

# Seventy-Five Percent of National Football League Teams Use Pregame Hyperhydration With Intravenous Fluid

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**Objective:** To determine the number of National Football League (NFL) teams using pregame hyperhydration with intravenous fluid (IVF), the most common protocols for using the IVF, the complications from this routine, and the perceived efficacy of this treatment.

**Design:** Cross-sectional survey study.

**Setting:** National Football League.

**Participants:** The head athletic trainer from all 32 NFL teams received and completed the survey.

**Intervention:** A survey designed to answer the aforementioned topics.

**Main Outcome Measures:** Number of teams using IVF to hyperhydrate euvoletic players before NFL games.

**Results:** All teams (100%, 32 of 32) responded. Seventy-five percent (24 of 32) of NFL teams used pregame hyperhydration with IVF. On average, 5 to 7 players per team per game received IVF. Players received an average of 1.5 L of fluid, an average of 2.5 hours before the game. When the athletic trainers were asked to mark all the reasons why they use pregame hyperhydration with IVF, the most commonly cited reason was muscle cramps (23 of 24). However, player request was the number one answer (10 of 24) when the athletic trainers were asked to mark only the primary reason for giving IVF. Of the 27 head athletic trainers who had used pregame hyperhydration with IVF in the past, 13 (48%) reported complications.

**Conclusions:** Pregame hyperhydration is a common practice in the NFL. Because pregame hyperhydration with IVF is often a player-driven routine and has potential complications, more scientific studies are needed to determine its true efficacy.

**Key Words:** hydration, hyperhydration

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## INTRODUCTION

Pre-exercise hyperhydration with oral fluid has been found to improve physiologic responses to heat stress and exercise performance in some trials. However, these results have not been reproducible.<sup>1,2</sup> One study found that hyperhydrating individuals with intravenous fluid (IVF) did not convey a physiologic advantage, did not increase exercise time, and did not improve ratings of perceptual strain compared with the euhydrated state.<sup>3</sup> Moreover, multiple rehydration trials have shown that IVF does not consistently improve fluid retention, thermoregulation, cardiovascular response, ratings of perceived exertion, or exercise tolerance compared with oral fluids.<sup>4–8</sup>

Despite the inconclusive evidence for hyperhydrating athletes with IVF before exercise, many teams in the National Football League (NFL) use pregame hyperhydration with IVF to gain a competitive advantage. The goals of this study were to determine the number of teams using pregame hyperhydration with IVF, the most common protocols for using the IVF, the complications from this routine, and the perceived efficacy of this treatment.

## MATERIALS AND METHODS

We created and distributed a survey (Appendix) based on the guidelines described by Sprague et al.<sup>9</sup> The survey was first distributed to the current medical staff of an NFL team and members of the research department at our institution to determine if all terms (specifically the term “hyperhydration”) were clearly defined. The reviewers also examined the questions and answers from the survey to ensure that they were clear, concise, and addressed all major topics regarding the practice of hyperhydration.

We used an online survey tool called surveymonkey.com to help collect and analyze results. Surveymonkey.com LLC is a licensee of the TRUSTe Privacy Program and abides by the EU Safe Harbor Framework as outlined by the US Department of Commerce and the European Union. SurveyMonkey.com meets all BBBOnLine participation and Better Business Bureau accreditation standards and is authorized to display the BBB Accredited Business seal. The study was not approved by an institutional review board or other ethics approval body because the study did not apply an intervention to patients and was a retrospective survey of a practice during the 2009–2010 NFL season.

The survey was distributed to the head athletic trainer from all 32 NFL teams via e-mail. The survey was administered

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at the end of the 2009-1010 NFL season, and all surveys were completed within 4 weeks of distribution. The survey was filled out anonymously by each athletic trainer. Any surveys that were not received by online response were completed by phone. One author (S.F.) reviewed each survey for inconsistent answers and contacted the athletic trainer to clarify those answers. The online survey tool compiled the answers to each question and calculated percentages for each answer.

The survey asked if teams use pregame hyperhydration with IVF, how many players (on average) receive the IVF on hot (>80°F), warm (65-80°F), and cold (<65°F) days, who inserts the intravenous catheter, what IVF is used, how much IVF is given, when is the IVF given, why is the IVF given, what complications the athletic trainers have encountered from this practice, and what is the perceived efficacy of the IVF. We also asked the athletic trainers who do not use IVF for hyperhydration why they do not use this method. Our last question asked the athletic trainers to identify the region of the United States in which each team is located to correlate the number of intravenous catheters placed per game with climate.

**RESULTS**

All teams (32 of 32, 100%) responded to the survey over a 3-week to 4-week period. Seventy-five percent (24 of 32) of the NFL teams used pregame hyperhydration with IVF. On hot days (>80°F), an average of 7 players per team (range, 1-20) received pregame hyperhydration with IVF. On warm days (65-80°F) and cold days (<65°F), an average of 6 (range, 0-20) and 5 (range, 0-20) players received pregame hyperhydration with IVF, respectively. The players received the fluid an average of 2.5 hours before the game (range, 0.5-5.0). The players received an average of 1.5 L of IVF before the game (range, 1.0-2.0). The most commonly used IVF was normal saline (14 of 24).

When asked to choose all professionals who insert the intravenous catheter, the team internist was the most common answer (21 of 24). The team orthopedist places the catheter on 10 teams. Other answers were paramedic (4), athletic trainer (4), fellow (3), anesthesiologist (2), and emergency room doctor (2).

When the athletic trainers were asked to mark all of the reasons why they administer pregame hyperhydration with IVF, “to prevent muscle cramps” was the number one answer (23 of 24). The other answers chosen in order of frequency were “to prevent dehydration”(19), “player request” (17), “to prevent heat illness”(14), and “to improve player exercise tolerance” (8).

When the athletic trainers were asked to mark the primary reason why they administer pregame hyperhydration with IVF, “player request” (10 of 24) was the number one answer given. The other answers chosen in order of frequency were “to prevent muscle cramps” (8), “to prevent heat illness” (3), and “to prevent dehydration” (2). No athletic trainer chose the answer “to improve player exercise tolerance”. One athletic trainer wrote that in hot weather he uses it to prevent muscle cramps, but when the weather is cold the primary reason is player request.

Eight teams do not use pregame hyperhydration with IVF. Seven of these teams chose the answer, “My players hydrate orally, I don’t feel they need to use IVF” when they were asked why they do not use pregame hyperhydration with IVF. One athletic trainer answered “other” and wrote in that he feels he educates his players to hydrate orally and that if he used IVF, the players may not drink as much.

Of the 27 head athletic trainers who currently use or have used pregame hyperhydration with IVF in the past, 13 (48%) reported complications. Three athletic trainers had used pregame hyperhydration in the past but do not use it currently. Superficial venous clot was reported by 3 teams. Other complications and the number of teams reporting these complications were air embolus (2), pulmonary edema (2), peripheral edema (2), provider needle stick (2), and arterial puncture (1). Two teams reported that this practice develops a mental dependence in players who feel they need the IVF before every game. One team had reported 2 complications resulting in a total of 14 complications reported by 13 teams.

Athletic trainers were asked to rate how effective they felt that pregame hyperhydration was in 4 situations (Table). Of the 27 athletic trainers who had implemented this practice in the past, more than half felt that it was extremely effective or very effective to prevent muscle cramps (19 of 27), prevent heat illness (15 of 27), and prevent dehydration (18 of 27). Only 7 of the 27 athletic trainers felt that pregame hyperhydration with IVF was extremely effective or very effective to improve player exercise tolerance. Five athletic trainers had never used pregame hyperhydration with IVF.

When the athletic trainers were asked if they felt that the IVF improved their teams overall performance, 8 answered “yes,” 15 answered “no,” and 9 answered “I’m not sure.”

We asked the athletic trainers to identify the region of the country in which their team played. Teams in one region of the country with a high heat index tended to give the most players per game IVF. Teams from cities with lower heat indices tended to give IVF to fewer players per game. We have not named the regions to help preserve the anonymity of these teams because many members of the NFL medical teams

**TABLE.** The Perceived Efficacy of Hyperhydration With Intravenous Fluid in 4 Conditions

	Extremely Effective No. (%)	Very Effective No. (%)	Mildly Effective No. (%)	Not Effective No. (%)	I Am Unsure No. (%)	Never Used No. (%)
To prevent muscle cramps	4 (12.5)	15 (46.9)	6 (18.8)	0 (0.0)	2 (6.3)	5 (15.6)
To prevent heat illness	6 (18.8)	9 (28.1)	6 (18.8)	0 (0.0)	6 (18.8)	5 (15.6)
To prevent dehydration	5 (15.6)	13 (40.6)	6 (18.8)	0 (0.0)	3 (9.4)	5 (15.6)
To improve player exercise tolerance	1 (3.1)	6 (18.8)	9 (28.1)	4 (12.5)	7 (21.9)	5 (15.6)

believe that the IVF gives their players a competitive advantage.

## DISCUSSION

A survey of the NFL head athletic trainers indicates that 75% of NFL teams use pregame hyperhydration with IVF, with an average of 5 to 7 players per team. Player request was the number one answer when the athletic trainers were asked to mark the primary reason for giving IVF. Although we believed this to be a common practice, we did not anticipate that more than half of NFL teams would use this routine.

The only trial that we are aware of that compares pre-exercise hyperhydration with IVF with the euhydrated state has shown that the IVF conveys no advantage. In this trial, 10 emergency responders wearing personal protective equipment performed a walking trial that alternated walking at low speed without weights with walking at higher speeds on an incline with weights. In this trial, maximum core temperature, maximum heart rate, and exercise tolerance did not differ significantly between the 2 states. There was also no difference in perceptual measures of exertion.<sup>3</sup> This would suggest that intravenous hyperhydration may not be beneficial for NFL players. However, this trial did not simulate an NFL game situation. The trial was not performed on NFL players, did not simulate NFL game conditions, and was not performed at a high heat index (21°C, 70% relative humidity), and the participants were given the IVF (on average 1.3 L) only 10 to 15 minutes before exercise.<sup>3</sup>

In the most recent review on the topic, van Rosendal et al<sup>10</sup> found that the highest quality studies showed that pre-exercise hyperhydration with glycerol can attenuate dehydration and may benefit athletes who participate in endurance events. However, the practice of hyperhydration before exercise has not consistently been shown to have a reproducible benefit on exercise tolerance or physiologic markers of heat illness.<sup>1,2</sup> This is commonly implemented as glycerol hyperhydration because of the potential for fluid retention. It has been postulated that the mechanism of action is increased water absorption in the nephron due to an increase in the kidney's medullary gradient.<sup>1</sup> Hyperhydration with water has also been shown to have no clear physiologic advantage over the euhydrated state.<sup>11,12</sup>

There have been multiple trials comparing rehydration with IVF with rehydration with oral fluid.<sup>4-8</sup> These trials have not shown a clear advantage to the IVF groups. Kenefick et al<sup>6</sup> showed a transient increase in plasma volume and decrease in core temperature in the IVF group compared with those in the oral group. However, these differences were no longer significant at the first reported temperature and plasma volume measurements during the heat tolerance test. In a study by Castellani et al,<sup>5</sup> the IVF rehydration group had lower heart rates at times 45, 60, and 75 minutes compared with the oral rehydration group. All other physiologic parameters were equal.

Some trials have shown oral rehydration to be superior to rehydration with IVF. Riebe et al<sup>8</sup> found that their oral rehydration group had lower ratings of central perceived exertion and thirst compared with the IVF group. Kenefick et al<sup>6</sup> also showed a decrease in thirst in the oral rehydration

group. Casa et al<sup>4</sup> found that the oral group had a lower core temperature at 0 to 20 minutes and that skin temperature was lower in the oral group at 0 to 12 minutes. Maresh et al<sup>7</sup> found that their oral group had lower central and overall ratings of perceived exertion at 15 minutes, but this difference did not last until the end of the exercise trial. They also found a lower thermal sensation in the oral group at 15 minutes. The oral group in this study had a lower thirst sensation throughout the trial compared with the IVF group.

When 1 L of 0.9% saline is infused into normovolemic subjects, there is an increase in blood volume of between 100 and 200 mL at 2 to 3 hours after infusion.<sup>13</sup> This would imply that with 1.5 L, the increase would be between 150 and 300 mL. Another study by the same authors found a 483 mL increase in blood volume 1 hour after a 2-L infusion of normal saline. This was only a 24% volume expanding efficiency, which is less than the 33% efficiency that is classically taught.<sup>14</sup> For an average human being (70 kg), the normal blood volume is 5 L (3 L of plasma and 2 L inside red blood cells). Therefore, the increase in blood volume from 1.5 L of fluid would likely be negligible, especially in NFL players who typically weigh more than 70 kg.

The athletic trainers' responses indicate that they commonly use IVF before games to prevent muscle cramps and that 19 of 27 trainers believe that IVF is either extremely helpful or very helpful in preventing muscle cramps. One theory suggests that exercise-associated muscle cramps result from a combination of fluid and sodium losses when muscles are fatigued.<sup>15</sup> Because of this, it is possible that the combination of sodium and fluid load from the IVF could help prevent cramps. It has been suggested that maintaining hydration during games and increasing dietary salt load are effective to prevent cramps.<sup>15</sup> This may be safer, easier, and less expensive than using IVF before games to prevent cramps.

Complications were reported by 13 of 27 athletic trainers (48%) who had used pregame hyperhydration in the past. The number of complications per team or per diagnosis was not determined by the survey. The most common complication reported was superficial venous thrombosis. The most potentially serious complications reported were air embolus, pulmonary edema, and peripheral edema. It is important to note that we did not ask the diagnostic criteria for each complication and we did not ask which medical provider diagnosed each complication. This means that a complication may have been identified by a provider not trained to make that diagnosis. Two teams reported psychological dependence on IVF before games as a complication. This is interesting because player request was the primary reason that most teams administer IVF. A better understanding of the true benefit of pregame hyperhydration with IVF is needed. This would either confirm or refute the use of this player-driven practice that has potential complications.

The most obvious limitation of this study was that it was a retrospective survey study and it has the inherent flaws of this type of design. One of these flaws is recall bias, although we performed the survey at the end of the season to try to reduce this bias. Our study is also limited because we did not survey the head team physician from each team. Many teams have different protocols regarding who oversees the administration of

IVF before games. We felt that the most uniform way to obtain results was to ask the head athletic trainer. Physicians may have had a different perspective on the efficacy and utility of hyperhydration with IVF. Another limitation of our survey of complications is that we did not ask how many of each type of complication each team had encountered. Only 1 team reported more than 1 complication type. Teams may have seen multiple cases of the same complication, but were unable to report these multiple cases based on the survey. Our question about perceived effectiveness is limited by the “strength of choice” principle, because “extremely effective,” “very effective,” and “mildly effective” can mean different things to different people. The largest strength of the study is the 100% response rate.

### CONCLUSIONS

A survey of the NFL head athletic trainers indicates that 75% of NFL teams use pregame hyperhydration with IVF, with an average of 5 to 7 players per team receiving IVF. Because the use of pregame hyperhydration with IVF is often a player-driven routine and has potential complications, more scientific studies are needed to determine its true efficacy.

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APPENDIX: SURVEY DISTRIBUTED TO THE HEAD ATHLETIC TRAINER FROM EACH NFL TEAM.

**1. Default Section**

**\* 1. Does your team use pregame hyperhydration with intravenous fluid (IVF) \*?**

**\*Please note that hyperhydration refers to what many athletic trainers and doctors routinely call "prehydration" or "pregame hydration". Hyperhydration is the use of fluids to increase total body water to prevent muscle cramps, to prevent heat illness, to prevent dehydration, and/or to improve exercise tolerance in players with a normal baseline volume status. Please do not include players that require IVF for a medical problem (for example dehydration from diarrhea).**

YES

NO

**2.**

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**\* 1. On average, how many players on your team routinely receive pregame IVF for hyperhydration before a game when the on field temperature is "hot" (for example greater than 80°F)? (please include preseason and postseason games)**

Please Choose from Dropdown Menu

Number of Players

Other (please specify)

**\* 2. On average, how many players on your team routinely receive pregame IVF for hyperhydration before a game when the on field temperature is "warm" (for example 65-80°F)? (please include preseason and postseason games)**

Please Choose from Dropdown Menu

Number of Players

Other (please specify)

**\* 3. On average, how many players on your team routinely receive pregame IVF for hyperhydration before a game when on the field temperature is "cold" (for example less than 65°F)? (please include preseason and postseason games)**

Please Choose from Dropdown Menu

Number of Players

Other (please specify)

**\* 4. On average, how many hours before the game do the players receive the IVF?**

Please Choose from Dropdown Menu

Number of Hours Before the Game

Other (please specify)

**\* 5. On average, how many liters of IVF does each player receive?**

Please Choose from Dropdown Menu

Number of Liters of IVF

Other (please specify)

**\* 6. What IVF do you most commonly use?**

- 0.9% NaCl (normal saline)
- 0.45% NaCl (half normal saline)
- LR (lactated ringer's solution)
- Plasma-Lyte
- Other (please specify in box)

Other (please specify)

**\* 7. Who inserts the venous catheter through which the IVF is administered? (please select all that apply)**

- Team orthopaedist
- Team internist
- Athletic Trainer
- Fellow
- Paramedic
- Resident
- Medical student
- Other (please specify in box)

Other (please specify)

**\* 8. List ALL reasons why you administer pregame hyperhydration. (please choose all that apply)**

- To prevent muscle cramps
- To prevent heat illness
- To prevent dehydration
- To improve player exercise tolerance
- Player request
- Other (please specify in box)

Other (please specify)

**\* 9. What is the PRIMARY reason that you administer pregame hyperhydration with IVF? (please select only one answer)**

- To prevent muscle cramps
- To prevent heat illness
- To prevent dehydration
- To improve player exercise tolerance
- Player request
- Other (please specify in box)

Other (please specify)

**3.**

**\* 1. If your team DOES NOT USE pregame hyperhydration with IVF please select the reasons why. (please select all that apply)**

**If your team DOES USE pregame hyperhydration with IVF, please check the first box.**

MY TEAM DOES USE PREGAME HYPERHYDRATION WITH IVF

My players hydrate orally, I don't feel they need to use IVF

I do not feel it works

The team physician does not feel it works

I have had players with complications from IVF

It is too difficult to organize

Players do not like it

I have never considered using IVF for hyperhydration

Other (please specify in box)

Other (please specify)

\_\_\_\_\_

**\* 2. If you have EVER USED pregame hyperhydration with IVF, please indicate how effective you feel the IVF was for each situation.**

**If you have NEVER USED pregame hyperhydration with IVF please select Never Used for all four situations.**

	Extremely Effective	Very Effective	Mildly Effective	Not Effective	I Am Unsure	Never Used
To prevent muscle cramps	<input type="radio"/>					
To prevent heat illness	<input type="radio"/>					
To prevent dehydration	<input type="radio"/>					
To improve player exercise tolerance	<input type="radio"/>					

**\* 3. What complications have you experienced with pregame hyperhydration with IVF? (please select all that apply)**

- Infection (for example cellulitis or phlebitis)
- Superficial venous thrombosis (superficial venous blood clot)
- Pulmonary edema
- Peripheral edema
- Arterial puncture
- Provider needlestick
- None
- I have never used pregame hyperhydration with IVF
- Other (please specify in box)

Please Specify Other

**\* 4. In your opinion does pregame hyperhydration with IVF improve your team's overall performance?**

- Yes
- No
- I'm not sure



**5. Using the map above, please select the region in which your team plays its home games. This question is optional if you feel uncomfortable revealing your team's location.**

- I or II
- III
- IV
- V
- VI
- VII, VIII, or X
- IX