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Article Title: Estimated Sweat Loss, Fluid and CHO Intake, and Sodium Balance of Male Major Junior, AHL, and NHL Players During On-Ice Practices

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Running Head: Hydration habits in elite male ice hockey players

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Estimated sweat loss, fluid and CHO intake, and sodium balance of male Major Junior, AHL, and NHL players during on-ice practices

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ABSTRACT

Several previous studies have reported performance decrements in team sport athletes that dehydrated ~1.5-2% of their body mass (BM) through sweating. This study measured on-ice sweat loss, fluid intake, sodium balance, and carbohydrate (CHO) intake of 77 major junior (JR) (19 ± 1 yr), 60 American Hockey League (AHL) (24 ± 4 yr), and 77 National Hockey League (NHL) (27 ± 5 yr) players. Sweat loss was calculated from pre- and post-exercise BM, plus fluid intake, minus urine loss. AHL (2.03 ± 0.62 L/hr) and NHL (2.02 ± 0.74 L/hr) players had higher sweat rates ($p < 0.05$) than JR players (1.63 ± 0.58 L/hr). AHL ($1.23 \pm 0.69\%$; $p = 0.006$) and NHL ($1.29 \pm 0.63\%$; $p < 0.001$) players had ~30% greater BM losses than JR ($0.89 \pm 0.57\%$) players. There was no difference in fluid intake between groups ($p > 0.05$). Sodium deficits (sodium loss - intake) were greater ($p < 0.05$) in AHL (1.68 ± 0.74 g/hr) and NHL (1.56 ± 0.84 g/hr) players compared to JR players (1.01 ± 0.50 g/hr). CHO intake was similar between groups (14-20 g CHO/hr), with 29, 32, and 40% of JR, AHL, and NHL players consuming no CHO. In summary, sweat rates were high in all players, but the majority of players (74/77, 54/60, and 68/77 of JR, AHL, and NHL) avoided mild dehydration ($>2\%$ BM) during 60 min of practice. However, ~15, 41 and 48% of the JR, AHL, and NHL players may have reached mild dehydration and increased risk of performance decrements in a 90 min practice.

Key words: hydration, elite ice hockey, sweat rates

INTRODUCTION

Ice hockey is a fast, intense, and highly tactile sport, especially as skill levels increase. Past research has shown skill and decision-making performance decrements in “stop-and-go” sports such as basketball, soccer, and ice hockey in players that become mildly dehydrated and lose as little as ~2% of their body mass (BM) through sweating (Baker et al., 2007; Dougherty et al., 2006; Edwards et al., 2007; Linseman et al., 2014; McGregor et al., 1999; Owen et al., 2013; Palmer et al., 2017). The equipment worn by ice hockey players becomes problematic as sweat rates increase to dissipate heat production during intense practices and games (Logan-Sprenger et al., 2011; Palmer and Spriet, 2008). Previous research reported that elite junior ice hockey players lost an average of 1.4-1.8 L/hr of sweat during practices (Palmer and Spriet, 2008; Palmer et al., 2010), and professional players lost an average 1.3-2.5 L/hr of sweat during practices (Emerson et al., 2017; Godek et al., 2006). High sweat rates increase the possibility of mild dehydration, especially if players do not replace fluid lost through sweating. This can lead to increases in fatigue, rate of perceived exertion (RPE), core body temperature (T_c), heart rate (HR), and decreased performance and decision-making abilities (Adams et al., 2014; Batchelder et al., 2010; Dougherty et al., 2006; Linseman et al., 2014). It should be noted that these studies were not able to blind the subjects to the no fluid trial but recent studies that were able to blind subjects to hydration status also reported performance decrements when mildly dehydrated (Adams et al., 2018; Funnell et al., 2019).

During stop-and-go sports like ice hockey that involve repeated sprints and quick changes in intensity, players lose water and salt through sweating but also rely predominately on carbohydrate (CHO) in the form of muscle glycogen and glucose for energy production (Green et al., 1978; Simard et al., 1988). To supplement these sources, players can consume a sports drink that contains CHO and are recommended to consume 30-60 g of CHO/hour when exercising at

high intensities to maintain performance (Rodriguez et al., 2009; Sawka et al., 2007; Thomas et al., 2016).

There is some previous hydration research with smaller sample sizes reporting data for elite junior ice hockey players (Palmer and Spriet, 2008; Palmer et al., 2010) and professional players (Emerson et al., 2017; Godek et al., 2006). However, it is reasonable to speculate that JR, AHL, and NHL players may differ in age, body size, skill level, and team resources, which may affect hydration status and measures before and during practices between the levels of play. The purpose of this study was to reexamine elite major junior (JR) players' hydration measures and compare them to the hydration measures collected from professional players in the American Hockey League (AHL) and National Hockey League (NHL) using larger sample sizes and more than one team for each level of play.

METHODS

Subject Characteristics

This study included 214 players from three elite levels (JR=77, AHL=60, NHL=77) of ice hockey within North America (Table 1). The players were informed of all protocols, requirements, and risks, both verbally and in writing, prior to obtaining oral and written consent. The study was approved by the Research Ethics Board at the University of Guelph.

Study Design

All data was collected using the same protocol during the years 2013-2015 from different elite hockey teams during on-ice practices that included skating, passing, shooting, battling drills and scrimmages. All practices were subjectively assessed as high-intensity, players wore full hockey equipment, and environmental conditions ranged from 8-12°C and 35-48% relative

humidity during practices. All data were expressed per hour to account for differences in practice length (1-1.5 hr with an average of 1.26 ± 0.19 hr).

As players arrived at the arena, they provided a small urine sample (~50-100 mL), voided their bladder, and were weighed in dry shorts to record a pre-practice BM on a Zenith scale (LG Electronics Canada, Mississauga, On.). Players were then asked to consume what they normally drink before and during practice and indicated their choice of water and/or CES. Pre-practice drinks were individually labeled, weighed and consumed from the time the pre-practice BM was collected to the time practice started. The bottles were reweighed once the practice had started to determine the fluid consumed before practice. Individual bottles with drink(s) of choice were provided on the bench during practice and were weighed before and after practice in order to measure fluid consumed during practice.

Immediately after measuring pre-practice BM, the players' foreheads were rinsed with distilled water, dried, and sweat patches (3M Tegaderm + pad, London, ON) were applied to collect sweat samples during practice. The sweat patches were removed ~30-45 min into the practice and were centrifuged to extract the sweat and measure the sweat $[Na^+]$. After practice, players undressed quickly, dried off and were weighed in dry shorts to determine their post-practice BM.

Measurements

Pre-practice hydration status (urine specific gravity, USG) was measured in the urine samples using a digital hand-held “pen” refractometer (ATAGO USA Inc., Bellevue, WA.). This device was calibrated prior to measuring each urine sample. USG values >1.020 were considered to represent dehydration upon arrival to the practice (Casa et al., 2000; Sawka et al., 2007; Thomas et al., 2016). Forehead sweat $[Na^+]$ was measured with the Sweat Chek conductivity analyzer

(Wescor, Logan, Utah) and corrected to predict whole body sweat $[Na^+]$ (Baker et al., 2009). All other calculations have been outlined by Palmer and Spriet (2008).

Statistical Analysis

All data are presented as the mean \pm SD and were analyzed using STATA/IC 15.0 software. A one-way Analysis of Variance with Bonferroni’s correction for multiple comparisons tests was used to compare hydration measures between players at the three levels of play for each position and all players in groups. Goalies were only compared between groups due to the small sample size. An unpaired two-sample t-test was used to compare hydration measures between positions (only forwards vs. defencemen) within the same level of play. Statistical significance was determined by $p < 0.05$.

RESULTS

Subject characteristics

NHL and AHL players were older than JR players ($p < 0.001$) and NHL players were older than AHL players ($p < 0.001$) (Table 1). Player height did not differ between groups ($p > 0.606$), but BM was greater for NHL and AHL players compared to JR players ($p < 0.001$) (Table 1).

Pre-practice hydration status and fluid intake

Pre-practice USG values ranged from 1.002 to 1.031 with 40, 43, and 51% of players arriving for practice mildly dehydrated in JR, AHL, and NHL groups, respectively (Table 2). There were no significant differences between USG measures specific to group or position.

Pre-practice fluid intake was greater in JR and AHL players compared to NHL players ($p < 0.001$) (Table 2). JR and AHL forwards consumed more fluid before practice vs. NHL forwards ($p = 0.001$). NHL defencemen consumed more fluid than forwards before practices ($p = 0.008$).

There was no difference in pre-practice fluid intake between players who arrived hydrated (0.43 ± 0.34 L) and players who arrived dehydrated (0.36 ± 0.29 L) ($p=0.157$).

On-ice sweat loss and fluid intake

The mean on-ice sweat rate was greater in AHL and NHL players compared to JR players ($p=0.001$) (Figure 1A, Table 2). Sweat rates ranged from 0.65 to 3.57 L/hr for JR players, 0.85 to 3.76 L/hr for AHL players, and 0.36 to 3.99 L/hr for NHL players. NHL goalies had greater sweat rates compared to JR goalies ($p=0.018$), AHL forwards had greater sweat rates compared to JR forwards ($p=0.021$) and NHL defencemen had greater sweat rates compared to JR defencemen ($p=0.014$) and NHL forwards ($p=0.018$) (Figure 2A). There was a trend for AHL goalies to have a higher sweat rate (~ 1.0 L/hr) than JR goalies ($p=0.074$).

When normalizing for BM between groups, sweat rates remained greater in AHL (0.022 ± 0.007 L/kg/hr) and NHL (0.022 ± 0.008 L/kg/hr) players compared to JR (0.019 ± 0.006 L/kg/hr) players ($p=0.012$) (Figure 1B). AHL (0.032 ± 0.006 L/kg/hr, $p=0.047$) and NHL (0.033 ± 0.006 L/kg/hr, $p=0.024$) goalies had greater sweat rates than JR (0.021 ± 0.010 L/kg/hr) goalies (Figure 2B).

Average fluid intakes were not different between level of play and ranged from 0.174 to 1.986 L/hr in JR, 0.138 to $2.234 \pm$ L/hr in AHL, and 0.081 to 1.855 L/hr in NHL players (Table 2). While NHL defencemen drank significantly more compared to forwards ($p=0.044$), there were no differences in fluid intakes when adjusted for BM. The fluid consumed by players replaced 55, 46, and 41% of the fluid lost through sweating in JR, AHL, and NHL players. On average, players in all three groups drank about twice as much water (0.58 ± 0.35 L/hr) as CES (0.30 ± 0.32 L/hr). However, there were no differences between groups in water and CES drinking patterns ($p<0.05$).

Body mass losses

Average BM losses during a one-hour practice were greater in AHL ($p=0.006$) and NHL ($p<0.001$) players vs. JR players (Table 2, Figure 3). BM changes ranged from +0.3 to -3.1% for JR, +0.3 to -3.2 % for AHL, and +0.3 to -2.9% for NHL. Results showed that 11/77 JR, 15/60 AHL, and 28/77 NHL players lost at least 1.5% BM, and 3/77 JR, 6/60 AHL, and 9/77 NHL players lost $>2\%$ BM during the one-hour practice.

Sodium balance

The mean forehead sweat $[Na^+]$ were 56 ± 15 , 69 ± 20 , and 62 ± 19 mmol/L for JR, AHL, and NHL groups. AHL and NHL players lost more Na^+ than JR players ($p<0.001$) (Table 3). Whole body Na^+ losses ranged from 0.29 to 2.47 g/hr in JR, 0.37 to 3.54 g/hr in AHL, and 0.22 to 4.44 g/hr in NHL players.

Na^+ replacement ranged from 0 to 0.77 g/hr for JR, 0 to 1.23 g/hr for AHL, and 0 to 0.67 g/hr for NHL players, with 29, 32, 31% of JR, AHL, and NHL players not replacing any Na^+ during the practice (Table 3). After Na^+ intake was accounted for, AHL (1.68 ± 0.74 g/hr) and NHL (1.56 ± 0.84 g/hr) players had a greater Na^+ deficit vs. JR (1.01 ± 0.50 g/hr) players ($p<0.001$).

Carbohydrate intake

CHO intake ranged from 0 to 69 g/hr for JR, 0 to 70 g/hr for AHL, and 0 to 87 g/hr for NHL players (Table 2). There were no significant differences in CHO intake between the three groups. Although the majority of players consumed some CHO through a sports drink, gel, bar, or other supplements, 29, 32, and 40% of JR, AHL, NHL players consumed no CHO during the practice.

DISCUSSION

The aim of the present study was to measure contemporary hydration and sweat testing characteristics across three elite levels of male ice hockey players including JR, AHL, and NHL players. The results from the study suggest that (i) there was no difference in baseline hydration level between levels of play as 40-51% of players were mildly dehydrated when arriving for practice, (ii) there was no difference in pre-practice fluid intake between players who arrived hydrated and players who arrived dehydrated, (iii) AHL and NHL players had greater sweat rates and BM losses compared to JR players, (iv) fluid intake during the practices was comparable between levels of play replacing 41-55% of the sweat loss, (v) most players avoided mild dehydration during one hour of practice, (vi) Na⁺ losses were greater in AHL and NHL vs. JR players, and (vii) CHO intake was not different between levels of play with 60-71% of players in each group consuming some CHO during practice.

Pre-practice hydration status and fluid intake

The mean USG values in all groups were just into the hydrated range (USG of 1.018-1.019; USG <1.020 = hydrated) (Casa et al., 2000; Sawka et al., 2007; Thomas et al., 2016). These results are similar to previously reported values in elite male JR ice hockey players (Palmer and Spriet, 2008), while two other studies reported JR and minor professional players arriving dehydrated (1.023-1.027) (Emerson et al., 2017; Palmer et al., 2010). If players arrive mildly dehydrated due to not drinking enough during the day or being mildly dehydrated from a previous ice time, and then lose even more BM through sweating when practicing, they could be at an even greater level of mild dehydration and exacerbate any negative consequences.

Regardless of player USG, players can ensure proper hydration at the start of exercise by consuming fluid in the final 60 min before stepping on the ice (Logan-Sprenger and Spriet, 2013).

The differences in time between measuring USG and players starting practice will affect whether players started practice dehydrated. However, mean pre-practice fluid intakes for JR, AHL, and NHL were all less than the suggested guidelines of 500-700 mL in the hour before exercise (Casa et al., 2000) or ~3-5 mL/kg BM in the two hours prior to exercise (Sawka et al., 2007; Thomas et al., 2016). Furthermore, given that pre-practice fluid intake between players who arrived hydrated and dehydrated (40-50% in all groups) was similar, it is probable that players who arrived mildly dehydrated also began practice mildly dehydrated.

Sweat loss, fluid intake, and BM losses

The high sweat rates in the current study were comparable to elite athletes in American football (1.4-2.3 L/hr) (Godek et al., 2010a,b), basketball (2.2 L during a game) (Osterberg et al., 2009), and soccer (0.8 – 1.6 L/h) (Aragon-Vargas et al., 2009; Duffield et al., 2012; Maughan et al., 2004; Shirreffs et al., 2005). The sweat rate of 1.63 ± 0.58 L/hr for JR players was comparable to the rate of 1.8 L/hr previously reported for this population (Palmer and Spriet, 2008). The sweat rates for AHL (2.03 ± 0.62 L/hr) and NHL (2.02 ± 0.74 L/hr) groups were comparable to the sweat rates (2.1-2.5 L/hr) reported in minor professional players (Emerson et al., 2017) and higher than reported in professional players (1.3 L/hr) (Godek et al., 2006). The greater sweat rates of the professional groups compared to JR in this study cannot be explained by greater BM, as the sweat rates remained higher when normalized to BM. Differences in practice drills and intensities could help explain this, however, not being able to objectively quantify the intense training load during the practice intensity remains a limitation that should be addressed in future research.

The mean fluid intake replaced 55, 46, and 41% of the fluid lost in JR, AHL, and NHL groups, and prevented most players from losing more than 2% BM. AHL and NHL groups did not replace more fluid to make up for their greater sweat losses. The rates of fluid replacement in this

study were higher than previously reported (~25-36% of fluid losses) in minor professional players (Emerson et al., 2017), but similar to reports in JR players (Palmer and Spriet, 2008; Palmer et al., 2010). While hockey provides more chances to replace fluid between shifts on the ice during a game (Godek et al., 2006), this is not always the case in practices. Importantly, it should be noted that extending practices to 90 min, would result in ~15, 41, and 48 % of JR, AHL, and NHL players becoming mildly dehydrated (~2% BM loss).

Players with high sweat rates and BM losses have increased risk of reaching mild dehydration and experiencing fatigue, increased Tc and HR, and decreased performance and decision-making abilities (Adams et al., 2014; Batchelder et al., 2010; Dougherty et al., 2006; Linseman et al., 2014). In collegiate hockey players, Tc was significantly increased during an intense 120 min on-ice practice (Batchelder et al., 2010). This increase in Tc was significantly greater in players who progressively dehydrated (1.94% BM loss) during a 70 min on-ice scrimmage compared to players who hydrated (0.12% BM loss) with a CES (Linseman et al., 2014). Performance measured by shooting accuracy, passing accuracy, and puck handling was also impaired in dehydrated vs. hydrated players. Given the elite training status of these athletes and the intensity of their training, it is not surprising that some of these players had sweat rates >3 L/hr to limit the increase in Tc.

Sodium balance

Given that athletes lose salt in their sweat, Na⁺ replacement during intense exercise is important to maximize the retention of ingested fluid (Maughan et al., 2005; Shirreffs et al., 2004; Takamata et al., 1994). The average forehead sweat [Na⁺] for JR players was similar to that previously reported in JR (Palmer and Spriet, 2008). The forehead [Na⁺] for AHL and NHL players was also similar to that reported in practices for minor professional players (Emerson et al., 2017)

and professional players (Godek et al., 2006). Whole body Na^+ losses were higher for the professional players in this study and 29-32% of players in all groups did not replace any Na^+ during practice (1.0 g/hr for JR; 1.6-1.7 g/hr for AHL and NHL). These results were similar to losses reported during practices in elite American football players (~1.6-2.6 g/hr) (Godek et al., 2010b) and soccer players (~0.7-1.5 g/hr) (Duffield et al., 2012; Maughan et al., 2004).

CHO intake

General recommendations suggest that 30-60 g/h of exogenous CHO should be consumed during steady state exercise to maintain glycogen stores and blood glucose levels (Rodriguez et al., 2009; Sawka et al., 2007; Thomas et al., 2016). It is not clear how much exogenous CHO can be oxidized during stop-and-go sports. Of the 71% of JR, 68% of AHL, and 60% of NHL players that consumed some CHO during the practice, the mean CHO intakes were 26 ± 15 , 30 ± 19 , and 24 ± 19 g/hr for JR, AHL, and NHL players. These intakes were close to the lower limit of what is considered adequate. Mouth rinsing is another possible benefit of CES ingestion, but the frequency of drinking was not considered in this research (Carter et al., 2004, Chambers et al., 2009).

CONCLUSION

The current research examined the hydration and sweat characteristics of elite ice hockey players during practices at the JR, AHL, and NHL levels. The results from the study suggest that i) there was no difference in pre-practice hydration level (~40-50% of players arrived dehydrated) or fluid intake between levels of play, (ii) AHL and NHL players had greater sweat rates, BM losses, and Na^+ losses compared to JR players, (iii) fluid intake during the practices were comparable between levels of play, (iv) most players avoided mild dehydration (<2% BM loss)

during one hour of practice, but many players would be at risk of becoming dehydrated during longer practices, and (v) there were many (29-40%) players who did not consume CHO during practice. While not being able to quantify the practice intensity and control other factors in these field settings, these results can be used to estimate sweat and hydration characteristics and CHO intake of elite ice hockey players at three levels of play in real world settings. However, support personnel and players should adopt an individual approach to understand variation during games and practices of different lengths and intensities to ensure that fatigue, cognitive and physical performance deficits, and recovery can be minimized through proper hydration and fueling.

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AUTHORSHIPS

Alexander Gamble: First author, substantial contributions to conception and design, data collection methods, data analysis, interpretation of results, drafting and revising the manuscript and final version to be published.

Jessica Bigg: Second author, substantial contributions to conception and design, data collection methods, data analysis, interpretation of results, and final approval of the manuscript to be published.

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CONFLICTS OF INTEREST

None declared.

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“Estimated Sweat Loss, Fluid and CHO Intake, and Sodium Balance of Male Major Junior, AHL, and NHL Players During On-Ice Practices” by Gamble ASD et al.

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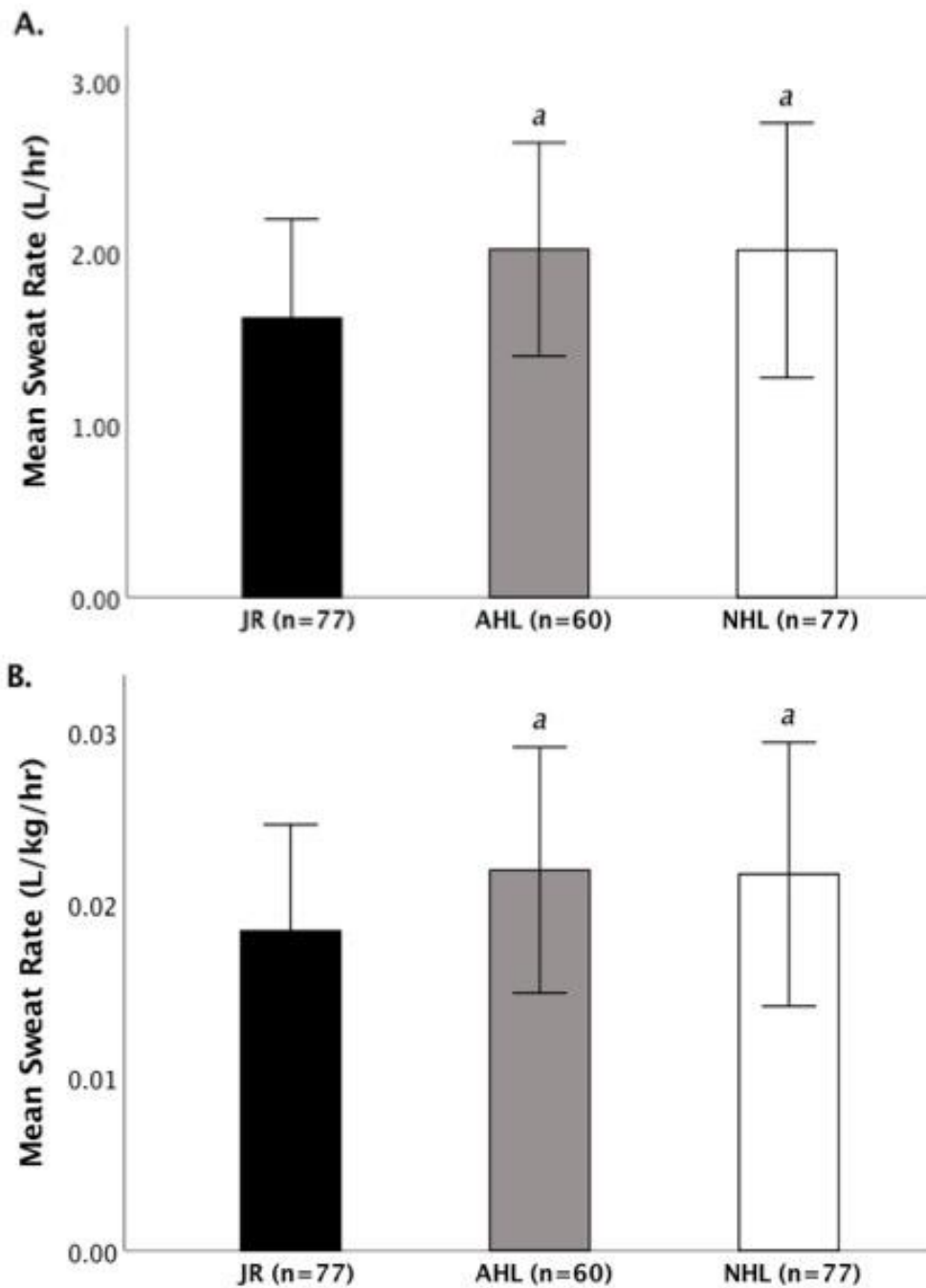


Figure 1. A. Mean sweat rates for major junior (JR), American Hockey League (AHL), and National Hockey League (NHL) players. **B.** Mean sweat rates when normalized for body mass (BM) for JR, AHL, and NHL players. *a*, represents statistical difference from JR players ($p < 0.05$).

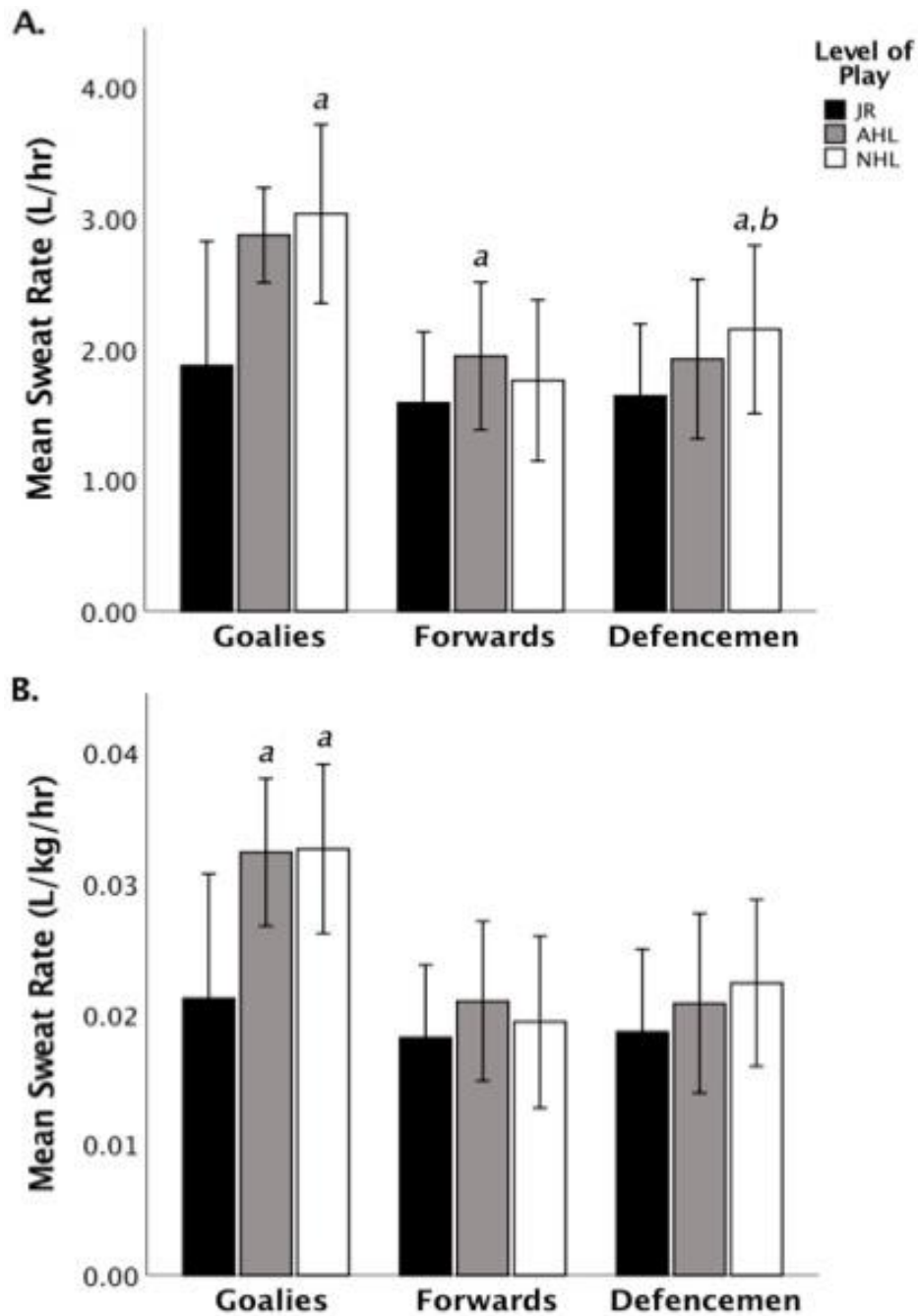


Figure 2. **A.** Mean sweat rates for major junior (JR), American Hockey League (AHL), and National Hockey League (NHL) players separated by player positions and, **B.** Mean sweat rates when normalized for body mass (BM). *a*, represents statistical difference from JR players, *b*, represents statistical difference between forwards and defencemen within level of play ($p < 0.05$). See Table 1 for sample size of goalies, forwards, and defencemen.

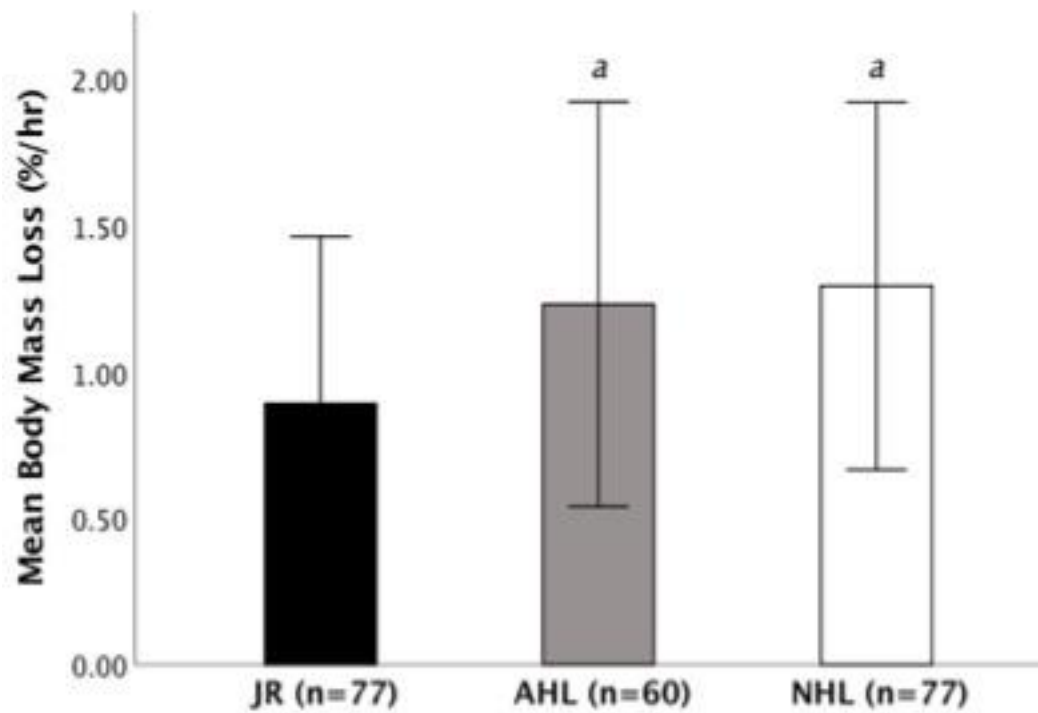


Figure 3. Mean body mass loss for major junior (JR), American Hockey League (AHL), and National Hockey League (NHL) players. *a*, represents statistical difference from JR players ($p < 0.05$).

Table 1. Player characteristics and positions for JR, AHL, and NHL ice hockey players.

	JR	AHL	NHL
Number of Players	77	60	77
Goalies	7	6	9
Defencemen	24	20	23
Forwards	46	34	45
Age (years)	19 ± 1	24 ± 4 ^a	27 ± 5 ^{a,b}
Height (cm)	185.0 ± 5.6	186.3 ± 5.5	185.8 ± 5.4
Pre-trial Body Mass (kg)	87.7 ± 7.6	92.7 ± 7.3 ^a	92.4 ± 7.0 ^a

Data are presented as mean ± SD. ^a, represents statistical difference from major junior (JR) and ^b, represents statistical difference between American Hockey League (AHL) and National Hockey League (NHL) (p<0.05).

Table 2. Mean urine specific gravity, pre-practice fluid intake, total fluid intake, sweat loss, and body mass loss of JR, AHL, and NHL players during on-ice practices.

		JR (n=77)	AHL (n=60)	NHL (n=77)
Urine Specific Gravity	All Players	1.018 ± 0.007	1.019 ± 0.007	1.018 ± 0.008
	Goalies	1.021 ± 0.006	1.019 ± 0.002	1.025 ± 0.006
	Defencemen	1.015 ± 0.007	1.019 ± 0.006	1.020 ± 0.007
	Forwards	1.018 ± 0.007	1.020 ± 0.006	1.016 ± 0.009
Pre-practice Fluid Intake (L)	All Players	0.45 ± 0.29	0.45 ± 0.37	0.22 ± 0.22 ^{a,b}
	Goalies	0.42 ± 0.21	0.53 ± 0.62	0.18 ± 0.16
	Defencemen	0.51 ± 0.32	0.53 ± 0.35	0.33 ± 0.24 ^b
	Forwards	0.43 ± 0.28	0.38 ± 0.32	0.18 ± 0.20 ^{a,b,c}
Sweat Rate (L/hr)	All Players	1.63 ± 0.58	2.03 ± 0.62 ^a	2.02 ± 0.74 ^a
	Goalies	1.87 ± 0.95	2.87 ± 0.36	3.03 ± 0.68 ^a
	Defencemen	1.64 ± 0.55	1.92 ± 0.61	2.15 ± 0.64 ^a
	Forwards	1.59 ± 0.54	1.94 ± 0.56 ^a	1.76 ± 0.61 ^c
Total Fluid Intake (L/hr)	All Players	0.89 ± 0.37	0.93 ± 0.34	0.83 ± 0.42
	Goalies	1.05 ± 0.46	1.34 ± 0.38	1.28 ± 0.43
	Defencemen	0.97 ± 0.42	0.92 ± 0.27	0.90 ± 0.38
	Forwards	0.83 ± 0.32	0.86 ± 0.40	0.70 ± 0.37 ^c
BM Loss (%/hr)	All Players	0.89 ± 0.57	1.23 ± 0.69 ^a	1.29 ± 0.63 ^a
	Goalies	1.12 ± 0.93	1.92 ± 0.67	1.88 ± 0.50
	Defencemen	0.82 ± 0.45	1.11 ± 0.64	1.30 ± 0.52 ^a
	Forwards	0.90 ± 0.58	1.18 ± 0.67	1.17 ± 0.64

See Table 1 for sample size of goalies, forwards, and defencemen. Data are presented as mean ± SD. ^a, represents statistical difference from major junior (JR), ^b, represents statistical difference between American Hockey League (AHL) and National Hockey League (NHL), and ^c, represents statistical difference between forwards and defencemen within level of play (p<0.05).

Table 3. Mean sodium intake, sodium loss, and carbohydrate intake of JR, AHL, and NHL players during on-ice practices.

		JR (n=77)	AHL (n=60)	NHL (n=77)
Sodium Loss (g/hr)	All Players	1.17 ± 0.51	1.83 ± 0.78 ^a	1.69 ± 0.89 ^a
	Goalies	1.18 ± 0.81	2.99 ± 0.67 ^a	2.63 ± 1.10 ^a
	Defencemen	1.19 ± 0.53	1.64 ± 0.56	1.73 ± 0.85 ^a
	Forwards	1.15 ± 0.46	1.77 ± 0.78 ^a	1.45 ± 0.72
Sodium Intake (g/hr)	All Players	0.15 ± 0.15	0.15 ± 0.19	0.13 ± 0.15
	Goalies	0.16 ± 0.31	0.21 ± 0.15	0.30 ± 0.23
	Defencemen	0.19 ± 0.15	0.11 ± 0.10	0.11 ± 0.14
	Forwards	0.13 ± 0.12 ^c	0.16 ± 0.23	0.10 ± 0.11
Carbohydrate Intake (g/hr)	All Players	19 ± 17	20 ± 21	14 ± 19
	Goalies	12 ± 21	33 ± 22	38 ± 30
	Defencemen	24 ± 18	17 ± 18	12 ± 15
	Forwards	17 ± 16	20 ± 22	11 ± 14

See Table 1 for sample size of goalies, forwards, and defencemen. Data are presented as mean ± SD. ^a, represents statistical difference from major junior (JR) players, ^b, represents statistical difference between American Hockey League (AHL) and National Hockey League (NHL), and ^c, represents statistical difference between forwards and defencemen within level of play (p<0.05).