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Fluid Consumption and Sweating in National Football League and Collegiate Football Players With Different Access to Fluids During Practice

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Context: Considerable controversy regarding fluid replacement during exercise currently exists.

Objective: To compare fluid turnover between National Football League (NFL) players who have constant fluid access and collegiate football players who replace fluids during water breaks in practices.

Design: Observational study.

Setting: Respective preseason training camps of 1 National Collegiate Athletic Association Division II (DII) football team and 1 NFL football team. Both morning and afternoon practices for DII players were 2.25 hours in length, and NFL players practiced for 2.25 hours in the morning and 1 hour in the afternoon. Environmental conditions did not differ.

Patients or Other Participants: Eight NFL players (4 linemen, 4 backs) and 8 physically matched DII players (4 linemen, 4 backs) participated.

Intervention(s): All players drank fluids only from their predetermined individual containers. The NFL players could consume both water and sports drinks, and the DII players could only consume water.

Main Outcome Measure(s): We measured fluid consumption, sweat rate, total sweat loss, and percentage of sweat loss replaced. Sweat rate was calculated as change in mass adjusted for fluids consumed and urine produced.

Results: Mean sweat rate was not different between NFL (2.1 ± 0.25 L/h) and DII (1.8 ± 0.15 L/h) players ($F_{1,12} = 2$, $P = .18$) but was different between linemen (2.3 ± 0.2 L/h) and backs (1.6 ± 0.2 L/h) ($t_{14} = 3.14$, $P = .007$). We found no differences between NFL and DII players in terms of percentage of weight loss ($t_7 = -0.03$, $P = .98$) or rate of fluid consumption ($t_7 = -0.76$, $P = .47$). Daily sweat loss was greater in DII (8.0 ± 2.0 L) than in NFL (6.4 ± 2.1 L) players ($t_7 = -3$, $P = .02$), and fluid consumed was also greater in DII (5.0 ± 1.5 L) than in NFL (4.0 ± 1.1 L) players ($t_7 = -2.8$, $P = .026$). We found a correlation between sweat loss and fluids consumed ($r = 0.79$, $P < .001$).

Conclusions: During preseason practices, the DII players drinking water at water breaks replaced the same volume of fluid (66% of weight lost) as NFL players with constant access to both water and sports drinks.

Key Words: thermoregulation, sodium loss, dehydration, hydration, carbohydrate and electrolyte drinks

Key Points

- Although the access of professional and collegiate players to fluids differed, fluid balance was not different between the 2 groups.
- The linemen consumed fluids at a higher rate compared with the backs, indicating that although individual drinking behaviors varied, larger athletes appeared to consume fluids at a greater rate than smaller athletes.
- More frequent fluid consumption did not result in a higher total volume of fluid consumed.
- Hydration status was not different between football players in programs that offered commercial sports drinks and water and players in programs that offered only water.

Maintaining fluid balance during exercise and regaining it postexercise through oral rehydration has been studied[1–21] extensively over the past 30 years, with particular attention given to factors such as thirst and palatability of fluids,[2,6–11] gastric emptying,[12,14,22] intestinal absorption,[13,14] and fluid retention.[15,21] Research[6–11,15,19,20,23] has indicated that during exercise and postexercise, athletes tend to drink more when fluids are cold or have an appealing taste. Fluid consumption studies are generally designed so that fluid availability is held constant; drink preference and how that preference relates to the volume of fluid consumed are typically measured. However, little attention has been focused on drinking behavior based on the availability of fluids during exercise. This question might be of importance, especially in the sport of American football, as players frequently practice and play in environmentally stressful conditions.[23–25] Although individual variations are considerable because sweat rate (SwtR) is largely influenced by metabolic rate and environmental factors, such as air temperature, wind velocity, and humidity,[26,27] football players sweat at higher rates compared with average-sized athletes (eg, runners) exercising in the same environmental conditions.[25]

Table. Physical Characteristics of Participants (Mean ± SD)

Physical Characteristics	National Football League	Division II	*t* Value	*P* Value
Age, y	27.6 ± 3.7	21 ± 2.3[a]	4.25[b]	<.001
Height, cm	187.3 ± 7	186.7 ± 5	0.32[c]	.76
Mass, kg	119 ± 26	113 ± 24	1.98[c]	.09
Body surface area, m^2	2.4 ± 0.3	2.36 ± 0.2	1.4[c]	.21

[a] Indicates different from National Football League ($P < .001$).
[b] Indicates t_{14}.
[c] Indicates t_7.

It is well known that both during exercise and postexercise athletes do not entirely replace the fluid deficits incurred as a result of sweating. This phenomenon of involuntary dehydration, which was first described as *voluntary dehydration*,[28] has been documented in numerous studies.[3,4,6,8–11,29–33] Many authors[9,30,32–36] have insisted that dehydration is detrimental to both thermoregulation and performance, whereas others[3,29,31,37–39] have argued that the fluid loss that commonly occurs during exercise is of little consequence. A controversy has existed for decades about fluid replacement, with some authors and sports medicine associations[34–36] touting the need to drink before being thirsty and frequently during exercise, with the goal of replacing 100% of sweat loss. Although dehydration has been frequently implicated as a cause of heat illness,* drinking to excess has also led to numerous, and sometimes fatal, cases of exercise-associated hyponatremia (serum sodium <135 mmol/L) in endurance athletes[31,38,39,43–46] and, more recently, in football players.[47,48] This has resulted in other groups and individual researchers[3,31,37–39,44–46,49] disputing the need for aggressive fluid replacement and suggesting that individuals use thirst as a guide for drinking. This has spurred a debate over different hydration protocols: some researchers[35,36] argue that fluid consumption should replace all fluids lost as a result of sweating and urine production, and others[3,29,37,38] argue that fluid consumption should be thirst driven (ad libitum), with athletes generally replacing 50% to 70% of their sweat losses while exercising in the heat. Although the sports medicine staffs at the professional and National Collegiate Athletic Association (NCAA) Division I levels of football probably have the human resources necessary to provide players with constant access to fluids during practices, programs at the high school and NCAA Division II (DII) and Division III levels are not likely to have these same resources and may not be capable of providing players with constant access to fluids.

Using the same methods in separate investigations, we observed SwtR, sweat loss, and fluid replacement in football players at both the DII and professional levels of competition. In these investigations, the DII players consumed only water during regular water breaks in practice at 1 centrally located place between 2 practice fields.[23,25] Conversely, the professional players had free access to both water and sports drinks between nearly all repetitions during individual drills and at all times when they were not engaged in plays during practices.[24,50] However, we have not directly studied fluid turnover between these 2 groups that play at different levels of competition and that have different access to fluids during practices. Therefore, the purpose of our study was to compare fluid consumption, percentage of fluid replacement, SwtR, and fluid loss during preseason practice (1) between National Football League (NFL) players with constant access to fluids and matched (details of matching provided in next section) DII football players who had access to fluid only during breaks in practice and (2) between interior linemen and running and defensive backs. We hypothesized that the NFL players would consume more fluid during practices and, therefore, would lose less body mass compared with the DII players.

*References 9–11, 15, 17–19, 30, 33–36, 40–42.

METHODS

Participants

Eight football players (4 interior linemen and 4 backs) from the same DII football team and 8 NFL players from the same professional team (4 interior linemen and 4 backs) volunteered to participate. The DII players were matched with the NFL players based on height, mass, body surface area, position, and playing time during practice (all were first-team or second-team players) (Table). All participants provided written informed consent, and the study was approved by the university's Institutional Review Board for Human Subjects Subcommittee.

Procedures

Sweat Rate Measurements. The SwtR data were collected for the NFL players during both practices on the 10th day of their team's training camp. The identical data were collected for the DII players during both practices on the eighth day of the team's training camp; on that day, the environmental conditions were similar to those on the NFL team's data collection day. Mean wet bulb globe temperatures were recorded on the playing field at the beginning, middle, and end of the respective practices and were not different between NFL and DII in the morning (26.3°C and 28°C, respectively; $t_7 = -1.58$, $P = 1.65$) or in the afternoon (24.8°C and 24°C, respectively; $t_7 = 0.643$, $P = .54$).

Sweat loss was calculated from change in mass adjusted for fluid intake and urine volume produced and did not account for insensible fluid loss, which is considered minimal, or fluid gained as a result of glycogen metabolism. We did not collect environmental data in the respective locker rooms, and although both facilities were air conditioned, environmental conditions possibly were different. The specific protocol that was used to determine SwtR and sweat loss has been previously described in detail.[24,25] Briefly, the protocol involved the players voiding their bladders completely, then weighing themselves while dressed in dry shorts just before putting on their equipment for practice. The players refrained from drinking until they entered the field, where they drank only from their own premeasured, prelabeled containers and were instructed not to let any fluid drop to the ground. All athletes had previously participated in sweat data collection and clearly knew the importance of measuring all fluids that they consumed between body mass measurements. After practice, players showered, towel dried, emptied their bladders into containers for volumetric measurements, and recorded a postpractice body mass while dressed the same as for the prepractice measurement. Each player's postpractice urine volume was accurately measured and recorded, and the fluid that remained in each bottle was measured and subtracted from the starting volume to calculate fluid consumed during each practice.

The following formula was used to calculate SwtR: SwtR = {[prepractice mass (kg) − postpractice mass (kg)] − urine volume (L) + fluids consumed during practice (L)}/ length of practice session (h).

National Football League Fluid Availability. To minimize the number of researchers on the field, we purposefully chose the NFL players in pairs based on their playing position: 2 offensive linemen, 2 defensive linemen, 2 running backs, and 2 defensive backs. At all times during practice, each pair of players had a personal fluid attendant who provided cold fluids of choice (water or sports drinks) that were kept in small ice-filled coolers. All participants were veteran players on this team and clearly understood the intrusive hydration program (constant fluids) that the sports medicine staff used and that consisted of having cold water offered to each player between nearly all repetitions during practice and sports drinks provided upon request.

Division II Fluid Availability. The hydration program used by the DII sports medicine staff involved 4 separate water pumpers that were placed every 18 to 22 m between 2 adjacent practice fields. The DII participants had access to their individual water containers that were kept in ice-filled coolers by the water pumpers between the fields. The players did not have constant access to water but were able to drink ad libitum during regular water breaks during practice, which usually occurred every 10 to 15 minutes. Only cold water was available to the DII participants during practices.

Hydration Education and Practices. The certified athletic trainers with each team met with their players before practices and explained the preseason hydration routine. Recording body mass before and after each practice was mandatory for all players on both teams. Additionally, players were educated about the importance of drinking frequently to minimize weight loss during practices, and all participants were familiar with these expectations, as they were returning players to their respective teams.

Both the NFL and DII players wore full pads (helmets, regular shoulder pads, football pants with pads) during the morning practices and helmets, shorts, and shells (lightweight foam shoulder pads without protective plastic covering) during the afternoon practices. The length of the morning practices (2.25 hours) was the same for both groups, but afternoon practice was 1 hour for NFL players and 2.25 hours for DII players.

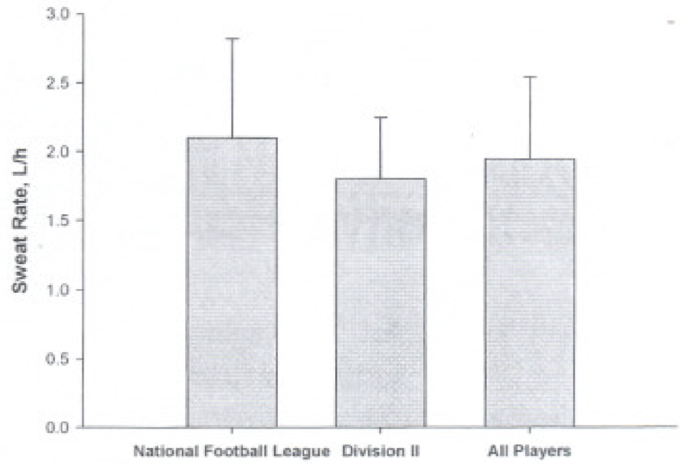

Figure 1. Sweat rate (L/h) in National Football League and Division II players and in all 16 players combined.

Statistical Analysis

Sweat rate was calculated for each of the 16 players (8 NFL and 8 DII) in both morning and afternoon practices. The mean SwtR for each player was used in the statistical analysis. We compared SwtRs using a 2 (position) × 2 (competitive level) analysis of variance, where position included linemen and backs and competitive level included NFL and DII. Two-tailed correlated t tests were used to analyze fluid turnover between NFL and DII players, and 2-tailed independent-samples t tests were used to analyze fluid turnover between linemen and backs. Pearson product moment correlations were calculated to assess the relationship between body surface area and SwtR and between volume of sweat loss and volume of fluid consumed. We used post hoc 2-tailed independent-samples t tests to compare SwtR between NFL and DII players when length of practice varied. The α level was set a priori at $P < .05$. We used VassarStats (Vassar College, Poughkeepsie, NY) to analyze the data.

RESULTS

National Football League Versus Division II

Other than age, we found no differences in physical characteristics between the NFL and DII groups (Table). The SwtR was not different between NFL and DII players ($F_{1,12} = 2$, $P = .18$) (Figure 1), and we did not find differences in the percentage of weight loss during practices ($t_7 = -0.03$, $P = .98$) or the amount of weight regained before the afternoon practice ($t_7 = 0.47$, $P = .65$) (Figure 2). We also found no differences in sweat loss ($t_7 = -0.28$, $P = .79$) or fluids consumed during the morning practice ($t_7 = 0.01$, $P = .99$) (Figure 3). During the afternoon practice, the volume of sweat loss was greater in DII (3.9 ± 1.3 L) than in NFL (2.3 ± 0.8 L) players ($t_7 = -4.75$, $P = .002$), and fluid consumed was greater in DII (2.6 ± 0.9 L) than in NFL (1.3 ± 0.4 L) players ($t_7 = -5.33$, $P = .001$) (Figure 3). Daily sweat loss was higher in DII (8.0 ± 2.0 L; range, 5–11.3 L) than in NFL (6.4 ± 2.1 L; range, 2.23–8.9 L) players ($t_7 = -3$, $P = .02$). Total fluid consumed during both practices was also higher in

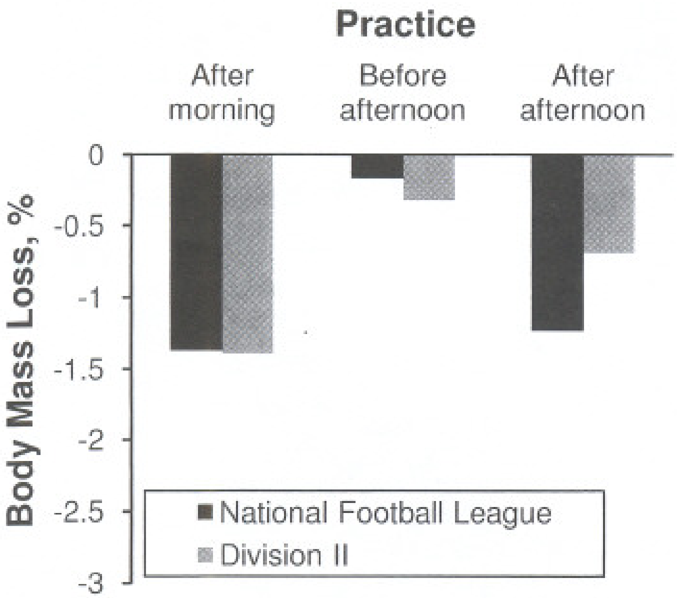

Figure 2. Percentage of dehydration in National Football League and Division II players after the morning practice, before the afternoon practice, and after the afternoon practice.

DII (5.0 ± 1.5 L; range, 3.1–8 L) than in NFL (4.0 ± 1.1 L; range, 1.9–5.3 L) players ($t_7 = -2.8$, $P = .026$) (Figure 3). We found no difference between NFL and DII players in the rate of fluid consumption (mL/h) ($t_7 = -0.76$, $P = .47$) or in the percentage of sweat loss voluntarily replaced with fluids during practices ($t_7 = 0.03$, $P = .98$) (Figure 4).

Additional Analysis

When we did not find a difference in overall SwtRs between NFL (2.1 L/h) and DII (1.8 L/h) players, we wondered why the overall SwtRs were not more similar between the groups. The players were matched, and environmental, equipment conditions, and methods were identical, so exercise intensity and practice time remained potential causes for this finding. We could not retrospectively evaluate exercise intensity, but further statistical analysis did reveal differences in SwtR when length of practice varied. Using 2-tailed independent t tests, we found no differences in the SwtR of the DII (1.8 ± 0.3 L/h) and NFL (2.0 ± 0.7 L/h) participants during the 2.25-hour morning practice ($t_{14} = 0.62$, $P = .55$); however, the NFL players' SwtR (2.2 ± 0.8 L/h) in the 1-hour afternoon practice was different from that of the DII players (1.7 ± .6 L/h) in their 2.25-hour afternoon practice ($t_{14} = 1.17$, $P = .03$).

Linemen Versus Backs

The SwtR of the 8 NFL and DII linemen combined (2.3 ± 0.2 L/h) was higher than the SwtR of the 8 backs (1.6 ± 0.2 L/h) ($t_{14} = 3.15$, $P = .007$). We also found a moderate correlation between body surface area and mean SwtR for all 16 players ($r = 0.56$, $P = .02$). Daily sweat loss was higher in linemen (8.5 ± 1.4 L) than in backs (5.9 ± 2.0 L) ($t_{14} = 3.15$, $P = .007$), but linemen (5.5 ± 1.4 L) consumed more fluids during practices than did backs (3.9 ± 1.1 L) ($t_{14} = 2.53$, $P = .02$). Subsequently, we found no differences in percentage of weight loss between the linemen (−1.37% ± 0.6%) and backs (−1.38% ± 0.7%)

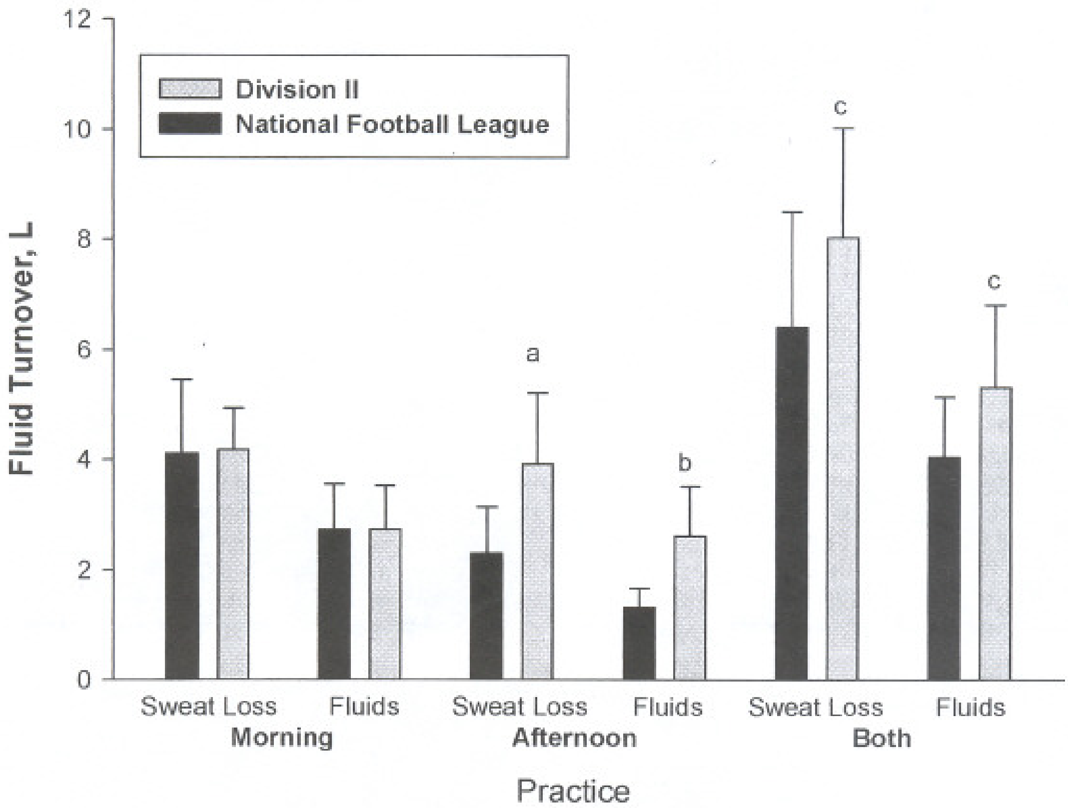

Figure 3. Fluid turnover between National Football League and Division II players in morning practice, afternoon practice, and practices combined. [a] Indicates $P < .01$; [b] $P < .001$; [c] $P < .05$.

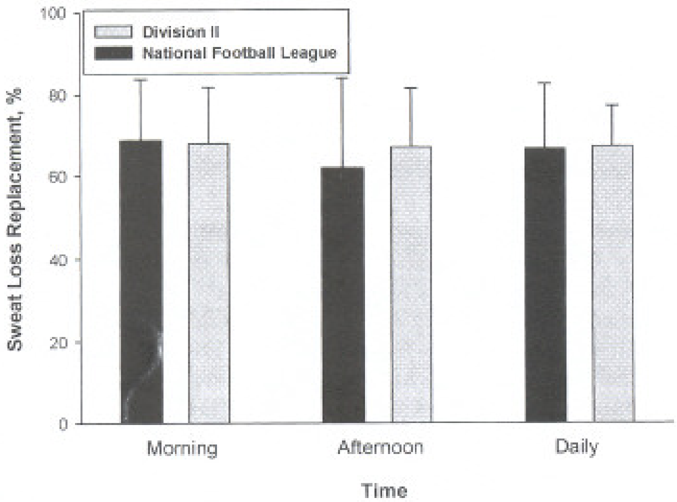

Figure 4. Percentage of sweat loss replaced with fluid consumption during morning and afternoon practice and both practices combined.

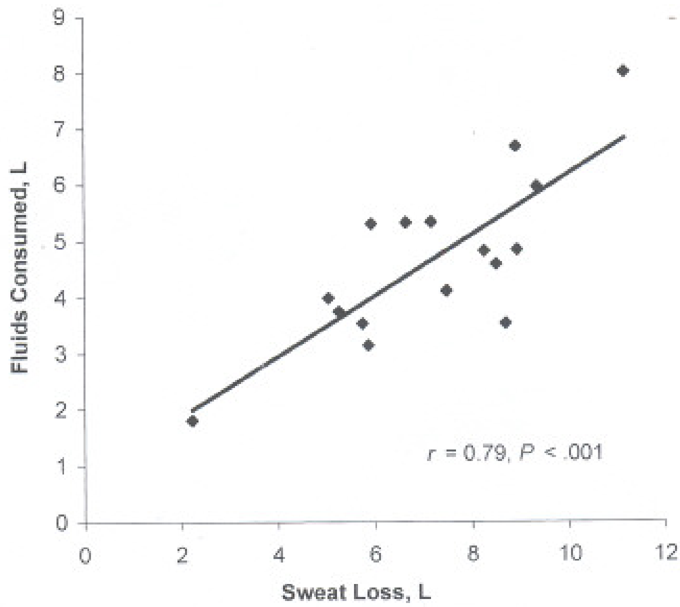

Figure 5. Correlation between sweat loss and fluid consumed during practices with National Football League and Division II players combined (n = 16).

($t_{14} = -0.03$, $P = .98$). The rate of fluid consumption was also higher in the linemen (1440 ± 240 mL/h) than in the backs (1020 ± 300 mL/h) ($t_{14} = -2.9$, $P = .011$). We found a strong correlation between sweat loss and fluids consumed during practices ($r = 0.79$, $P < .001$) (Figure 5).

DISCUSSION

The NFL players had nearly constant access to fluids during practices and did not need to go to a "water station" for water or sports drinks. Conversely, the DII players had to go to a central place between the 2 practice fields, which could be 35 to 45 m away, for their individual water bottles and had no access to any other fluids during practices. Therefore, the most interesting and most important finding of this study was that although the NFL and DII players' access to fluids was different, we found no differences in fluid balance between the 2 groups. The DII players ingested fluids at a rate of 1200 mL/h during the morning practice and 1140 mL/h during the afternoon practice; the NFL players drank at nearly identical rates of 1200 mL/h and 1320 mL/h during their morning and afternoon practices, respectively. The larger linemen consumed fluids at a higher rate compared with the running backs and defensive backs, indicating that although individual drinking behaviors are variable, larger athletes appear to consume fluids at a greater rate compared with smaller athletes. Although runners may not tolerate the ingestion of large volumes of fluid during exercise,[22] it appears that football players, particularly the large linemen in our study, could consume fluids in excess of 1600 mL/h. This finding further supports the belief that fluid replacement guidelines should not be viewed as "one size fits all," as they are largely based on average-sized male athletes exercising continuously while dressed in minimal clothing.[25,35,36]

Fluid consumption during breaks was adequate because it allowed all DII players to maintain body mass to within 2% to 2.5%, which is a level not implicated as a risk for heat-related illness or performance decrements.[3,29,31,37] The term *dehydration* is often overstated and causes confusion, because athletic trainers may not realize that an athlete who begins exercise well hydrated (serum osmolality = 280 mOsm/kg) will still be in a "normal" state of hydration (serum osmolality <295 mOsm/kg) after losing 2% to 3% of body mass. Understanding the topic of thermoregulation and fluid balance, and particularly the term *dehydration*, is often confounded by discrepancies in research findings between laboratory and field studies.†

Inconsistent terminology or study methods sometimes make laboratory research findings difficult to interpret and nearly impossible to accurately generalize to real-life sport participation. For example, participants are frequently fluid restricted and/or dehydrated (using exercise, passive heat exposure, or diuretics) before data collection and are subsequently beginning exercise trials in a hypohydrated state.[32,40,41,52] Strong evidence[41] has indicated that rectal temperatures and heart rates reach higher levels during exercise when participants are hypohydrated and fluid restricted than when they are euhydrated and/or have free access to cold water. When participants begin exercise 3.6% hypohydrated but are free to drink cold water ad libitum during exercise, they simply drink more and consequently have the same temperature and heart rate responses compared with when they are euhydrated. Rectal temperature and heart rate are only higher when participants are both hypohydrated before and fluid restricted during exercise trials.[41] Although athletes should not begin exercise hypohydrated, data[41] clearly have shown that cold water consumption during exercise is the important factor. Although our DII and NFL players had different access to cold fluids, all were allowed to drink as much as they wanted and subsequently lost an acceptable amount of body mass.

Importantly, laboratory methods or environmental conditions may not duplicate actual outdoor exercise, particularly for team sport athletes. In most laboratory studies, researchers use fixed workloads that often force

†*References 3, 18, 29, 31, 33–37, 40, 41, 50–53.*

participants to exercise at higher intensities than they normally would use if given the choice.[3,6,26,32,51,53] Additionally, the facing wind speeds (2.5 m/s) in a frequently cited cycling study[33] were dissimilar to those of real-life conditions, in which wind speeds would be 5 to 6 times higher, allowing for much greater convective cooling. As Dugas et al[37] showed, participants cycling with appropriate-facing wind speeds performed best when ad libitum fluid consumption replaced 51% of their sweat losses while maintaining body temperatures similar to when they replaced either 66% or 100% of their sweat losses. Whereas recently published fluid replacement guidelines[36] still contend that fluid consumption should approximate sweat loss, but that "individuals should avoid drinking more fluid than the amount needed to replace their sweat losses," laboratory and field research has provided solid evidence that healthy athletes can lose 2% to 3% of their body mass during exercise (dehydration) with little consequence to either thermoregulation or performance. Importantly, overhydration by 2% to 3% can have a severe, and even fatal, outcome and is no longer an illness found just in endurance athletes.[43,45–48] Seizures due to hyponatremia (serum sodium = 116 mmol/L) were reported in a professional football player who became ill after the second practice during a minicamp but continued to consume large volumes of water and sports drinks.[48] Overhydrating also recently caused the death of a high school football player.[47]

Our observations indicated that the DII players who do not have constant access to fluid simply drink more during a break than many of the NFL players who take 1 mouthful every few minutes. The frequent drinking by the NFL players may act to inhibit the ingestion of greater volumes of fluid as a result of several mechanisms that terminate the dipsogenic drive. Figaro and Mack[54] described 3 mechanisms responsible for the termination of drinking: (1) wetting the oropharyngeal region (eliminating dry-mouth sensations); (2) reflex inhibition of thirst and the secretion of arginine vasopression, which is a hormone released by the hypothalamus in response to hypovolemia and elevated serum osmolality; and (3) a separate mechanism independent of oropharyngeal wetness that is associated with swallowing and that is described as *oropharyngeal metering*. Stomach distention also possibly plays a minor role in diminishing the drive to drink.[54] In our NFL participants, drinking more frequently may have inhibited their thirst drive, minimizing the amount that they consumed at one time. Our data and on-field observations clearly indicated that drinking more frequently does not mean that a higher total volume of fluid will be consumed, as we originally hypothesized (Figure 4).

Our findings regarding the accessibility of fluids are especially important for programs (high schools or colleges and universities that are not Division I) in which athletes do not have access to unlimited fluid replacement options or numerous sideline fluid attendants. Our data indicated that having cold water readily available for consumption during water breaks in football practice is just as appropriate as having constant access to both water and sports drinks. We are not suggesting that programs currently using more aggressive hydration protocols should change their hydration practices (although education about the potential for overhydrating may be important), but, rather, our findings give credence to the idea that the critical factors are the availability of cold fluids on the field accompanied by appropriate breaks in practice.

Interestingly, we also did not find differences in hydration with a program that offered commercial sports drinks on the field versus one that did not. Five of the 8 NFL players consumed sports drinks during practices, but the NFL participants were not more hydrated after practices compared with the 8 DII players who consumed only water. In fact, the 2 groups of players consumed exactly the same volume of fluid (2.72 L) during their respective 2.25-hour morning practices. These data dispute those from studies[6,9–11,13,15–20] conducted or funded by the sports drink industry, which may be explained by the fact that our findings were simply a measurable observation.

We were not surprised to find that playing level had little effect on the SwtR of adult male football players. Our data supported previous findings[24,25] because the mean SwtR of the 16 participants, who represent the 2 ends of the physical size spectrum in football players (small backs and large linemen), was just less than 2.0 L/h. Regardless of playing level, linemen clearly sweated at higher rates (2.3 L/h) than backs (1.6 L/h), which has been documented[24] in professional players. In addition, they drank considerably more fluid during practice and subsequently did not lose a greater percentage of body mass. However, American football players can lose tremendous volumes of fluid daily, so they may have difficulty maintaining sodium and fluid balance.[23,55]

Certainly, the length of time that football players are on the field daily largely determines the total volume of fluid that they lose. Compared with NFL players, the DII players lost greater volumes of fluid on the days that they were studied because they were on the field for 4.5 hours, compared with 3.25 hours for the NFL players. The mean daily sweat loss of the DII players (8.0 L/d) was nearly identical to those losses previously reported[25] in collegiate players who also practiced 4.5 h/d. Additionally, the DII players consumed more fluid per day (5.0 L/d) during practices than did the NFL players (4.0 L/d). Players who have the greatest fluid turnover (sweat loss and fluid replaced) may be at the greatest risk of developing low blood sodium levels, which can lead to hypovolemia.[25,55] Therefore, preserving fluid and electrolyte balance may be challenging for some football players during preseason, particularly if they are practicing twice daily and their dietary sodium consumption is inadequate.[23–25,55]

The difference in SwtR between the DII and NFL players in the afternoon when the length of practice differed was interesting. Although SwtR was higher in the NFL players and we were not able to document exercise intensity, the DII players appeared to work harder than the NFL players who participated in "toned-down" 10 (offensive)–10 (defensive)–10 (special teams) plays during practice. To our knowledge, the highest SwtR reported in the literature[56] is 3.9 L/h in a large collegiate offensive lineman. His mean SwtR was 2.89 L/h in 5 separate practices lasting 2.25 hours, compared with 3.9 L/h during a practice that was shortened (1.45 hours) because of lightning. Experimental data[57] have shown that as core temperature rises and the athlete becomes less hydrated, the sweat response is attenuated subsequent to extracellular fluid deficits and hyperosmolality, so SwtR diminishes.

Researchers[23,50] have documented both elevated core temperatures and mild dehydration in college and professional football players during preseason practices. Although the general belief is that dehydration decreases sweating and, therefore, evaporative heat loss,[34,35] involuntary dehydration possibly serves as a stimulus for fluid conservation via a decreased sweat response as exercise time increases.

Limitations

As with any observational field study, our study had inherent limitations, such as the inability to control exercise intensity and, to a lesser extent, the environmental conditions. For example, we could not control the temperature of the respective locker rooms, and, although not statistically significant, the 1.7°C difference in morning wet bulb globe temperature could have affected the data.

CONCLUSIONS

Both NFL players with constant access to fluids and DII players drinking during water breaks replaced approximately 66% of sweat loss and lost less than 1.4% of their initial body mass. Importantly, simply having cold water available for football players to drink during regular breaks in preseason practices resulted in the same modest weight loss as providing players constant access to both water and sports drinks.

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