

State-Specific Differences in School Sports Preparticipation Physical Evaluation Policies

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abstract **OBJECTIVE:** This study evaluated the current preparticipation physical evaluation (PPE) administrative policies and cardiovascular screening content of all 50 states and Washington, DC.

METHODS: PPE policies, documents, and forms from all 50 states and Washington, DC, were compared with the preparticipation physical evaluation–fourth edition (PPE-4) consensus recommendations. All electronic documents were publicly available and obtained from state interscholastic athletic associations.

RESULTS: Fifty (98%) states required a PPE before participation. Most states (53%, $n = 27$) required a specific PPE form, whereas 24% ($n = 12$) of states recommended a specific form. Twenty-three states (45%) required or recommended use of the PPE-4 form or a modified version of it, and 27 states (53%) required or recommended use of outdated or unidentifiable forms. Ten states (20%) had not revised their PPE forms in >5 years. States permitted 9 different health care providers to administer PPEs. Only 22 states (43%) addressed all 12 of the PPE-4 personal and family history cardiovascular screening items, and 2 states (4%) addressed between 8 and 11 items. For the remaining 26 states, most (29%) addressed ≤ 3 screening items.

CONCLUSIONS: Our results show that inconsistencies in PPE policies exist nationwide. Most states have been slow to adopt PPE-4 recommendations and do not adequately address the personal and family cardiovascular history questions. Findings suggest a need for PPE standardization nationwide and adoption of an electronic PPE process. This approach would enable creation of a national database and benefit the public by facilitating a more evidenced PPE.

WHAT'S KNOWN ON THIS SUBJECT: Preparticipation physical evaluations (PPEs) are considered necessary for a high standard of care for US scholastic athletes. However, important questions remain regarding consistency of implementation and content of cardiovascular screening practices among states.

WHAT THIS STUDY ADDS: Our results show that PPE policies are variable among US states, and adoption of current PPE-4 best practices is slow, demonstrating the need for nationwide PPE standardization.

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Participation in scholastic sport is at an all-time high, with participants engaging in nearly 8 million high school athlete seasons annually in the United States.^{1,2} The American Medical Association's Committee on Medical Aspects of Sports recommends athletes complete a preparticipation physical evaluation (PPE) before sports participation.^{3,4} The PPE screens for health risks that may place participants at higher risk of injury, illness, and/or life-threatening conditions (eg, sudden cardiac death) to help increase safe participation in sports.⁵ Rifat et al⁶ reported that an appropriate PPE history was important in identifying nearly 90% of the abnormal findings and more than one-half of the reasons cited for activity restriction. The *Preparticipation Physical Evaluation, Fourth Edition* (PPE-4), monograph is a consensus document among leading medical organizations, including the American Academy of Pediatrics, outlining best practice recommendations for screening supported by expert opinion and evidence-based research.⁵ However, no nationwide PPE requirements exist in the United States. The requirements for PPE implementation are most frequently determined by state high school athletic associations. The National Federation of State High School Associations (NFHS), the national leadership organization for high school sports, endorses the utilization of a PPE before athletic participation.¹ Although most state athletic associations recommend a PPE as a prerequisite to athletic competition, no mandated nationwide PPE standard exists, and there is minimal evidence regarding the implementation of PPEs nationwide.^{5,7,8} Previous research suggests a lack of adherence to earlier editions of the PPE monograph,⁹⁻¹¹ indicating a continuing discrepancy between expert recommendation and clinical practice. In addition, this research also suggests a wide

variation in PPE implementation practices in terms of evaluation frequency and the qualifications of providers; the result is that there is much to be learned about differences in outcomes based on the examination frequency or the provider type. Presently, little is known regarding the implementation of the most recent PPE-4 monograph recommendations or current PPE administration practices in terms of frequency of administration and the qualifications of providers.

An important function of the PPE is the cardiovascular screening component. The goal of cardiovascular screening is to identify subjects with abnormalities or conditions that may place them at high risk of cardiac events, including sudden cardiac death. These occurrences are a leading cause of unexpected death in athletes and are often due to a variety of unsuspected cardiovascular diseases.^{12,13} The PPE-4 monograph includes the American Heart Association's (AHA) 2007 consensus recommendations on screening for cardiovascular abnormalities in competitive athletes.¹⁴ These recommendations are recognized as the standard of care in the United States and advocate for the cardiovascular screening of athletes based on a personal and family heart health history questionnaire and a physical examination.^{8,15-22} However, the PPE-4 adds personal and family history questions in an attempt to identify subjects with rare electrical cardiac abnormalities, characterized as channelopathies, which are believed to account for a segment of sudden unexplained death cases among athletes.¹⁵ Research has suggested that cardiovascular screening recommendations are frequently not followed.^{9-11,23} However, little is known about current cardiovascular screening practices and states' adherence to AHA recommendations as described in the PPE-4. The present study

evaluated the current PPE administrative policies of all 50 states plus Washington, DC, and examined each state's adherence to the cardiovascular screening recommendations described in PPE-4.

METHODS

PPE policies and content from the NFHS-sanctioned public high school state athletic associations in all 50 states and Washington, DC, were obtained and reviewed. Policy documents obtained for analysis included each state association's PPE forms and any associated policy and procedure manuals, handbooks, or administrative documents pertaining to the PPE. We obtained the most recent forms of all publicly available documents via state athletic association Web sites as of August 2014. A "policy" was defined as any published administrative procedure, requirement, or recommendation set forth by the state athletic association regarding administration and content of the PPE.²⁴⁻²⁶ Content from each state's PPE administrative policies and PPE form content were independently reviewed by 2 investigators and compared with the content of cardiovascular history and physical examination content recommended in the PPE-4. Each investigator evaluated all PPE forms by using a standardized electronic coding form (Qualtrics Software, Provo, UT).

Administrative Requirements

The electronic coding form consisted of 8 items describing PPE administrative policies. Specifically, each state's administrative documents were reviewed to determine if a PPE is mandated and if so, if the state required or recommended specific PPE content. In addition, each state's PPE policies were reviewed to determine when the PPE was last revised, how frequently and in what grade levels are the PPE administered, and what

health care providers are approved to deliver the screening.

Cardiovascular History and Physical Examination

Each state's cardiovascular history and physical examination content were reviewed and compared against the recommendations for cardiovascular screening as described within the PPE-4. The cardiovascular screening recommendations as described within the PPE-4 consist of the following: (1) history (personal and family history comprising 8 and 4 items, respectively) and (2) physical examination (4 items). Criterion for reviewing the cardiovascular history and physical examination items was adapted as previously described.^{10,11} Each PPE form was evaluated to determine whether each of the 12 recommended personal and family history items was completely addressed, partially addressed, or absent. Similar to previous research,⁹⁻¹¹ we evaluated content to be more inclusive than exclusive. In this regard, our review focused on question content rather than terminology. For example, a broadly worded question about a history of pain, discomfort, or pressure in the chest was evaluated to be completely addressed even if it failed to specify about symptoms during exercise. Similarly, if the physical examination indicated that seated blood pressure should be assessed, we evaluated this component as "complete" even if the question did not specify the brachial artery.

Statistical Analysis

Descriptive statistics were calculated by using SPSS version 22 (IBM SPSS Statistics, IBM Corporation, Armonk, NY) to characterize states' PPE administrative policies and cardiovascular screening content.

RESULTS

Administrative Requirements

Of the 51 jurisdictions evaluated, 50 (98%) required a PPE before

participation in scholastic sport; only Vermont permitted individual school systems to direct these decisions. Regarding forms used for the PPE, we found that most states (53%, $n = 27$) required use of a specific PPE form. Only 19 states (37%) required or recommended use of the PPE-4 form, and 4 states (8%) used a modified version of it. In total, 27 states (53%) required or recommended use of a form with content based on an outdated edition of the PPE monograph (24%, $n = 12$) or a form not associated with any PPE monograph (29%, $n = 15$). To evaluate how frequently states are reviewing and revising their respective PPEs, data were obtained from PPE forms regarding the most recent year in which the forms were revised. Sixteen (31%) and 4 (8%) states indicated the most recent revision of their PPE forms to be in 2014 and 2013, respectively. Twenty-one states (41%) indicated that their forms had been revised within the previous 4 years, with the majority (31%, $n = 16$) of these states revising forms in 2010. The remaining 10 (20%) states had either not revised their forms in >5 years (8%, $n = 4$) or did not provide a revision date (12%, $n = 6$).

The frequency of the PPE implementation varied among states. The majority of states (80%, $n = 41$) required an annual PPE before participation. The remaining states required completion biennially (14%, $n = 7$), and 1 state (South Dakota) requiring completion less frequently; 2 states (4%) were unspecified. States also differed regarding the grade level in which PPE administration begins. Most frequently (45%, $n = 23$), PPE administration began in ninth grade to coincide with participation in high school sports. Fewer states required a PPE in junior high or middle school, with 1 (2%), 13 (26%), and 10 (20%) states having PPE administration that begins in grades 8, 7, and 6, respectively. In addition, states

differed considerably regarding the medical personnel approved to provide PPEs, with 9 different providers permitted to administer PPEs (Fig 1).

Cardiovascular History and Physical Examination

The cardiovascular history and physical examination content from each state's PPE form was examined and compared against recommendations for cardiovascular screening as described within the PPE-4. Our findings indicate that states completely addressed an average of 7 (58%) of the 12 personal and family history items recommended in the PPE-4. Only 22 states (43%) addressed all 12 of the PPE-4 personal and family history items, and 2 states (4%) addressed between 8 and 11 items. For the remaining 26 states, 11 (22%) completely addressed between 4 and 7 items, and 15 (29%) completely addressed ≤ 3 items. The most commonly absent cardiovascular screening history item pertained to family history of unexplained fainting, unexplained seizures, or near drowning (Table 1).

Both the AHA and the PPE-4 recommend that the physical examination component of cardiovascular screening include 4 elements: (1) presence of a heart murmur; (2) femoral and peripheral pulses to exclude coarctation of the aorta; (3) physical stigmata of Marfan syndrome; and (4) sitting blood pressure. The results of the evaluation of compliance with recommendations for the cardiovascular examination are described in Table 2.

DISCUSSION

The PPE is considered an effective, pragmatic, and cost-efficient tool to help reduce the incidence of sports-related sudden cardiac death and other serious injuries. Considerable dispute remains whether the history

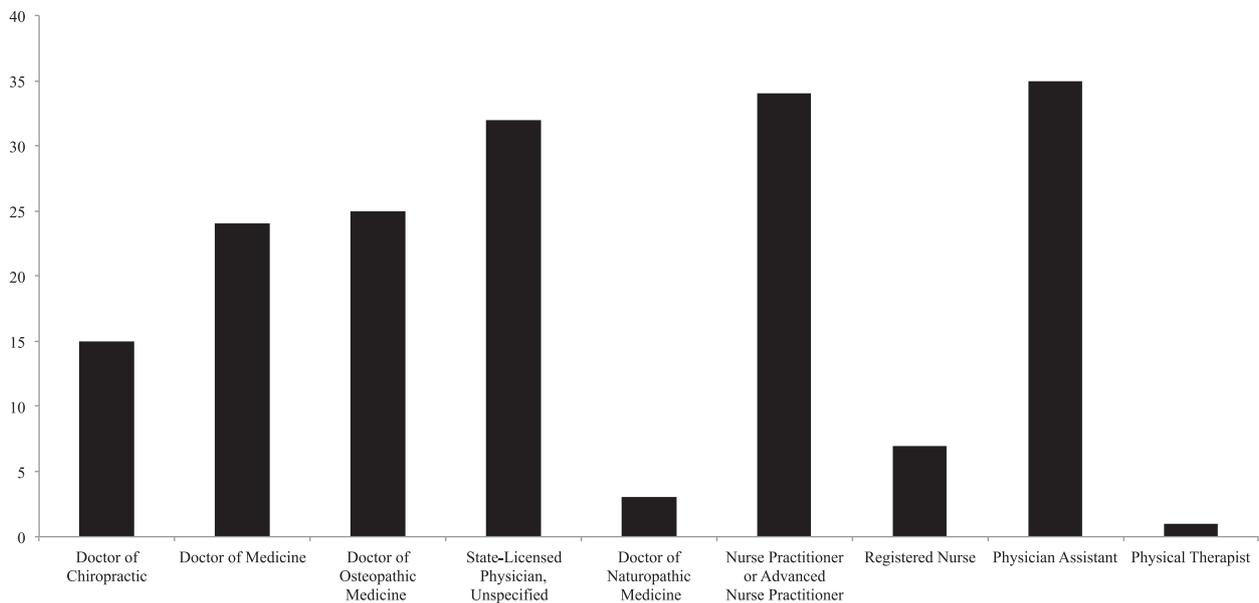


FIGURE 1
Frequency of approved PPE-4 providers.

and physical alone are sufficiently sensitive for sudden cardiac death. The authors of the 2010 PPE-4 monograph strongly recommended that the United States adopt a standardized approach to the PPE.⁵ Although the NFHS considers the PPE a prerequisite to sports participation and has endorsed the PPE-4, the association lacks the authority to mandate that its member states adopt PPE-4.¹ As such, PPE requirements and content are determined by each state. Our findings indicate that 98% of states require a PPE before participation in scholastic sports and that 53% require use of a specific PPE form, but only 23 states (45%) had updated their forms to follow the PPE-4 recommendations. However, the value of the PPE as a screening tool is incompletely understood because there is substantial variability nationally regarding its actual practice. As participation in interscholastic sport continues to increase, so will the importance of a uniform PPE process and form to aid discussions regarding PPE utility and effectiveness as a screening tool for conditions that may predispose athletes to injury or sudden death. Therefore, we recommend that all

states adopt and mandate use of a nationally recognized and standardized PPE form as outlined in the PPE-4. We further recommend that states move toward an electronic PPE process to facilitate data collection. An electronic PPE process would improve the PPE questions and communication between medical providers, schools, and family stakeholders regarding student health and safety.¹⁵

Our findings confirm that nationwide, nearly all states require that scholastic athletes submit to a PPE before participation. Only Vermont recommended that a PPE be completed before participation, leaving regulations to be directed by the local school divisions. Our study supports previous research showing that administrative policies regarding implementation of the PPE continue to vary considerably among states.^{10,11,18,25-27} For example, a 2009 study by Rausch and Phillips¹⁰ reported that 47 (92%) states recommended, approved, or required a specific PPE form related to the third edition of the PPE. Since the aforementioned study, the PPE-4 was introduced in 2010. Comparatively, our findings indicate

an improvement as all but one state (98%) either recommended or required use of a PPE form. Improvements in adherence to PPE recommendations have been demonstrated in previous studies.^{10,11,18,27,28} However, it seems that adoption by policy makers after publication of new PPE recommendations is a slow process. Recently, Madsen et al²⁹ evaluated PPE-4 clinical practice behaviors and examined perceived obstacles for its implementation. The authors reported that PPE-4 clinical practice behaviors are highly variable and that the PPE-4 is poorly adhered to and not well understood by primary care physicians and school systems.

Previous research has raised concerns regarding qualifications of medical providers approved to conduct PPEs. Glover et al²⁸ reported that 80% of states permitted nonphysicians to administer examinations. Our findings demonstrate a small decrease, with 74% of the states continuing to permit a wide range of nonphysician providers to administer the PPE. Three states permitted professionals who practice complementary alternative medicine, and 15

TABLE 1 Frequency and Percentage of Personal and Family History Components of PPE-4

PPE-4 Cardiovascular Screening History Items	Frequency (%)		
	C	P	A
Personal history			
5. Have you ever passed out or nearly passed out during or after exercise?	36 (72%)	13 (26%)	1 (2%)
6. Have you ever had discomfort, pain, tightness, or pressure in your chest during exercise?	33 (65%)	14 (28%)	3 (6%)
7. Does your heart ever race or skip beats (irregular beats) during exercise?	40 (80%)	6 (12%)	4 (8%)
8. Has a doctor ever told you that you have any heart problems (high blood pressure, high cholesterol, a heart murmur, a heart infection, Kawasaki disease, or other)?	24 (66%)	25 (50%)	1 (2%)
9. Has a doctor ever ordered a test for your heart (eg, ECG or echocardiogram)?	33 (57%)	0	17 (34%)
10. Do you get lightheaded or feel more short of breath than expected during exercise?	26 (52%)	15 (30%)	9 (18%)
11. Have you ever had an unexplained seizure?	38 (76%)	10 (20%)	2 (4%)
12. Do you get more tired or short of breath more quickly than your friends during exercise?	27 (54%)	21 (42%)	12 (24%)
Family history			
13. Has any family member or relative died of heart problems or had any unexpected or unexplained sudden death before 50 y of age, including drowning, unexplained car accident, or sudden infant death syndrome?	27 (54%)	21 (42%)	2 (4%)
14. Does anyone in your family have hypertrophic cardiomyopathy, Marfan syndrome, arrhythmogenic right ventricular cardiomyopathy, long QT syndrome, short QT syndrome, Brugada syndrome, or catecholaminergic polymorphic ventricular tachycardia?	24 (48%)	12 (24%)	14 (28%)
15. Does anyone in your family have a heart problem, pacemaker, or implanted defibrillator?	25 (50%)	4 (8%)	21 (42%)
16. Has anyone in your family had unexplained fainting, unexplained seizures, or near-drowning?	26 (52%)	2 (4%)	22 (44%)

Percentages calculated from $n = 50$. A, Absent; C, Complete; P, Partial.

permitted doctors of chiropractic medicine. A proposed benefit of a PPE conducted by a sole medical provider, ideally in the medical home, is the assumption that the examiner is knowledgeable about his or her patient's health history and qualified

to screen for cardiovascular conditions.^{5,15,30} However, upon reviewing the educational requirements described by the accrediting agencies, we were unable to find a listing of specific cardiovascular competencies in their

TABLE 2 Frequency and Percentage of PPE-4 Physical Examination Items by State

PPE-4 Physical Examination Items	Frequency (%)		
	C	P	A
1. Dynamic auscultation for heart murmurs. Should be performed in both the supine and standing position or with Valsalva maneuver. (The standing position is preferred to help accentuate the murmur of hypertrophic cardiomyopathy.)	26 (52%)	15 (30%)	9 (18%)
2. Palpation of radial and femoral pulses to exclude aortic coarctation	25 (50%)	22 (44%)	3 (6%)
3. Examination for physical stigmata of Marfan syndrome, kyphoscoliosis, high-arched palate, pectus excavatum, arachnodactyly, arm span greater than height, hyperlaxity, myopia, mitral valve prolapse, and aortic insufficiency	23 (46%)	10 (20%)	17 (34%)
4. Brachial artery blood pressure taken in the sitting position	50 (100%)	0	0

Percentages calculated from $n = 50$. A, Absent; C, Complete; P, Partial.

literature, and we found no information available regarding the availability of or requirements for specialized training for these nonphysician professionals in recognizing cardiovascular conditions. We are uncertain of the underlying medical reasons for permitting nonphysician professionals to conduct the PPE. Reasons could be due to access, convenience, cost efficiency, or politics within each state. Important questions also exist regarding knowledge of some physicians regarding the PPE. A study by Drezner et al²³ found that 41% of families with a child suffering sudden cardiac arrest reported that at least 1 cardiovascular symptom was brought to the attention of their physician before the event. More recently, Madsen et al²⁹ found that nearly one-half (46%) of physicians they surveyed were unsure of the relative importance of a positive or negative PPE finding and approximately one-third (36%) were unsure how to perform the physical examination. As such, significant concerns regarding sufficient training of all providers to ensure quality and consistency of the PPE remain especially in regard to cardiovascular screening.

Sudden cardiac death is the leading cause of death in young athletes during sports,¹³ and the PPE is recognized to be an essential component in cardiovascular screening to safeguard participants. Many conditions requiring further evaluation can be identified by taking a systematic history during the PPE.^{6,30} A 2009 study by Rausch et al¹⁰ reported that 85% of state PPE forms reflected the outdated 1996 AHA guidelines for cardiovascular screening. In addition, they reported that only 8 (16%) of the 51 state forms completely addressed the personal and family history cardiac screening questions specified in the PPE-3. In 2010, the PPE-4 was released containing the 2007 AHA recommendations and additional personal and family history

questions in an attempt to identify subjects with rare electrical cardiac abnormalities referred to as channelopathies. These abnormalities reportedly account for ~3% of sudden cardiac death in athletes.¹⁵

The results of our study of the PPE-4 demonstrate improvements but continue to point to slow implementation of best PPE practices. We found only 23 states using the PPE-4 ($n = 19$) or a modified version ($n = 4$) the form. The majority (53%) of states were using outdated or unidentifiable versions of the PPE form. This finding raises concerns because the NFHS states that the preparticipation evaluation process should be reviewed no less than every 3 years.¹ However, our study found a considerable improvement since the study of Rausch et al,¹⁰ in that 22 states (43%), compared with 8 (16%) from the earlier study, completely addressed all PPE-4 personal and family history items. Nevertheless, discouragingly, the majority of states ($n = 26$) continue to fall short, with 11% completely addressing between 4 and 7 items, and 29% states completely addressing only ≤ 3 items. Our findings also revealed that the 2 most frequently absent items were family history items. The most commonly absent cardiovascular screening history item pertained to a family history of channelopathies (eg, unexpected or unexplained sudden death).¹⁵ These findings are concerning because a 2012 study by Drezner et al²³ reported that in 40% of the sudden cardiac arrest cases studied, parents described the presence of at least 1 significant family history component before their child's sudden cardiac arrest and in 27% of cases, a family

member had suffered sudden death before 50 years of age because of a heart condition. Therefore, we reaffirm authors of the PPE-4 who strongly recommended that all states adopt a nationally recognized and uniform PPE form. This recommendation is further supported by the recent findings of Madsen et al,²⁹ who reported physicians and athletic directors throughout Washington state strongly supported a single standardized PPE form. In addition, we support Seto et al¹⁵ who espoused the benefits of an electronic PPE. Based on our findings and those of other researchers,^{10,14,15,29,31} we suggest that adoption of a nationally accepted electronic PPE format would enable standardization of important family history items and improve parental responses by allowing them to easily complete and submit the form before the evaluation. This method would enable a review of any changes in family history or health status and facilitate a more time-efficient and meaningful communication with patient and parent in both the medical home and during mass screenings by flagging history questions in need of more extensive follow-up. In addition, an electronic PPE would also improve the efficiency of mass screenings by serving as a requirement for preregistration for the onsite PPE. Such information would help with PPE planning and assist organizers with ensuring that the PPE is properly resourced. Other benefits would be improved communication regarding health status and eligibility among care providers, parents, and school personnel. Finally, adoption of a standardized

electronic PPE would greatly assist in determining the validity of each component of the questionnaire and ultimately help to assess outcomes and the utility of the evaluation.

Our study is limited in that we collected only publicly available documents via state athletic association Web sites. It is possible that some state athletic associations may have had policies and procedures that were not publicly available at the time of this study and at the conclusion of our data collection time period (August 2014). This study represents only a point in time, and it is possible that states have since updated their policies and PPE form.

CONCLUSIONS

Our findings show that nationwide inconsistencies in PPE policies continue to exist within and between all 50 states and Washington, DC. The majority of states have been slow to adopt the most recent PPE-4 recommendations and most notably have failed to adequately address the personal and family history cardiovascular screening questions. Our findings suggest the need for a nationwide standardized PPE form and the use of an electronic PPE process to improve adherence and develop a nationwide database. Such an approach would benefit the public by facilitating the creation of a robust and uniform nationwide data resource to evaluate and develop an evidenced PPE and help safeguard participation in sport.

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