Optimal hydration is essential for multiple physiological functions, including thermoregulation and nutrient transportation (Cheuvront & Kenefick, 2014; Sawka et al., 2007). By impairing key physiological functions and impairing heat tolerance, exercise-induced dehydration can negatively affect physical and mental performance in athletes (Armstrong et al., 2012; Casa et al., 2000; Cheuvront & Kenefick, 2014; Judelson et al., 2007a; Lopez et al., 2011; Maughan & Shirreffs, 2010a). Previous studies suggest that dehydration of as little as 2% can impair performance during intense exercise in the heat (Casa et al., 2000; Cheuvront & Kenefick, 2014; Judelson et al., 2007b; Lopez et al., 2011).

Previous observation studies in athletes have identified two key problems: 1) Many athletes start exercising in a hypohydrated state, and 2) many athletes become dehydrated during prolonged exercise (Gibson, Stuart-Hill, Pethick, & Gaul, 2012; Maughan, Watson, Evans, Broad, & Shirreffs, 2007; Shirreffs et al., 2005; Silva et al., 2011; Stover et al., 2006; Phillips et al., 2014). However, there is only limited evidence that hydration interventions are successful in preventing athletes from starting or becoming hydrated during exercise (Bandelow et al., 2010; Kurtdak et al., 2010; Maughan et al., 2007; Maughan & Shirreffs, 2010a; Shirreffs et al., 2005; Silva et al., 2011; Phillips et al., 2014; Yeargin, Casa, Armstrong, Watson, Judelson, Psathas, & Sparrow, 2006; Yeargin et al., 2010).

Furthermore, most studies have been conducted in male athletes. And while general hydration guidelines are typically also applied to female athletes (Maughan & Shirreffs, 2007), this approach fails to acknowledge that heat production, sweat rates, and body weight (BW), which is typically used to normalize hydration recommendations, are typically lower in female athletes when compared with their male counterparts (MacLeod & Sunderland, 2012). In one of the few studies conducted in female athletes, Gibson et al. (2012) demonstrated that almost half of elite female soccer players started exercising in a hypohydrated state. However, this study was conducted in a cool environment. To the best of our knowledge, no study has comprehensively assessed hydration status in female athletes exercising in hot and humid conditions.

The main objective of this study was to assess fluid status, as characterized by fluid intake, fluid losses, and urinary measures of hydration, in female collegiate soccer players in a hot and humid environment over the course of a preseason. Our secondary objective was to use our findings to conduct an individualized intervention aimed at preventing players from exercising in a dehydrated state. We hypothesized that the intervention would improve hydration status, as indicated by greater voluntary fluid intake and lower preexercise urine-specific gravity (USG) urine color (UC).

Presentation of the Athletes

The case study was performed while the lead author, who is a graduate student in exercise science and holds undergraduate degrees in sports nutrition and exercise science and human performance, served as an assistant coach for a Division I women’s soccer team. The author noted the lack of hydration counseling in these young female soccer players. The case study was conducted during the
Preseason and nonconference games (August-September 2014) at a state University in Mississippi, USA. Data from ten players (20.4 ± 1.4yrs.; 166 ± 7 cm; 64 ± 9 kg) were included in the final analysis. Due to injuries or late arrival to the team, data for several players were not included in the final analysis. In addition, one player was excluded from the study because she consumed excessive amounts of dietary supplements, and another player was excluded because she was on medication for a chronic inflammatory disease.

Written consent was provided by all of the participants. The present study was performed in a hot and humid climate (mean 31 °C; 89%) over a period of 7 weeks (Figure 1). To minimize any behavioral changes, the main objective of the study was not disclosed to the participants until the pretests were completed.

Pre-Test
Players recorded their daily fluid intake over a period of 3 days. On day two and three, players collected a urine sample before practice. Urine samples were stored in a cool container and were analyzed for USG with a digital refractometer (index instruments Ltd, serial No DR 303, England) and for UC according to an eight-point UC scale (Armstrong, 2005). Before and after afternoon practice sessions on day two and three, players were weighed on an electronic body weight scale (Tanita model WB-100PMA). During training sessions, water was provided to players ad libitum. Players were instructed to only drink out of their own bottle, to not spit out any water and not to spray any water for cooling.

Intervention Phase
Following assessment and analysis of pretest data, a 4-week intervention phase was implemented. Based on daily fluid intake, recommended daily intake, and fluid losses during exercise, all players received individual hydration recommendations. In addition, hydration counseling was provided in a group setting both during and after practice sessions. A commercially available carbohydrate drink (6%) was provided to all of the players throughout the training session and players were instructed to consume 1.5 times the amount of their fluid loss immediately after each practice session. Further, a fat-reduced chocolate milk (500 ml; 48g CHO, 16g protein, 5g Fat), was provided to all players to facilitate postexercise muscle protein and glycogen synthesis (Phillips & Van Loon, 2011). Before the start of each game, USG and UC was measured and analyzed immediately. If USG and UC data indicated that an athlete was dehydrated (USG >1.020g/ml or UC ≥ 3), the player was instructed to hydrate before starting the warm-up (3–5 ml per kg BW 2 hr before exercise).

Posttest
Following completion of the intervention after 4 weeks, an unannounced test was conducted two hours before a warm-up of a game (Game 1) at the end of the preseason. Urine samples were collected and USG and UC were measured instantly. Players were provided immediate feedback about their hydration status. Two days later, urine samples were collected four hours before the beginning of the warm-up of a second game (Game 2). Urine specific gravity and UC were measured immediately and each player was provided with specific advice (verbally and in written form). Players who exhibited a USG ≥ 1.020g/ml and UC ≥ 4 were instructed to consume 5–7 ml/kg BW (Sawka et al., 2007) and to record their fluid intake during the two-hour rehydration period.

Figure 1 — Schematic illustration of the study design