Compliance With the National Athletic Trainers' Association Inter-Association Task Force Preseason Heat-Acclimatization Guidelines in High School Football

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Context: In 2009, the National Athletic Trainers' Association Inter-Association Task Force (NATA-IATF) released preseason heat-acclimatization guidelines for gradually acclimatizing high school (HS) athletes to the environment during the first 2 weeks of the preseason and reducing the risk of exertional heat illness. However, researchers who studied the 2011 preseason found a low level of overall compliance.

Objective: To assess compliance with the NATA-IATF guidelines during the 2017 preseason and compare the findings with 2011 preseason data and between states mandating and not mandating the guidelines.

- Design: Cross-sectional study.
- Setting: Preseason HS football, 2017.

Patients or Other Participants: A total of 1023 athletic trainers working with HS football (14.2% response rate).

Main Outcome Measure(s): Using a survey, we acquired information from athletic trainers on their HS football programs, including location and compliance with 17 NATA-IATF guide-lines during the 2017 football preseason. The outcome measures were full compliance with all 17 NATA-IATF guide-lines and compliance with \geq 10 NATA-IATF guidelines. Prevalence ratios (PRs) with 95% confidence intervals (CIs) compared

findings between (1) the 2017 and 2011 preseasons and (2) states whose HS athletic associations imposed a full or partial or no mandate to follow the NATA-IATF guidelines.

Results: Overall, 3.9% reported full compliance with NATA-IATF guidelines; 73.9% complied with \geq 10 guidelines. The proportion reporting full compliance was higher in 2017 than in 2011 but not statistically different (3.9% versus 2.5%; PR = 1.54; 95% CI = 0.96, 2.46). However, the proportion reporting compliance with \geq 10 guidelines was higher in 2017 (73.9% versus 57.9%; PR = 1.28; 95% CI = 1.20, 1.36). The proportion of respondents reporting their HSs were fully compliant was highest among the with-mandate group (9.4%), followed by the partial-mandate group (4.6%) and the without-mandate group (0.6%). Group differences retained significance when we examined compliance with \geq 10 guidelines.

Conclusions: Although full compliance with NATA-IATF guidelines remained low, many HS football programs complied with \geq 10 guidelines.

Key Words: high school athletes, exertional heat illness, heat stroke, policy, injury prevention

Key Points

- Compared with a previous cross-section of data from the 2011 preseason, some evidence suggested greater compliance with the National Athletic Trainers' Association Inter-Association Task Force preseason acclimatization guidelines during the 2017 preseason.
- Although full compliance was low across the sample during the 2017 preseason (1 in 25 respondents), nearly threefourths of respondents noted compliance with ≥10 of the 17 guidelines.
- The proportion of respondents who reported that their high schools were fully compliant with the National Athletic Trainers' Association Inter-Association Task Force guidelines was highest in states mandating the guidelines.

pproximately 9000 exertional heat illness (EHI) events are treated annually in US high school (HS) athletes.¹ In particular, exertional heat stroke, the most severe type of EHI, has been estimated to account for

about 1 in 6 of all football-related deaths² and can result in permanent disability if not properly treated.^{3–5} Given that EHI-related deaths are preventable,³ continued awareness and preventive strategies are integral. Additionally, in HS

sports, athletic trainers (ATs) are often the individuals managing injured athletes while also ensuring complete and proper implementation of preventive strategies.

Heat acclimatization is one recommended approach for preventing EHI.⁶⁻⁹ The National Athletic Trainers' Association (NATA) created an Inter-Association Task Force (NATA-IATF) to develop preseason heat-acclimatization guidelines for helping HS athletes reduce their risk of EHI.⁶ The guidelines, released in 2009, recommended gradual acclimatization to a hot environment over the first 2 weeks of the preseason, during which 95% of heat-acclimatization adaptations occur.¹⁰ The guidelines included specific recommendations for football, including the lengths of practice and rest breaks, limitations on double-practice days, a requirement of AT presence, and limitations on practice contact and the equipment worn (Table 1). Since 2009, a number of state HS athletic associations have mandated implementation of the NATA-IATF guidelines in their state HSs.¹¹

Recent researchers¹² suggested that EHI rates were reduced 55% when state HS athletic associations-which regulate HS rules and safety at the state level in the United States-mandated the NATA-IATF guidelines. However, during the 2011 preseason, only an estimated 2.5% of HS football programs fully complied with NATA-IATF guidelines.¹³ Also, programs in states whose athletic association-mandated guidelines met the criteria set forth by the NATA-IATF guidelines had higher levels of compliance.¹³ Alongside outcome evaluation (ie, how effective the intervention is in producing change), process evaluation (ie, how stakeholders see that an intervention may have achieved change) is also needed to assess the value and effects of the implemented guidelines.¹⁴ Such a process evaluation may help to ensure that the potential benefits associated with implementing the NATA-IATF guidelines (as examined by outcome evaluation) are realized and that barriers to proper implementation are identified to aid the reach of these guidelines. Therefore, we assessed the level of compliance with the NATA-IATF guidelines during the 2017 HS football preseason. Our hypotheses were

- Hypothesis 1: The prevalence of school compliance with the NATA-IATF heat-acclimatization guidelines during the 2017 HS football preseason would exceed that of the 2011 preseason.¹³
- Hypothesis 2: The prevalence of school compliance with the NATA-IATF heat-acclimatization guidelines during the 2017 HS football preseason would be highest in states whose state athletic association-mandated guidelines met the criteria set forth by the NATA-IATF guidelines.

METHODS

We used a cross-sectional survey design similar to that of previous researchers¹³ who assessed compliance with NATA-IATF guidelines during the 2011 HS football preseason. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill. Participants provided informed consent by answering the survey.

Table 1. National Athletic Trainers' Association Inter-Association Task Force Preseason Heat-Acclimatization Categories and Guidelines^a

Category 1. First 5 days

- 1.1. During the first 5 days of formal football practices, walkthroughs were no more than 1 hour in length
- 1.2. Double-practice days did not occur during the first 5 days of formal football practices

Category 2. Length of practice

- 2.1. Single-practice days consisted of practices no more than 3 hours in length
- 2.2. Double-practice days consisted of practices no more than 5 hours in length in total
- 2.3. No more than 2 practices per day

Category 3. Length of rest breaks

- 3.1. A 3-hour recovery period occurred between the practice and walk-through (or vice versa)
- 3.2. Two practices were separated by a break of at least 3 continuous hours that was in a cool environment
- 3.3. Double-practice days were not followed by another doublepractice day
- 3.4. One day of complete rest after 6 consecutive days of practice

Category 4. AT presence

- 4.1. AT must be on site before, during, and after all practices
- 4.2. AT had ability to cancel/delay practice because of inclement weather/heat restrictions

Category 5. Equipment alterations

- 5.1. Helmet was the only equipment worn on first 2 days of practice
- 5.2. During days 3-5, only helmets and shoulder pads were worn
- 5.3. All protective equipment was not worn until day 6

Category 6. Contact drills

- 6.1. Contact with blocking sleds was not initiated until day 3
- 6.2. Contact with tackling dummies was not initiated until day 3
- 6.3. One-hundred percent full-contact drills were not initiated until day 6

Abbreviation: AT, athletic trainer.

^a Adapted from Casa et al.⁶ A *practice* was defined as the period of time a participant engages in a coach-supervised, school-approved, sport- or conditioning-related physical activity; warm-up, stretching, and cool-down activities were included as part of the 3-hour practice time; all conditioning and weight-room activities should be considered part of practice. A *walk-through* was defined as a teaching opportunity with the athletes not wearing protective equipment (eg, helmets, shoulder pads, catcher's gear, shin guards) or using other sport-related equipment (eg, footballs, lacrosse sticks, blocking sleds, pitching machines, soccer balls, marker cones).

Study Sample and Recruitment

The population of interest was NATA-affiliated ATs working with US HS football programs during the 2017 season. To be eligible for inclusion in the study, ATs had to (1) have a valid e-mail address, (2) be NATA affiliated, (3) have opted in to take surveys on the NATA membership list, and (4) be either directly employed by a school district or working in the HS football setting via outreach for a clinic, hospital, or physician practice.

An invitation to participate was sent to all ATs on the NATA membership list who met the first 3 criteria (N = 7278). Nonrespondents received e-mail reminders on a biweekly basis during the 4-month data-collection period (December 2017 to March 2018). The membership list included ATs working in HSs that did not sponsor football,

but we could not discern which ATs worked in such settings. Thus, responding ATs were asked whether they worked with an HS football program during the 2017 season; those responding that they did not were notified that they did not meet the criteria to participate (n = 92). Of the remaining 7186, 1214 began the survey, and 1023 completed it. This led to an estimated 14.2% response rate, although this rate may be underestimated by additional ATs who did not work with HS football but did not notify us. The sampling strategy was unable to account for whether responding ATs from the same HSs responded to the survey.

Survey Instrument

The survey used was replicated from the previous study,¹³ whose investigators reviewed the NATA-IATF guidelines⁶ and identified 17 specific items to use as key metrics. These 17 guidelines were grouped into 6 major categories (Table 1). We retained the guidelines and categories to allow for comparability with the previous study.¹³

Participating ATs provided information on whether the HS football programs with which they worked complied with the NATA-IATF guidelines during the 2017 preseason. The *preseason* was defined as the period, usually 2–3 weeks before the first game of the regular football season, characterized by athletes participating in football-specific training, in which equipment is phased in and football-specific training and skills are conducted. This definition excluded summer conditioning that occurred before football-specific training. We also emphasized that the focus of this compliance was on the HS football programs and not the ATs; this was done intentionally to ensure that participating ATs were comfortable providing answers that might indicate noncompliance.

The survey never explicitly mentioned the implementation of the 17 specific NATA-IATF guidelines. This was done to minimize the potential for reporting bias. The survey also collected ATs' demographic information and experience and school-related characteristics including state, enrollment size, and number of student-athletes at their school(s) during the 2017–2018 school year. Last, ATs provided data on their HS football program's 2017 preseason training, including the size of the preseason squad and the schedule of practice sessions and rest breaks. The previous survey¹³ had been pilot tested with a

The previous survey¹³ had been pilot tested with a convenience sample of 11 ATs from 2 universities who provided care to HS athletes in order to ensure that the content was clear, concise, and error free. Similarly, we pilot tested the current survey with a convenience sample of 5 ATs who provided care to HS athletes. We explained the study purpose to the ATs pilot testing the survey, emphasizing our intent to ensure comparability between our findings and the previous investigation. The ATs' recommended changes, which focused on aiding participant comprehension, were applied to the survey.

Statistical Analysis

We were interested in how compliance differed between (1) the 2017 and 2011 HS football preseasons and (2) the HS football programs in states whose athletic association—mandated guidelines for football preseason heat-acclimatization met (*with-mandate* group) or did not meet (*without*-

Table 2.	Athletic Trainer (AT) and High School	I (HS)
Characte	istics (N = 1023), 2017 Football Prese	ason

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Characteristics	No. (%)
AT	
Sex	
Female	552 (55.0)
Male	452 (45.0)
Missing	19
Age. v	
20–29	387 (38.2)
30–39	281 (27.7)
40–49	188 (18.5)
50 +	158 (15.6)
Missing	9
Years as AT	
<5	279 (27.4)
5–9	238 (23.4)
10–14	117 (11.5)
15–19	108 (10.6)
20–24	103 (10.1)
25+	172 (16.9)
Missing	6
Years as AT in current HS	
<5	521 (51.2)
5–9	183 (18.0)
10–14	120 (11.8)
15–19	86 (8.5)
20–24	44 (4.3)
25+	64 (6.3)
Missing	5
HS	
Region ^a	
Midwest	250 (24.4)
Northeast	210 (20.5)
South	371 (36.3)
West	192 (18.8)
Student enrollment (2017–2018)	
<500	183 (18.4)
500–999	247 (24.8)
1000–1499	217 (21.8)
1500–1999	138 (13.8)
2000–2499	122 (12.2)
2500+	90 (9.0)
	29
Student-athlete population (2017–2018)	
<250	192 (19.6)
250-499	411 (42.0)
500-999	318 (32.5)
	57 (5.8)
	43
	240 (00 0)
 <0 	342 (33.8) 242 (22.0)
80-00 00-79	343 (33.9) 150 (14 9)
100 -	177 (17 5)
Missing	11

^a Region categorizations originated from US Census Bureau.¹⁶

mandate group) the criteria set forth by the NATA-IATF guidelines. We calculated the number of guidelines with which each respondent indicated school compliance. From this, we computed the percentage of HS football programs whose ATs reported compliance with each of the 17 NATA-IATF guidelines and full compliance (ie, all 17 guidelines; Table 1). We also computed the percentages reporting compliance with ≥ 10 guidelines. This cutoff was



Figure. Distribution of high schools' levels of compliance with the National Athletic Trainers' Association Inter-Association Task Force (NATA-IATF) preseason heat-acclimatization guidelines during the 2017 preseason. Abbreviation: IQR, interquartile range.

selected to aid comparability with the previous finding¹³ that 57.9% reported compliance with ≥ 10 of the guidelines during the 2011 preseason.

To test hypothesis 1, we reexamined data from the original 2011 study.¹³ The 2011 sample consisted of a cross-section of 1142 ATs from all 51 US jurisdictions except Alaska and Rhode Island.¹³ Most were male (51.8%), with an average age of 37.0 \pm 10.2 years and more than 10 years of experience (57.9%), and worked in HSs with 2011–2012 school-year student enrollments greater than 1000 (62.6%).¹³ Because of the deidentified nature of the data collected for the studies, we were unable to account for how many ATs participated in both. Prevalence ratios (PRs) compared the prevalence of a PR comparing full compliance in 2017 versus 2011 preseason is

$$PR = \frac{\left[\frac{\text{Number of Responding Schools With Full Compliance in 2017}}{\text{Number of Schools With Responding ATs in 2017}}\right]}{\left[\frac{\text{Number of Responding Schools With Full Compliance in 2011}}{\text{Number of Schools With Responding ATs in 2011}}\right]}$$

A Wilcoxon rank sum test also compared distributions of the number of guidelines with which programs complied in 2017 and 2011.

To test hypothesis 2, we compared results between ATs working in states with mandates, with partial mandates, and without mandates. The 8 states that met the NATA-IATF guidelines during the 2017 HS football season (with *mandate*), as indicated by Adams et al,¹¹ were Arizona, Connecticut, Iowa, Mississippi, New Jersey, North Carolina, Rhode Island, and Utah. The partial-mandate group consisted of those from states whose guidelines included (1) meeting at least 1 of the NATA-IATF guidelines or (2) a comprehensive plan that considered all of the NATA-IATF guidelines but lacked best-practice wording (eg, using "should" over "must"). This consisted of 24 states, as identified by Adams et al.¹¹ All remaining states were included in the without-mandate category. Prevalence ratios with 95% confidence intervals (CIs) compared compliance prevalences among the 3 groups. A Kruskal-Wallis test was used to compare distributions.

All PRs whose 95% CIs excluded 1.00 were considered statistically significant. We were concerned that the large

sample size (N = 1023) might result in small effect estimates (ie, PR close to the null) being statistically significant. Thus, our findings focused on those statistically significant PRs that (1) indicated moderate associations (PR ≥ 1.40 or ≤ 0.71)¹⁵ and (2) yielded differences of ≥ 15.0 percentage points between the groups; *t* statistics, *F* ratios, and Tukey post hoc comparisons with *P* values <.05 were considered statistically significant.

RESULTS

Characteristics of the ATs and HSs

Characteristics of the ATs and their HSs are presented in Table 2. All US jurisdictions except Alaska were represented, with the largest proportions from Texas (10.3%), Pennsylvania (7.4%), California (6.7%), New Jersey (5.1%), and Ohio (5.1%). Overall, 15.6% of respondents worked in states with mandated heat-acclimatization guidelines. Of the 84.6% in states without such mandates, 501 (49.0% of the total sample) worked in states with partial mandates.

Overall Compliance With the NATA-IATF Preseason Heat-Acclimatization Guidelines

Overall, ATs reported that their HS football programs complied with an average of 12 ± 3 of the 17 individual NATA-IATF preseason heat-acclimatization guidelines (median = 12; interquartile range [IQR] = 9–14; Figure). However, this distribution was skewed left, with the majority of ATs reporting compliance with ≥ 10 guidelines (73.9%). Only 3.9% reported full compliance with all 17 guidelines (Table 3).

The guidelines with the most compliance were "no more than 2 practices per day" (96.6%); "1 day of complete rest after 6 consecutive days of practice" (95.4%); "AT must be on site before, during, and after all practices" (93.1%); and "double-practice days consisted of practices no more than 5 hours in length in total" (91.0%; Table 3). In contrast, the guideline with the least compliance was "a 3-hour recovery period occurred between the practice and walk-through (or vice versa)"

Table 3. High School Football Programs Complying With National Athletic Trainers' Association Inter-Association Task Force Preseason Heat-Acclimatization Guidelines During the 2017 Preseason

	Pe	rcentage	
Categories and Guidelines	Total 2017 Sample	Data From 2011 Fall Preseason	Prevalence Ratio (95% Confidence Interval)
1. First 5 days			
1.1. During the first 5 days of formal football practices, walk- throughs were no more than 1 hour in length	69.4	77.4	0.90 (0.85, 0.94)
1.2. Double-practice days did not occur during first 5 days of formal football practices	70.4	41.2	1.71 (1.58, 1.85) ^{a,b}
2. Length of practices			
2.1. Single-practice days consisted of practices no more than 3 hours in length	60.2	39.7	1.52 (1.39, 1.66) ^{a,b}
2.2. Double-practice days consisted of practices no more than 5 hours in length in total	91.0	76.9	1.18 (1.14, 1.23)
2.3. No more than 2 practices per day	96.6	91.5	1.06 (1.03, 1.08)
3. Length of rest breaks			
3.1. A 3-hour recovery period occurred between the practice and walk-through (or vice versa)	44.7	58.3	0.77 (0.70, 0.83)
3.2. Two practices were separated by a break of at least 3 continuous hours that was in a cool environment	69.3	48.9	1.42 (1.32, 1.52) ^{a,b}
3.3. Double-practice days were not followed by another double- practice day	73.5	87.0	0.84 (0.81, 0.88)
3.4. One day of complete rest after 6 consecutive days of practice	95.4	96.8	0.99 (0.97, 1.002)
4. AT presence			
4.1. AT must be on site before, during, and after all practices	93.1	95.0	0.98 (0.96, 1.001)
4.2. A1 had ability to cancel/delay practice because of inclement weather/heat restrictions	70.9	80.9	0.88 (0.83, 0.92)
5. Equipment alterations			
5.1. Helmet was the only equipment worn on first 2 days of practice	72.8	77.0	0.95 (0.90, 0.99)
5.2. During days 3–5, only helmets and shoulder pads were worn	49.5	39.0	1.27 (1.15, 1.40)
5.3. All protective equipment not worn until day 6	51.5	40.3	1.28 (1.17, 1.40)
6. Contact drills			
6.1. Contact with blocking sleds was not initiated until day 3	46.3	50.5	0.92 (0.84, 1.003)
6.2. Contact with tackling dummies was not initiated until day 3	52.6	56.8	0.93 (0.86, 1.01)
6.3. One-hundred percent full-contact drills were not initiated until day 6	54.6	43.0	1.27 (1.17, 1.39)
Compliance with ≥ 10 guidelines	73.9	57.9	1.28 (1.20, 1.36)
Full compliance (all 17 guidelines)	3.9	2.5	1.54 (0.96, 2.46)

Abbreviation: AT, athletic trainer.

^a Indicates a difference of \geq 15.0 percentage points.

^b Denotes prevalence ratio with 95% confidence interval not including 1.00 and at least a moderate association (ie, prevalence ratio ≥1.40 or ≤0.71).

(44.7%). A number of additional guidelines also had low levels of compliance, particularly those related to equipment alterations and contact drills.

Comparison of the 2017 and 2011 Preseason Data (Hypothesis 1)

The distributions of the number of guidelines with compliance differed between 2017 (median = 12; IQR, 9–14) and 2011 (median = 10; IQR, 8–13; Wilcoxon rank sum P < .001). The proportions of HSs that were fully compliant were not statistically different (3.9% versus 2.5%, respectively; PR = 1.54; 95% CI = 0.96, 2.46; Table 3). However, the proportion that was compliant with ≥ 10

guidelines was higher in 2017 than in 2011 (73.9% versus 57.9%, respectively; PR = 1.28; 95% CI = 1.20, 1.36). Certain guidelines had at least moderate associations with differences \geq 15.0 percentage points, including "double-practice days did not occur during first 5 days of formal football practices" (70.4% versus 41.2%, respectively; PR = 1.71; 95% CI = 1.58, 1.85); "single-practice days consisted of practice no more than 3 hours in length" (60.2% versus 39.7%, respectively; PR = 1.52; 95% CI = 1.39, 1.66); and "2 practices were separated by a break of at least 3 continuous hours that was in a cool environment" (69.3% versus 48.9%, respectively; PR = 1.42; 95% CI = 1.32, 1.52).

Preseason by Whether Guidelines Were	e Fully, Partially, or Not N	//andated by State's High Schoo	I Athletics Association Con	tinued on Next Page)
		Percentage		Prevalence	Ratio (95% Confiden	ce Interval)
Categories and Guidelines	States With Mandated Guidelines ($n = 160$)	States With Partially Mandated Guidelines ($n = 501$)	States Without Mandated Guidelines ($n = 362$)	With Versus Without Mandate	Partial Versus Without Mandate	With Versus Partial Mandate
1. First 5 days						
1.1. During the first 5 days of formal football practices, walk-throughs were no more than 1 hour in	70.0	69.7	68.8	1.02 (0.90, 1.15)	1.01 (0.93, 1.11)	1.00 (0.89, 1.13)
1.2. Double-practice days did not occur during first 5 days of formal football practices	89.4	76.2	53.9	1.66 (1.49, 1.85) ^{a.b}	1.42 (1.27, 1.58) ^{a.b}	1.17 (1.09, 1.26)
2. Length of practice						
2.1. Single-practice days consisted of practices no more than 3 hours in	70.6	63.1	51.7	1.37 (1.19, 1.57) ^a	1.22 (1.08, 1.38)	1.12 (0.99, 1.26)
2.2. Double-practice days consisted of practices no more than 5 hours in length in total	91.9	94.2	86.2	1.07 (1.002, 1.13)	1.09 (1.04, 1.15)	0.98 (0.93, 1.03)
2.3. No more than 2 practices per day	96.9	97.0	95.9	1.01 (0.98, 1.05)	1.01 (0.99, 1.04)	1.00 (0.97, 1.03)
Length of rest breaks						
3.1. A 3-hour recovery period occurred between the practice and walk-thround (or vice versa)	48.8	44.7	42.8	1.14 (0.93, 1.39)	1.04 (0.90, 1.22)	1.09 (0.90, 1.31)
3.2. Two practices were separated by a break of at least 3 continuous hours that the second explored by a break of at least 3 continuous hours	77.5	77.8	53.9	1.44 (1.27, 1.63) ^{a.b}	1.45 (1.30, 1.61) ^{a.b}	1.00 (0.90, 1.10)
3.3. Double-practice days were not followed by another double-	86.9	79.6	59.1	1.47 (1.32, 1.63) ^{a,b}	1.35 (1.22, 1.48) ^a	1.09 (1.01, 1.18)
practice day 3.4. One day of complete rest after 6 consecutive days of practice	93.8	96.2	95.0	0.99 (0.94, 1.03)	1.01 (0.98, 1.04)	0.97 (0.93, 1.02)
4. AT presence						
4.1. AT must be on site before,	92.5	95.8	89.5	1.03 (0.98, 1.09)	1.07 (1.03, 1.11)	0.97 (0.92, 1.01)
4.2. AT had ability to cancel/delay practices because of inclement weather/heat restrictions	71.3	73.7	66.9	1.07 (0.94, 1.20)	1.10 (1.01, 1.20)	0.97 (0.87, 1.08)
5. Equipment alterations						
5.1. Helmet was the only equipment worn on first 2 days of practice	84.4	74.5	65.5	1.29 (1.17, 1.42) ^a	1.14 (1.04, 1.25)	1.13 (1.04, 1.23)
5.2. During days 3–5, only helmets	75.6	52.1	34.3	2.21 (1.87, 2.61) ^{a,b}	1.52 (1.29, 1.79) ^{a,b}	1.45 (1.29, 1.64) ^{a,b}
5.3. All protective equipment was not worn until day 6	77.5	53.1	37.8	2.05 (1.75, 2.39) ^{a,b}	1.40 (1.20, 1.64) ^{a,b}	1.46 (1.30, 1.64) ^{a.b}

		Percentage		Prevalence F	Ratio (95% Confidence	e Interval)
Categories and Guidelines	States With Mandated Guidelines ($n = 160$)	States With Partially Mandated Guidelines $(n = 501)$	States Without Mandated Guidelines ($n = 362$)	With Versus Without Mandate	Partial Versus Without Mandate	With Versus Partial Mandate
Contact drills						
6.1. Contact with blocking sleds was not initiated until day 3	50.6	47.5	43.1	1.17 (0.97, 1.43)	1.10 (0.95, 1.28)	1.07 (0.89, 1.27)
6.2. Contact with tackling dummies was not initiated until day 3	58.8	55.3	47.2	1.24 (1.05, 1.47)	1.17 (1.02, 1.34)	1.06 (0.91, 1.24)
6.3. One-hundred percent full-contact drills were not initiated until day 6	76.3	55.3	44.5	1.71 (1.48, 1.98) ^{a,b}	1.24 (1.08, 1.43)	1.38 (1.23, 1.55) ^a
Compliance with \geq 10 guidelines	85.0	80.6	59.7	1.42 (1.28, 1.59) ^{a,b}	1.35 (1.23, 1.49) ^a	1.05 (0.98, 1.14)
Full compliance (all 17 guidelines)	9.4	4.6	0.6	16.97 (3.93, 73.33) ^b	8.31 (1.97, 35.02) ^b	2.04 (1.09, 3.82) ^b
$^{\rm a}$ Indicates a difference of \geq 15.0 percen $^{\rm 2}$ Denotes prevalence ratio with 95% col	itage points. nfidence interval not incl	uding 1.00 and at least a moder	ate association (ie, prevalen	ice ratio ≥1.40).		

Comparison of States With and Without Mandated Guidelines (Hypothesis 2)

The distributions of the number of guidelines differed among the with-mandate group (median = 14, IQR = 11-15), partial-mandate group (median = 12, IQR = 10-14), and without-mandate group (median = 10, IOR = 8-13; Kruskal-Wallis P < .001). The proportion of respondents reporting their HSs were fully compliant was highest among the with-mandate group (9.4%), followed by the partial-mandate group (4.6%) and the without-mandate group (0.6%; Table 4). All prevalences were statistically different. Similar differences among groups were present when we examined compliance with ≥ 10 guidelines (with mandate = 85.0%, partial mandate = 80.6%, without mandate = 59.7%). Similarly, for specific guidelines, the with-mandate group had the highest level of compliance with regard to double-practice days, equipment alterations, and when contact drills occurred.

DISCUSSION

Up-to-date research on sports injury-prevention policies is integral to ensure a safe environment for athletic participation. Although heat acclimatization is a recommended EHI-prevention strategy,^{6–9} few investigators have specifically evaluated the effect of guidelines such as those from the NATA-IATF on the incidence of EHI.¹² Still, the guidelines were developed from formative work (ie, epidemiologic knowledge, biological and clinical evidence obtained from laboratory and sideline studies, and contentarea experts). As outcome evaluation occurs, process evaluation must assess the value and effects of the implemented guidelines.¹⁴

Our study updates research¹³ from the 2011 preseason that examined compliance among HS football programs with the NATA-IATF guidelines. Compliance increased in the 2017 versus 2011 preseason and among those programs located in states that mandated the NATA-IATF guidelines. It is also important to note that although our survey was built upon previous work and we sought feedback from ATs via pilot testing, our threshold for full compliance may be biased from our perspective as researchers as opposed to practicing ATs on site. Full compliance with all 17 specific guidelines that we identified from the document remained low in the 2017 preseason (3.9%), whereas nearly threefourths of respondents (73.9%) noted that their programs complied with ≥ 10 guidelines. Given that many ATs face numerous challenges beyond the care of their patients, including long work hours, limited resources, and other administrative duties,¹⁷ it is important for HSs to ensure support that includes both medical and administrative guidance so that the NATA-IATF guidelines, alongside other important preventive measures, are implemented properly.

Hypothesis 1: Improvements in Compliance During the 2017 Preseason Versus the 2011 Preseason

The percentage of programs in full compliance was not statistically significantly different between the 2017 and 2011 preseason studies. Nonetheless, the 54% higher prevalence in 2017 versus 2011 is considered a moderate association and may be clinically significant.¹⁵ In addition,

the percentage of participants reporting compliance with >10 guidelines increased. Why such increases occurred is unknown. Educational efforts, including those within athletic training education and continuing education programs, may have resulted in increased knowledge and subsequent implementation of the NATA-IATF guidelines. Also, ATs in our study as compared with the previous study may have first been exposed to the guidelines in different manners; those in the current study with less experience would likely have seen this information during their education, compared with those from the previous study, who may have had to learn this information on their own or via continuing education. Future investigations may inform as to how the mode of education about these guidelines affects ATs' understanding and implementation. Despite this, the low level of full compliance highlights the need for research to identify the barriers and facilitators that affect implementation of the NATA-IATF guidelines and the safety of football preseason practice settings. In particular, such authors can focus on those specific guidelines that had lower levels of compliance, such as "a 3-hour recovery period occurred between the practice and walk-through (or vice versa)" (44.7%), and those related to equipment alterations and contact drills.

A number of factors may play a role in limiting compliance with certain guidelines. Regarding 3-hour recovery breaks between practices and walk-throughs, coaches may not see the need because they perceive the walk-through as not being strenuous. Also, coaches may shorten the recovery time because it is logistically easier than keeping students on site for extended periods of time or requiring them to show up for football-related activities multiple times per day. Education may be important in emphasizing that the aims of this 3-hour break are to aid recovery from fatigue¹⁸ and fluid deficit¹⁹ and return core body temperature from high to normal levels.¹⁹⁻²¹ Other guidelines, such as limiting equipment and the use of contact drills during the first week of practice, may also be facilitated by increased education for HS football coaches and administrators. Because data verifying the reasons for noncompliance are limited, work is warranted to further explore the implementation of the NATA-IATF guidelines. In particular, strategies are needed to overcome barriers related to logistical planning and perceived inconvenience.

Hypothesis 2: State Mandate of NATA-IATF Guidelines and Compliance

Previous researchers¹² found that states whose HS athletic associations mandated NATA-IATF guidelines were more likely to have HS football programs in better compliance than those states without mandates. These results were replicated in our study, with full compliance and compliance with ≥ 10 guidelines being higher in states with versus without mandates. Thus, mandates created from policy may improve compliance with injury-prevention strategies. Earlier authors²⁰ noted that policy-level strategies may result in more effective changes than behavioral strategies, although prevention in general may benefit from considering individual, interpersonal, and environmental factors. Given that state-level mandates of the NATA-IATF guidelines potentially increased compli-

ance, it may be warranted for state HS athletic associations to mandate NATA-IATF guidelines while ensuring HSs have the appropriate organizational support to properly implement the guidelines. Also, although the analyses showed benefits from partially mandated guidelines, we did not specifically examine which specific types of partial mandates were associated with increased compliance. Still, the large discrepancies seen in states with full mandates compared with states with partial or no mandates further demonstrate that the strongest benefits of mandates occur when they include all recommended best practices.

Limitations

Our study had a 14.2% response rate from HSs with ATs, which may have resulted in a sample that was not generalizable to all HS football programs, particularly with 30% of HSs lacking AT coverage nationwide.²² Our estimate of compliance may be an overestimation, as our sample did not include HSs without ATs. In addition, respondents may have been more knowledgeable about EHI prevention and more likely to ensure proper implementation of the NATA-IATF guidelines. We were unable to account for whether responding ATs from the same HSs responded to the survey or had previously responded to the 2011 survey. Our study may also be limited by the typical biases related to survey research, such as recall and socialdesirability bias. However, the ATs were likely to have had good recall of preseason practice sessions because supervision of these sessions is a well-accepted role of ATs.

Although we provided overall comparisons with data gathered from the 2011 preseason,¹³ we were unable to compare those states noted as being compliant in the 2011 and 2017 preseasons, as the methods for classifying states varied between the studies. We opted to use more stringent categorizations of compliance based upon recent research¹¹ that we believe to be more valid than those used in the previous assessment. Also, our outcome measures for assessing compliance with all 17 and >10 guidelines were chosen to aid comparability with the earlier research¹³ but may not account for all variability in responses during the comparative analyses. Finally, because we relied on ATs as respondents to describe current practices at their HSs, we were unable to account for the roles of other football program stakeholders, including coaches, administrators, and parents. Given the limitations of the current study, future research is warranted to evaluate other facets of EHI prevention, including the education provided to coaches and players and specific barriers to and facilitators of compliance.

CONCLUSIONS

Our findings suggest increased compliance with the NATA-IATF heat-acclimatization guidelines during the 2017 preseason compared with the 2011 preseason.¹³ A low proportion of surveyed HS football programs fully complied with all 17 NATA-IATF guidelines, justifying the need for investigators to identify facilitators of proper safety guidelines implementation. Still, an average of 12 of the 17 guidelines were implemented, with nearly three-fourths of respondents (73.9%) noting compliance with

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