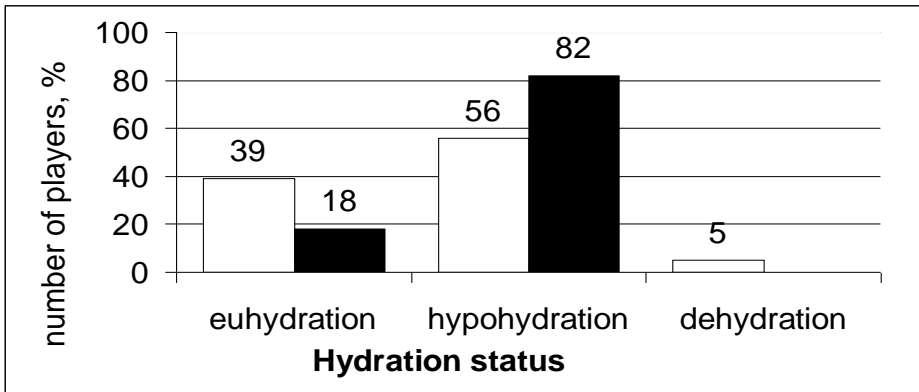
Every athlete collected mid-stream specimens of urine before and after the training. Urine samples were collected in 15 ml sterile tubes (Sarsted Aktiengesellschaft & Co, Germany). Urine specific gravity (USG) was measured by urine refractometer PAL – 10S (Atago, USA) with precision  $\pm 0.001$ , at  $\pm 0.1^{\circ}$ C. The players were weighed using special scales Midrics1 (Sartorius, Germany) after the training again.

The evaluation of the athlete hydration degree was performed by using National Athletic Trainers' Association and American College of Sports Medicine used scale, were USG under 1.020 means euhydration, USG in range 1.020 – 1.029 means hypohydration and USG equal or higher than 1.030 means serious hypohydration (Casa D.J., Armstrong L.E., Hillman S.K., Montain S.J., Reiff R.V., Rich B.S.E., Roberts W.O., Stone J.A., 2000). Every ice hockey player could uptake mineral water or sports drinks during the training without any limitation. The duration of training was 1.5 hours. The SPSS version 20 program was used for statistical analysis of the data.

## Results

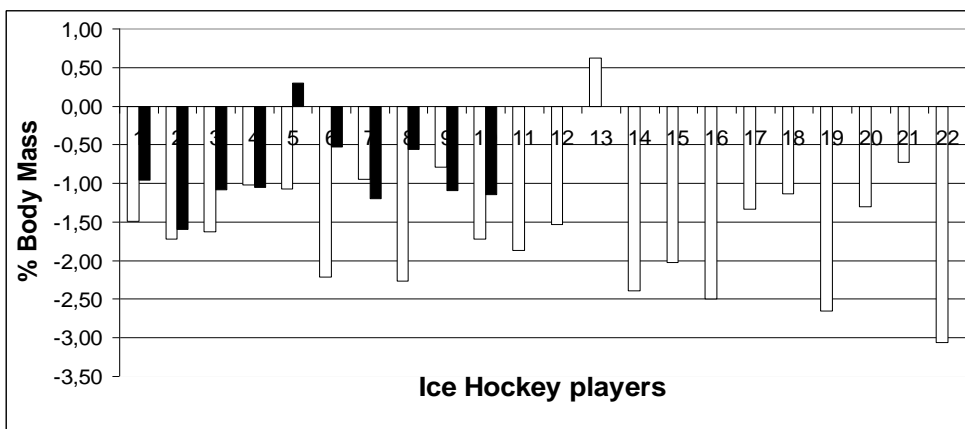
More than half of professional ice hockey players (56%) and greatest number (82%) of amateur players were hypohydrated before training according to their to USG values  $\geq 1.020$ , Fig.1. Five percent of professional

players were seriously dehydrated before the training,  $USG \geq 1.030$ . The mean USG value before the training in amateurs was  $1.021 \pm 0.004$  and in the professionals –  $1.020 \pm 0.008$ . The difference between both groups of hockey players was not significant ( $p=0.486$ ).



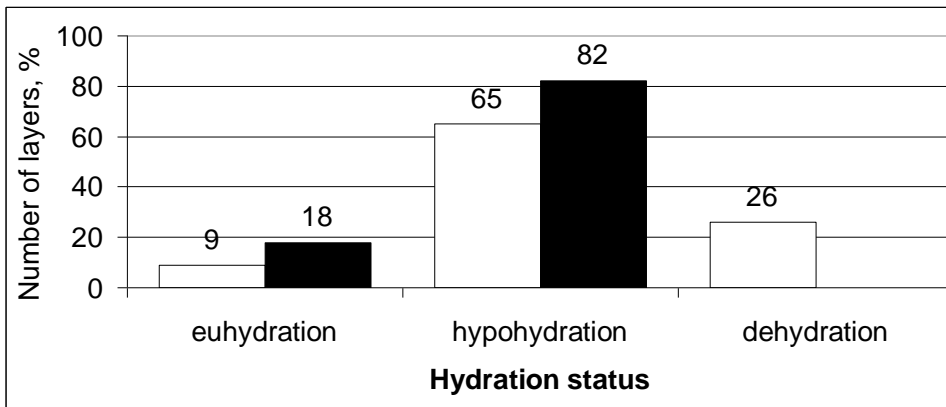
**Figure 1.** Hydration state of professional (□) and amateur (■) ice hockey players' before training from the data of USG

The mean body mass decreased for  $0.9 \pm 0.5\%$  in amateur players and for  $1.6 \pm 0.8\%$  in professionals, the difference between the groups is significant ( $p=0.005$ ). The body mass changed after training in comparison with the mass before the training in every athlete, this is shown in Fig.2. The body mass loss exceeded 2 % from pre- training value in seven professional players and was greater than 3 % in one professional player.



**Figure 2.** Changes of every ice hockey player body mass after training in comparison with the mass before training, professional (□) and amateur (■) ice hockey players

The mean USG value after the training in amateurs was  $1.022 \pm 0.005$  and in professionals –  $1.025 \pm 0.006$  ( $p=0.095$ ). After the training the professional players' hydration status worsened: 65 % were hypohydrated and 26% seriously dehydrated according to USG values (Fig.3.), the mean USG after training was significantly higher than before it ( $p=0.011$ ). The mean USG after training did not change in amateur players: their mean USG values before and after training did not differ significantly ( $p=0.677$ ) before and after training. Nobody of amateur players was seriously dehydrated after training, Fig.3.



**Figure 3.** Hydration state of professional (□) and amateur (■) ice hockey players' after training from the data of USG

## Discussion

Our data of the mean pre – practice USG indicating mild hypohydration ( $1.021 \pm 0.004$  in amateurs and  $1.020 \pm 0.008$  in professionals) are in good agreement with results obtained in junior ice hockey players where the mean pre-practice USG was  $1.020 \pm 0.001$  (Palmer Matthew S. and Spriet Lawrence L., 2008). In Palmer Matthew S. and Spriet Lawrence L. (2008) research, large number of ice hockey players arrived at practice well hydrated ( $n = 20$ ), but over 50% ( $n = 24$ ) were hypohydrated to varying extents prior to practice - 11 players had the USG between 1.021 and 1.025, in 12 players USG values were between 1.026 and 1.030, and one player USG was greater than  $> 1.030$ . In our case, pre-practice situation of ice hockey players was worse – more than 80% of tested amateur ice hockey players and 56 % of professional players were hypohydrated before practice, five percents of professional athletes were seriously dehydrated before the training (see Fig.1). This could be explained by inadequate nutritional and fluid intake habits in our athletes.

A different situation was in the study of junior ice hockey players performed by Logan-Sprenger H.M., Palmer M.S., and Spriet L.L. (2011), where pre - game urine sample USG analyses showed that on average players arrived at the rink in euhydrated state (USG  $1.016 \pm 0.002$ ). Mean USG for forwards was  $1.016 \pm 0.004$  and for defense players -  $1.016 \pm 0.004$ . However, of the 22 skaters, 41% (3/7 defense, 6/15 forwards) arrived hypohydrated (USG  $\geq 1.020$ ). Both goalies arrived at the game well hydrated with a USG of  $1.015 \pm 0.002$ . In our research pre-practice hydration data were worse may be due to the opinion of old generation Latvian ice hockey coaches to restrict the uptake of water or drinks during the training and the game and asking to ignore the thirst sensation in players. This leads to more expressed hypohydration and dehydration of athletes which can cause decrease of their performance. The research of body hydration in ice hockey players is rather new in Latvia. Therefore it is necessary to educate coaches and athletes about importance of well hydrated body.

Palmer Matthew S. and Spriet Lawrence L. (2008) reported that the mean body mass loss of the players during the training was  $0.8\% \pm 0.1\%$ . However, 13 players lost between one to two percents of body mass, and body mass decrease in one player exceeded two percents. In our research the mean changes in the body mass were:  $0.9 \pm 0.5\%$  in amateurs and close to twice greater -  $1.6 \pm 0.8\%$  in professionals, the difference between the groups was statistically significant ( $p=0.005$ ). The differences between the professional and amateur ice hockey players can be explained by higher intensity of exercises during training, the better athlete's physical conditioning and greater sweating rate in professional players in comparison with amateurs, which causes close to twice greater uncompensated fluid loss in professionals than in amateurs. Shirreffs (2010) suggested that soccer players to avoid decrease in physical performance should limit the degree of dehydration to less than 2% decrease of the pre- practice body mass. From our data the body mass loss exceeded 2% in seven from 23 or close to one third part of professional ice hockey players. This proved that fluid uptake during training was not sufficient to compensate sweat losses and may be to maintain performance. The body mass decrease was greater than 1.5% only in one amateur player. This allowed us to suggest that the hydration status of amateur players during the game was not so critical to affect their performance.

This is very important to personalize the recommendations for athletes (especially in professional players) taking into account the information about environment (temperature and relative humidity, solar load and

altitude above sea level), athletes' body composition, sweating rate and salt concentration in sweat, athletes diet and physical activity (duration and intensity) as well as taking into account fluid consumption possibilities (how often the athletes will be able to consume fluid, when next practice or competition round will happen), athletes clothing and adaptation level.

## Conclusions

1. More than half (56 %) of the professional ice hockey players and 82% of amateur players were hypohydrated before training according to their USG values  $\geq 1.020$ , 5% of professional players were seriously dehydrated their USG values  $\geq 1.030$ . This confirms that fluid uptake according to their thirst sensation in winter conditions cannot compensate the fluid loss at rest.
2. After the training with duration of 1.5 hours the mean body mass decreased for  $0.9 \pm 0.5\%$  of pre-training value in amateur players and for  $1.6 \pm 0.8\%$  in professionals, the difference is significant ( $p=0.005$ ). The body mass loss exceeded value critical for performance - 2 % in one third part of professionals. After the training the professional players' hydration status worsened: 66% were hypohydrated and 26% seriously dehydrated according to USG values, the mean USG after training was significantly higher than before it ( $p=0.011$ ). USG after training did not change in amateur players: their mean USG values before and after training did not differ significantly ( $p=0.677$ ). The differences can be explained by higher intensity of exercises during training, the better physical conditioning and greater sweating rate in professional players in comparison with amateurs, which causes close to twice greater uncompensated fluid loss in professionals than in amateurs.

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