BULLETS:

Factors effecting hydration and thermoregulation in the football athlete:

1. Football players have larger body surface areas' compared to other athletes.
2. Football players' sweat at higher rates compared to smaller athletes, and sweat rates in linemen are higher than backs and receivers.
3. Football players often lose large volumes of fluid during two-a-day practices due to sweat loss (7 to 14 $l \cdot d^{-1}$).
4. Sweat sodium is reportedly between 20 and 80 mmol $\cdot l^{-1}$ depending on acclimatization. Sweat sodium is less in those who are more acclimatized.
5. Football players are often not acclimatized prior to pre-season training.
6. Blood sodium declines in professional football players after successive days of two-a-day practices.
7. Blood, urine and body weight measurements suggest that college and professional football players are chronically under hydrated during pre-season.
8. Pre-practice urine specific gravity is frequently > 1.020 and often > 1.030 in college and professional football players.
9. Core body temperatures frequently exceed 39ºC (102.2ºF) in college and professional football players during pre-season practices.
10. Core body temperature is higher in professional linemen during practice compared to backs and receivers.

NFL linemen sweat at higher overall rates and lose greater volumes of sweat during practices compared to smaller backs and receivers. They consume more fluids and produce less urine during practice and are not more dehydrated compared to backs. Sodium supplementation may be necessary in NFL players during pre-season due to high daily sweat losses in both smaller (4.1 $l \cdot d^{-1}$) and larger (6.9 $l \cdot d^{-1}$) players.

Tc and sweat rate responses to continuous exercise in FB players participating in experimental dehydration trials do not accurately reflect actual Tc and sweat rate responses during pre-season FB practices.

Data indicate that core temperature cannot be accurately predicted from either % dehydration or sweat rates in NFL players.

NFL LM reached higher T_{cmax} during football practices compared to smaller BKS. T_{cmax} in all players were generally obtained at the end of practices. Level of dehydration as measured by body weight loss was not associated with T_{cmax}. Some of the players with the highest T_c were the least dehydrated.

It appears that the two episodes of muscle cramping in this football player may have been caused by different mechanisms or by a separate factor unrelated to either dehydration or

sodium depletion. Regardless of the cause, intravenous fluids alleviated the cramps on both occasions.

NFL linemen sweat at higher rates and lose greater volumes of sweat during practices in a hot compared to cool conditions. They consume more fluids during practices in the heat but were not more dehydrated. Sodium supplementation is necessary in NFL linemen during pre-season practices in the heat due to daily sweat losses of over 9 l and players need to be attentive to fluid replacement even in cool conditions.

BW and Urinary measures of hydration did not change during the first 9 days of preseason training in Na^+ supplemented NFL players. Oral supplementation using fluids containing two to four times more Na^+ than commercial sports drinks is useful in maintaining Na^+ and fluid balance in professional FB players during pre-season two-a-day training. UK^+ is higher in FB players after several consecutive days of two-a-day practices possibly indicating muscle damage.

Previous research shows football players require sodium supplementation during preseason. Inexpensive (or free) pickle juice maintains sodium balance in football players similarly to Rehydralyte which is cost prohibitive for many high school and college programs. Elevated blood K^+ above the normal range is a concern when using either Rehydralyte or pickle juice.

In similar environmental conditions NFL players reached similar maximal core temperatures regardless of equipment worn during practices. Individual players reached similar T_{cmax} and %DHY under both equipment conditions. Level of dehydration was not associated with T_{cmax}. Core temperatures of between 102ºF and 104ºF are common in football players even at mild levels of dehydration.

Mean SwtR was not different between NFL (2.08±0.25 $L \cdot h^{-1}$) and DII (1.77±0.15 $L \cdot h^{-1}$) but were different between linemen (2.29±0.17 $L \cdot h^{-1}$) and backs (1.56±0.15 $L \cdot h^{-1}$), $p<0.01$. There were no differences between NFL and DII in %Dehy after practices, or sweat loss and fluids consumed during the morning practice. During the afternoon practice sweat loss was greater in DII (3.9±1.3 L versus 2.3±0.83 L) as was fluid consumed (2.6±0.9 L versus 1.3±0.35 L). Daily sweat losses (8.0±2.0 L versus 6.4±2.1 L) and fluid consumed (5.03±1.5 L versus 4.0±1.1 L) were greater in DII. **Conclusions:** Body size influences sweat rate in football players regardless of playing level. The length of practice time determines total sweat losses and fluid consumption. Players who practice for long periods of time should be especially attentive to sodium replacement.

Blood Na^+ levels did not decline during the first 5 days of preseason training in Na^+ supplemented NFL players. BW was maintained through day 9. Na^+ supplementation is useful in maintaining Na^+ and fluid balance in professional FB players during the first week of pre-season two-a-day training.

NFL players reached higher T_c during the first few days of pre-season practices compared to day 10. The highest T_c in all FB was generally obtained during live scrimmaging. %Dehy on days 2 or 3 was not different from day 10 and was not associated with $T_{c\ max}$.

- NFL players still practice 2 times per day on consecutive days
- This schedule promotes
  - High daily sweat losses
  - Substantial Na+ losses
  - Low blood volume
  - Very high core Temperatures
  - Rhabdomyolysis – muscle damage/strains

- Supplementation is necessary for most players
- Supplementation needs vary widely and should be individualized
- Sodium and Chloride are important
- Football players <u>should not</u> consume extra potassium

- Football players reach very high core temperatures the first 3-5 days
- Pads versus Shells doesn't matter
- LM reach higher core temperatures compared to backs and receivers
- Core temperatures in all players are lower after the first week
- Core temperature <u>is not</u> related to dehydration when ≤ than 3%
- How hot a player gets <u>is related to</u>:
  - Exercise intensity and duration (#reps which determines metabolic rate)
  - Lack of rest breaks
  - Environmental factors
  - Acclimatization
  - Pre-disposition
  - Body size and fitness

- FB Players exhibit low blood volume until Day 3 of two-a-days
- FB players may have trouble maintaining normal body weight
- FB players may need a higher dietary intake of sodium

- FB players appear to struggle to maintain hydration and electrolyte balance during <u>consecutive days of 2-a-day</u> pre-season training
- Why? The rate at which they sweat
  - Body size – body surface area
  - Equipment
  - Environment
  - Exercise intensity and duration (4+ hr/day)
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- A football player who sweats 3.5 L **.** h-1 and practices 4.5 h per day = 13.5 L sweat loss
- At a sweat Na+ content of 50 mEq **.** L**-1** and 13.5 L per day he would lose 15.5 grams of Na+ (7.9 tsp salt) in one day
- Replacing ½ in food (~ 4 tsp salt)
- He needs to consume ~ **17 L** of CHO/Elec
- Won't this promote sodium dilution?

- An NFL player who sweats 3 L **.** h-1 and practices 4 h per day = 12 L sweat loss
- At a sweat Na+ content of 68.5 mEq **.** L**-1** and 12 L per day he would lose 19 grams of Na+ (9.5 tsp salt) in one day
- Replacing ½ in food (over 4.5 tsp salt)
- He needs to consume over 20 **L** of CHO/Elec drink

TOO much fluid – Not enough SALT

- Previous research shows football players require sodium supplementation during preseason
- Inexpensive (or free) pickle juice maintains sodium balance in football players similarly to Rehydralyte which is cost prohibitive for many high school and college programs

- Elevated blood K+ above the normal range is a concern when using either Rehydralyte or pickle juice
- Many players are consistently out of clinical range

- Tcmax (all players in 29 player practices)

were higher in LM (103 ± 1.1ºF, range = 101.7 to 105.7 ºF) than BKS (102 ± 0.8ºF, range = 100.9 to 103.3ºF), $p<0.01$.

- There were no differences in %Dehy between LM and BKS (-1.25 ± 0.9 % versus -1.6 ± 1.2 %)
- There was no correlation between Tcmax and %Dehy, $r = 0.122$, $p = 0.53$.

- Level of dehydration as measured by body mass loss was not associated with Tcmax
- Some of the players with the highest Tc were the least dehydrated
- Tcmax are lower the second week

- 9 out of 10 players were excreting protein after the game (2004) when it was HOT (96 ºF)
- 7 out of 11 players were excreting protein after a game in mild conditions (68 ºF)
- All had high urine K+