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**Preparticipation Examination Screening Practices
For NCAA Division I Female Athletes**

by

Sharon Whiteside

**A dissertation presented to the
Graduate Faculty of Middle Tennessee State University
In partial fulfillment of the requirements for the
Degree Doctor of Arts
December, 2000**

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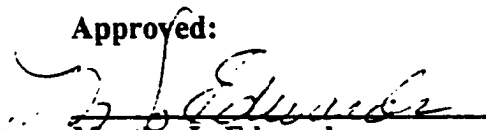
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For NCAA Division I Female Athletes**

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Sharon Whiteside

Approved:


Martha Jo Edwards

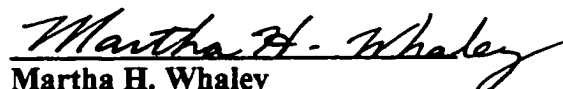
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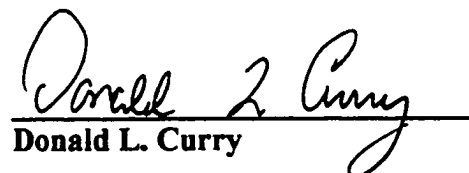
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ABSTRACT
PREPARTICIPATION EXAMINATION SCREENING PRACTICES
FOR NCAA DIVISION I FEMALE ATHLETES

Sharon Whiteside

The purpose of this study was to identify and assess screening practices used during the preparticipation examination (PPE) to detect medical and musculoskeletal conditions and potential cardiovascular diseases for female student-athletes. This study identified and described the screening parameters presently being used for PPE at 209 of 318 (66%) NCAA Division I universities having female basketball programs. Preparticipation examination forms were evaluated for content and compared to the AHA (1996) cardiovascular recommendations and to the monograph *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) developed by five national medical organizations. Information on the administration and scope of the preparticipation screening process was obtained from surveys completed by the Certified Athletic Trainers (ATCs).

Most (78%) of the universities performed the PPE in a university health care facility utilizing station-based mass screening and required PPE screening annually. Practically all the universities (99.5%) utilized a team physician to perform the PPE, usually with the assistance of a wide variety of other professional health care providers. The primary sources for determining the PPE requirements were the sports medicine committee, team physicians, ATCs, and the NCAA. The main source for the content of the PPE was the NCAA guidelines. The AHA cardiovascular recommendations and the

monograph by the five national medical association's recommendations were not utilized extensively on university forms. Universities that utilized ATCs, and/or dentists as a part of the health care team, and included items concerning the Female Athlete Triad as part of the PPE evaluation, had statistically significant more items from the AHA (1996) cardiovascular recommendations and the five national organizations' monograph (1997) PPE recommendations on their forms. Only 43% of the universities screen for the Female Athletic Triad syndrome components as a part of the PPE.

Recommendations include the development of national PPE standards of care that are specific to screening for participation in sports for both males and females. The NCAA should disseminate these standards of care, since it is already seen as the major source of the content and process of the PPE.

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Preparticipation Examination Screening Practices

For NCAA Division I Female Athletes

INTRODUCTION

The growing interest of females in athletics is evident in the increased participation in all sports. The opportunity for female athletes to participate in intercollegiate athletics increased in the past two decades since the Title IX Equal Rights Amendment passed in 1979. In just six years, 1992-1998 there was a 40% increase in the number of women participating in National Collegiate Athletic Association (NCAA) sponsored sports. Today, more than 129,000 women participate on NCAA sponsored teams (National Collegiate Athletic Association Participation Statistics, 1999). As more and more women have become interested in sports, the number of sports for women has also increased. Acosta and Carpenter (1996) reported the average number of sports offered for women per school increased from 5.6 in 1977 to 7.5 in 1996 with an average of 8.3 for women in NCAA Division I schools. Overall, females represent a total of 38.3% of all NCAA sponsored team participants, and 40% of Division I athletes (Suggs, 1999). Not only have the numbers of females participating in sports risen greatly, but the manner in which females play has also changed.

Historically, a slow, defensive style characterized female sports. However, today female athletes play with increased speed, precision, and power/aggressiveness and they are training at increasingly intensive levels (Maron & Mitchell, 1994a). This change in the level of competitiveness has led to an increase in risks of injuries. Female athletes have higher injury rates than males in many sports, particularly basketball, soccer,

volleyball, apparatus gymnastics, track, and alpine skiing (Arendt & Dick, 1995; Gersoff & Clancy, 1988; Linder, DuRant, Seklecki, & Strong, 1981; Moeller & Lamb, 1997).

KNEE INJURIES

An estimated 80,000 knee injuries occur annually in the United States, with 70% of those injuries resulting from sports participation (Daniel & Fritsch, 1994; Griffin, et al., 2000). The majority of knee injuries occur in 15-25 year olds participating in pivoting sports (Griffin, et al., 2000). Collegiate female athletes participating in volleyball, soccer or basketball have a two to eight times greater chance of sustaining a serious knee injury than male athletes participating in the same sports (Arendt & Dick, 1995; Kulund, 1982; Moeller & Lamb, 1997; Walsh, 1990; Wojtys, Huston, Lindenfeld, Hewett, & Greenfield, 1998). Over 10,000 debilitating knee injuries can be expected in collegiate female athletes in any given year. These knee injuries, most commonly ruptures of the anterior cruciate ligament (ACL), often result in intensive physical therapy, surgery, or both (American Orthopaedic Society for Sports Medicine, 1998).

In sports such as basketball, handball, gymnastics, and soccer, female athletes have a significantly higher prevalence of injuries to the ACL than do male athletes (Arendt & Dick, 1995; Costil, Daniels, et al., 1976; Gray, et al., 1985; Nilsson & Roaas, 1978; Zelisko, Noble, & Porter, 1982; Whiteside, 1980). Direct contact with another player or object accounts for approximately 30% of all ACL injuries (Malinzak, Colby, Kirkendall, & Garrett, 1999). The other 70% of knee injuries that occur during athletic

participation are of noncontact variety (Daniel, et al., 1994; Noyes, Mooar, Matthews, & Butler, 1983). The basic mechanism for the ACL injury is still unknown, although activities such as decelerating and pivoting, awkward landings, and “out of control” play are associated with significant risk. Other potential, complex, interrelated risk factors that are associated with female ACL injuries include equipment (knee braces), shoe-surface interactions, anatomic factors (knee and hip angle, joint laxity, small intercondylar notch dimensions, hamstring-quadriceps strength imbalances, and hormonal factors), biomechanical factors (muscular strength, body movement, skill level), and neuromuscular control (Anderson, Lipscomb, Liudahl, & Addlestone, 1987; Cabaud & Rodkey, 1985; Ferguson, 1973; Grana & Morte, 1978; Griffin, et al., 2000; Huston & Wojtys, 1996; LaPrade & Burnett, 1994; Marshall & Barbash, 1981; Moore & Wade, 1989; Nicholas, 1970; Sitler, et al., 1994; Souryal & Freeman, 1993; Souryal, Moore, & Evans, 1988).

Knee braces during the late 1970s were used to protect the knee’s collateral ligaments. While initial studies reported a decrease in the number of knee injuries in collegiate and high school athletes using braces (Randall, Miller, & Shurr, 1984), the American Academy of Orthopaedic Surgeons (1999) issued a position statement on knee braces stating there was no definitive evidence that prophylactic knee braces prevented knee injuries. Indeed, later studies reported an increase in the number of knee injuries in athletes using braces (Rovere, Haupt, & Yates, 1987; Teitz, Hermanson, Kronmal, & Diehr, 1987). Despite negative reports, athletes continue to use

prophylactic-bracing citing psychological and proprioceptive benefits (Griffin, et al., 2000).

Shoe-surface interactions that influence ACL injuries include variables such as hardness and age of the surface, weather conditions, and shoe type. In recent studies, high levels of friction between shoes and the playing surface were identified as major risk factors for non-contact ACL injury (Griffin, et al., 2000; Moeller & Lamb, 1997). Artificial turf is also blamed for causing many ACL injuries, although data do not support this claim. Severe injuries are just as likely to occur on natural turf and floors (Moeller & Lamb, 1997).

Anatomical differences and their influences on ACL injuries are beginning to be explored. Females in comparison to males have increased femoral anteversion, excessive tibial torsion, and foot pronation. One preliminary study found that an increase in thigh foot angle might be a risk factor for non-contact ACL injuries. The study compared the difference in thigh foot angles to ACL injured females athletes to non-injured female athletes (Griffin, et al., 2000).

Estrogen and the different phases of the menstrual cycle may affect the occurrence of ACL injuries. Estrogen has a direct effect on the menstrual cycle, and during the menstrual cycle neuromuscular performance varies. Wojtys, Huston, Lindenfeld, Hewett and Greenfield (1998) found a significant statistical association between the ovulatory phase of the menstrual cycle and the increased likelihood of ACL injuries. In contrast, during the follicular phase of the menstrual cycle fewer injuries occurred. Hormonal ACL injury related studies are quite new; however, preliminary

studies indicate hormones may be factors in knee ligament injuries in women (Moeller & Lamb, 1997; Wojtys, et al., 1998).

Knee injuries occur more often in games than in practice. They are often season ending injuries, but they can also be career ending (Bahr, Karlsen, Lian, Liudahl, & Addlestone, 1994; DeLee, & Farney, 1992; Ferretti, Papandrea, Conteduea, & Mariani, 1992).

STRESS FRACTURES

Another common sports injury is the stress fracture. Stress fractures comprise a substantial percentage of injuries to runners in general, but especially to women (Hukko & Orava, 1987; James, Bates, & Osternig, 1978; Kannus, Nittymaki, & Jarvinene, 1987; McBryde, 1985; Michelli, 1982). Forty-five percent of competitive female runners develop stress fractures (Malka Orthopaedics, 1999). Studies have shown that female athletes participating in tennis, track and field, gymnastics, and basketball are more susceptible to stress fractures than their counterparts (American Academy of Orthopaedic Surgeons, 1999). Common sites of stress fractures include: tibia, fibula, metatarsal bones, tarsal navicular, and pars interarticularis (Bennell, et al., 1995; Brukner, Bradshaw, Khan, White, & Crossley, 1996)

Stress fractures occur when muscles become fatigued and are unable to absorb added shock. The fatigued muscle eventually transfers the overload of stress to the bone causing a tiny crack. Clinically, stress fractures are defined as a partial or complete fracture of bone. The stress fracture is caused by the bone's inability to withstand non-

acute macrotraumatic stress applied in a rhythmic, repeated submaximal manner (McBryde, 1985). This occurs due to a number of different circumstances. First, stress fractures can result from increasing the amount of an activity too rapidly. They are also caused by the impact of an unfamiliar surface, e.g., when a tennis player switches surfaces from soft clay court to a hard court. Improper equipment may also cause stress fractures. For example, shoes that provide inadequate support or are not flexible enough may contribute to stress fractures. Increased physical stress, frequently brought on by substantially increase in playing time, adds to the risk of a stress fracture (American Academy of Orthopaedic Surgeons, 1999; Haycock & Gillette, 1976; Whiteside, 1980). Other causes include poor biomechanics, fatigue, anemia, depression, extremely low body fat stores, low dietary calcium intake, decreased estrogen levels, or low bone density. Finally, the athlete's noncompliance to medical advice contributes to stress fractures. Driven, high-achieving athletes often ignore a doctor's advice in order to continue training (Arena, Maffiuli, Maffiuli, & Morleo, 1995; Nattiv, Agostini, Drinkwater, & Yeager, 1994; Roberts, 1995).

Barrow and Saha (1988) investigated the prevalence of stress fractures in competitive collegiate female long distance runners in relationship to their menstrual histories. They found that stress fractures occurred in 49% of the very irregular (0 to 5 menses a year) runners, 39% of the irregular (6 to 9 menses a year) runners, and 29% of the regular (10 to 13 menses a year) runners. The majority of stress fractures occurred in the tibia. The runners who never used oral contraceptives were twice as likely to have stress fractures than the runners who had used oral contraceptives for more than one

year. Myburgh, Hutchins, Fataar, Hough, & Noakes (1990) found that female athletes who had a higher incidence of stress fractures also had lower calcium intakes as well as less use of birth control pills.

FEMALE ATHLETE TRIAD

Reflecting the interrelated risk factors and frequency of injuries is a syndrome known as the Female Athlete Triad, a serious sports-related health concern for the female athlete. The Female Athlete Triad is a recently recognized syndrome that consists of three distinct interrelated components: disordered eating, amenorrhea, and osteoporosis. To emphasize the seriousness and the magnitude of problems associated with the Female Athlete Triad, the American College of Sports Medicine published a position paper on the Female Athlete Triad listing warning signs and contributory physical and psychological factors (Otis, Drinkwater, Johnson, Loucks & Wilmore, 1997). The position of the American College of Sports Medicine (Otis, et al., 1997) is based upon a comprehensive literature survey, researched case reports, and the consensus of experts. The Female Athlete Triad occurs not only in elite athletes but also in physically active girls and women participating in a wide range of physical activities. The Triad is often either denied, not recognized, or under reported. Participation in sports that emphasize low body weight can also be a risk factor. Those sports include: (a) sports in which performance is subjectively scored, e.g., dance, figure skating, diving, gymnastics, aerobics; (b) endurance sports, e.g., distance running, cycling, cross-country skiing; (c) sports requiring body contour-revealing clothing for

competition, e.g., volleyball, swimming, diving, cross-country running, cross-country skiing, track, and cheerleading; (d) sports using weight categories for participation, e.g., horse racing, some martial arts, wrestling, rowing; and (e) sports emphasizing a “prepuberal body habitus” for performance success, e.g., figure skating, gymnastics, diving (Otis, et al., 1997). The Female Athlete Triad syndrome may result in irreversible bone loss and osteoporosis. Early detection is imperative (Smith, 1996). Any female athlete who is involved with intense physical training is at risk for the Female Athlete Triad (Carbon, 1995; Otis, et al., 1997; Thompson, 1990; Yeager, Agostini, Nattiv, & Drinkwater, 1993). Consequences of the Female Athlete Triad may also include psychological problems, disorders related to starvation and decreased serum estrogen levels, and even death (Smith, 1996).

DISORDERED EATING BEHAVIORS

In recent years, there has been growing interest in disordered eating behaviors, one of the components of the Female Athlete Triad, among athletes (Brownell, Rodin, & Wilmore, 1992; Thompson & Sherman, 1993). One factor that has heightened the interest concerning disordered eating behaviors is the focus on thinness among female athletes, especially those participating in sports that emphasize appearance or leanness. Appearance sports, such as gymnastics, ballet, figure skating, equestrian sports, and diving, is where disordered eating behavior is cited as most common (Smith, 1996). An example of this focus on thinness is that today’s female gymnast weighs almost 20 lbs. less than her counterpart of 20 years ago (Joy, et al., 1997).

Numerous studies indicate that athletes are more prone to developing disordered eating behaviors than non-athletes (Brooks-Gunn, Warren & Hamilton, 1987; Brownell & Rodin, 1992; Brownell, Rodin, & Wilmore, 1992; Burckes-Miller, Black, Miller, & Black, 1988; Passman & Thompson, 1988; Sundgot-Borgen, 1993 a, 1993b; Sundgot-Borgen, 1994; Sundgot-Borgen & Corbin, 1987; Thompson & Sherman, 1993; Wilmore, 1991). Disordered eating behaviors are more commonly found in female athletes than male athletes (Johnson, Powers, & Dick, 1999). Approximately 90% of disordered eating behaviors reported to the NCAA are women athletes (National Collegiate Athletic Association, 1999).

In 1991, a survey by the NCAA revealed that 40% of NCAA athletic programs reported athletes with disordered eating behaviors, primarily in women's sports (Dick, 1991). The prevalence of eating disorders among athletes is between 20% and 32% depending on the particular survey examined (Drummer, Rosen, Heusner, Roberts, & Counsilman, 1987; Rosen & Hough, 1988; Sundgot-Borgen & Corbin, 1987). Inadequate caloric intake is common in aesthetic and weight-conscious sports such as gymnastics, cheerleading, figure skating, ballet dancing, equestrian, and diving, but also observed in track and field, distance running, tennis, and swimming where leanness is considered important for performance (Chopak & Taylor-Nicholson, 1991; Garner & Garfinkel, 1980; Mosley, 1997; Roberts, 1995; Smith, 1996; Sundgot-Borgen, 1994; Sundgot-Borgen and Corbin, 1987).

Female athletes in these sports often do not take in enough calories to meet their training demands in efforts to maintain low body weight, low fat content, and perceived

performance expectations (McKeag, & Hough, 1986; Roberts, 1995; Rosen; Smith, 1996). While athletes in these sports appear to be at greater risk for disordered eating behaviors, no sport should be considered exempt from this problem (Dick, 1991).

Eating disorders include anorexia nervosa, bulimia nervosa, binge eating disorder, restrained eating, and insufficient caloric intake. Athletes with disordered eating behaviors often feel out of control, depressed, and are often overly concerned with body weight and shape. Disordered eating behaviors contribute to less than optimal athletic performance, and can cause suboptimal energy due to lower nutrient intakes, as well as compromise the nutritional status of the athlete (Beals & Manore, 1998; Costill & Miller, 1980; Katz, 1986). Disordered eating behaviors cause chronic illnesses and can have severe psychological and physical consequences, including death (O'Connor, Lewis, & Boyd, 1996; Ratnasuriya, Eisler, & Szmuckler, 1991; Wilson & Eldredge, 1992). Bulimia nervosa and anorexia nervosa are the two most common eating disorders among female athletes (Burckes-Miller, et al., 1988; Dick, 1991; Drewnowski, Hopkins, & Kessler, 1988; Garner & Garfinkel, 1985; Johnson, 1994; Pope, Hudson, Yurgelun-Tood, & Hudson, 1984; Rosen & Hough, 1988; Rosen, McKeag, & Hough, 1986; Schotte & Stunkard, 1987; Smith, 1996; Zuckerman, Colby, Ware, & Lazerson, 1986).

Bulimia nervosa is characterized by recurrent bingeing followed by purging at least two times a week for a minimum of three months (American Psychiatric Association, 1994; Clark, 1993; Otis, et al., 1997). Fluid and electrolyte losses resulting from purging are the major causes of short-term morbidity, i.e. diseases, including

dehydration, acid-base and electrolyte imbalances, and cardiac arrhythmia (Harris, 1983; Herzog & Copeland, 1985; Kreipe & Harris, 1992). Purging can cause chronic physical problems such as gastrointestinal disorders, parotid gland enlargement, and erosion of tooth enamel. In addition, acute and chronic psychological problems are associated with the binge-purge cycle which includes low self-esteem, anxiety, depression, and increased suicide risk (American Psychiatric Association, 1994; Garner & Garfinkel, 1985; Herzog & Copeland, 1985; Pomeroy, & Mitchell, 1992; Roberts & Li, 1987).

Anorexia nervosa, self-induced starvation, is characterized by severe caloric restriction. The current criteria according to the Diagnostic Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) for the diagnosis of anorexia are the refusal to maintain minimal normal weight of at least 85% of that expected for age and height, intense fear of fatness or gaining weight even when underweight, distorted perception of body image, amenorrhea, and lack of medical illness to cause any of the prior characteristics (Berg & Moore, 1996; Dalsky, 1996; Otis, et al., 1997; Smith, 1996).

Significant caloric restriction reduces metabolic rate and causes negative changes in musculoskeletal, cardiovascular, endocrine, thermoregulatory, and other systems. Problems result from depletion of muscle glycogen stores, loss of muscle mass, dehydration, hypoglycemia, electrolyte abnormalities, anemia, and absent menses (Amrein, Friedman, Kosinski, & Ellman, 1979; Bachrach, Guido, Katzman, & Marcus, 1990; Bowers & Eckert, 1978; Eichner, 1992; Garfinkel & Garner, 1982; Herzog &

Copeland, 1985; Hurd, Palumbo, & Gharid, 1977; Ingjer & Sundgot-Borgen, 1991; Isner, Roberts, Heymsfield, & Yager, 1985; Kreipe & Harris, 1992; Palla & Litt, 1988; Rigotti, Nussbaum, Herzog, & Neer, 1984; Salisbury & Mitchell, 1991; Vigorsky, Anderson, Thompson, & Loriaux, 1977; Warren, Brooks-Gunn, Fox, et al., 1991; Warren, Brooks-Gunn, Hamilton, Warren, & Hamilton, 1986; Warren & Vandewiele, 1973). Premature osteoporosis due to inadequate calcium intake may also be caused by anorexia nervosa (Beals & Manore, 1998; Erickson & Thomas, 1997).

Low body weight or excessive weight loss has been associated with menstrual irregularities in athletes. Data suggest that excessive exercise and low caloric intake can influence the incidence of menstrual dysfunction and amenorrhea (National Collegiate Athletic Association, 1999). Barrow and Saha (1988) studied female athlete runners and found that 47% who had no menses per year, 20% who had 1 to 5 menses per year, 10% who had 6 to 9 menses per year, and 7% who had 10 to 13 menses per year reported disordered eating behaviors.

AMENORRHEA

Amenorrhea, another component of the Female Athlete Triad, is the cessation of the menstrual cycle with ovulation occurring infrequently or not at all. Amenorrhea is classified as primary when onset of menses is delayed past age 16, or two years following the development of the secondary sex characteristics. Secondary amenorrhea occurs when there were previous normal cycles, but now the female has fewer than 6-9 periods annually (National Collegiate Athletic Association, 1999).

In surveys, the prevalence of amenorrhea reported depends on the definition of amenorrhea used (National Collegiate Athletic Association, 2000). Female athletes display a disproportionately high prevalence of amenorrhea (Loucks & Horvath, 1985). The prevalence of amenorrhea in the general population is only 2% to 5%, but studies report 3% to 66% for female athletes in different sports (Smith, 1996; Yeager, et al., 1993). The NCAA (1999 & 2000) reports the prevalence of amenorrhea in female athletes to be as high as 44%. Females competing in the sports of ballet and gymnastics have been reported to have a higher incidence of primary and secondary amenorrhea than female athletes competing in other sports (American Academy of Pediatrics, 1989; Drinkwater, Nilson, et al., 1984; Warren, Brooks-Gunn, Hamilton, et al., 1986).

Low body weight and low body fat were first postulated in the 1970s to cause amenorrhea (Frisch & McArthur, 1974; Frisch & Revelle, 1971). A major reduction in body fat is reported by some researchers as a significant causal factor of athletic amenorrhea which may be the result of physical training and/or disordered eating behavior. Adipose tissue (body fat) is the site for conversion of androstendione to estrone, so the distribution and amount of fat stores are critical for the amount of estrogen and the onset of amenorrhea in lean athletes (Carbon, 1995). Decreased serum estrogen levels often lead to reduced bone mineralization and increased risk of fractures (Drinkwater, Bruemner, & Chesnut, 1990; Roberts, 1995; Smith, 1996). Increased levels of stress hormones, corticosteroids and adrenocorticotrophic hormone (ACTH), may be other interrelated factors that cause secondary amenorrhea in athletes (Carbon, 1995; Dalsky, 1996; Haberland, Seddick, Marcus, & Bachrach, 1995; Smith, 1996).

Some researchers refuted the hypotheses concerning low body fat and indicated other factors (Bronson & Manning, 1991; Loucks & Horvath, 1984; Sanborn, Albrecht, & Wagner, 1987; Sinning & Little, 1987). Excessive exercise and a lack of sufficient energy caused by low caloric intake may influence the incidence of amenorrhea, with the hypothalamic-pituitary-gonadal (HPG) axis playing a key role. A reduction in the frequency of luteinizing hormone (LH) pulses from the pituitary gland is the direct cause of amenorrhea and subsequent ovarian suppression in female athletes (Loucks, 1990; Loucks, 1996; Loucks, Mortola, Girton, & Yen, 1989; Loucks, Vaitukaitis, & Cameron, 1992; Veldhuis, et al., 1985). Typically, amenorrheic athletes have low circulating estrogen, LH, follicle-stimulating hormone (FSH), and low thyroid hormones, triiodothyronine and tetraiodothyronine (T3 and T4), which are related to hypothalamic dysfunction (Loucks, 1990; Loucks, et al., 1989).

The decrease of LH pulse frequency is thought to cause a reduction in the frequency of gonadotrophic releasing hormone (GnRH) pulses secreted by the hypothalamus. How exercise training and diet alters the axis is unclear. Recent research shows that exercise has no effect on the HPG axis beyond the impact of its energy cost on energy availability. Exercise stress and energy availability are potential causes of the regulation of GnRH secreting cells, (Loucks, 1990; Loucks, et al., 1989; Loucks, Vaitukaitis, & Cameron, 1992).

Loucks, Verdun, and Heath (1998) investigated the two hypotheses of low energy availability and stress of exercise altering LH pulsatility in female athletes. Their results did not support the hypothesis that LH pulsatility is disrupted by exercise stress.

However, they did suggest that LH pulsatility in women depends on energy availability, i.e., consuming calories equal to high-energy expenditure.

The potential health consequences of decreased serum estrogen levels are reduced bone mineralization and increased risk of fractures (Drinkwater, Bruemner, & Chesnut, 1990; National Collegiate Athletic Association, 2000; Roberts, 1995; Smith, 1996). Delayed menarche in young female athletes, due to factors such as heavy training schedules and stresses from competing at an elite level, combined with low body fat and mass, may risk attainment of peak bone mass. A number of studies concerning amenorrheic athletes report significant decrease in the bone mineral density in the lumbar vertebrae (Cann, Martin, Genant, & Jaffe, 1984; Drinkwater, et al., 1984; Fisher, Nelson, Frontera, Turksoy, & Evans, 1986; Lindberg, et al., 1984; Marcus, Cann, Madvig, Mikoff, et al., 1985; Sneed, et al., 1991). The spine is the primary skeletal site where demineralization occurs. Skeletal demineralization was first observed in amenorrheic athletes in 1984 (National Collegiate Athletic Association, 2000).

Improvements in the precision of bone measurement techniques proved that a significantly lower bone mineral density at multiple skeletal sites in amenorrheic athletes (Myburgh, Bachrach, Lewis, Kent, & Marcus, 1993b; Rencken, Chesnut, & Drinkwater, 1996). Female athletes who have stopped menstruating are more likely to have low bone density in the spine, hip, femur, and tibia which increases the risk of stress fractures in these areas (Biller, et al., 1989; Drinkwater, 1996; Myburgh,

Bachrach, Lewis, et al., 1993a, 1993b; Rencken, Chesnut, Drinkwater, 1996; Rigotti, Neer, Skates, Herzog, Nussbaum, 1991).

Amenorrhea experienced by many young female athletes was thought to be a benign and reversible condition. However, studies found that prolonged low estrogen levels in amenorrheic female athletes may cause irreversible bone loss, despite resumption of menses or estrogen replacement therapy (Biller, et al., 1989; Cann, et al., 1984; Cumming, 1996; Drinkwater, 1996; Drinkwater, Bruemner, & Chesnut, 1990; Drinkwater, et al., 1984; Erickson & Thomas, 1997; Gulekli, Davies, & Jacobs, 1994; Haberland, et al., 1995; Haenggi, Casez, Birkhaeuser, Lippuner, & Jaeger, 1994; Jonnavithula, Warren, Fox, & Lazaro, 1993; Keen & Drinkwater, 1995; Marcus, Cann, & Madvig, Minkoff, et al., 1985; Myburgh, Hutchins, Fataar, et al., 1990; Nelson, Fisher, Catsos, Meredith, Turksoy, & Evans, 1986; Rencken, Chesnut, & Drinkwater, 1996; Thompson, 1990).

Although the positive effect of exercise on bone is diminished in amenorrheic athletes, some data suggest that portions of the skeleton may be protected from bone loss for sports such as figure skating and gymnastics (Smith, 1996). Robinson, et al., (1995) found gymnasts exhibit higher bone mass than runners despite similar prevalence of amenorrhea. Kirchner, Lewis, and O'Connor (1995) found college gymnasts had higher bone mineral density than control students matched by age, height, and weight, despite having a higher incidence of menstrual irregularities and inadequate calcium intake. In a similar study, Slemenda and Johnston (1993) measured

the bone density of figure skaters and found figure skaters had higher bone density than controls, even figure skaters with menstrual irregularities.

Female athletes with amenorrhea, secondary to low levels of circulating estrogen, are at risk for serious spinal bone loss and premature osteoporosis (Carbon, 1995; Haberland, et al., 1995). The potential for osteoporotic fractures later in life is one of the critical health risks of amenorrhea (Loosli & Ruud, 1998; National Collegiate Athletic Association, 2000).

OSTEOPOROSIS

The third component of the Female Athlete Triad is osteoporosis which is defined as “a disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility and a consequent increase in fracture risk” (Consensus Development Conference, 1991, p. 107). Osteoporosis is a major cause of mortality, morbidity, and medical expense, and causes more than 1,300,000 fractures annually in the United States alone (Consensus Development Conference, 1991). Although anyone can develop osteoporosis, postmenopausal women and young female athletes with menstrual irregularities are most commonly affected (Erickson & Sevier, 1997). Insufficient levels of estrogen are found in females with osteoporosis and excessive bone loss. The menstrual history as well as the current menstrual status has a significant impact on bone density. The age of menarche is used to predict lumbar bone mineral density (BMD) in amenorrheic and eumenorrheic, normal menses, athletes. Studies have found that the later the age of menarche, the lower BMD. Delayed menarche predicts lower BMD, especially in

amenorrheic athletes (Rencken, Chesnut, & Drinkwater, 1996). Rencken, Chesnut, and Drinkwater (1996) found in a case-control study involving 49 athletes, ages 17 to 39, that extended periods of amenorrhea can result in decreased BMD at multiple skeletal sites, including the lumbar spine, femoral neck, trochanter, Ward triangle, intertrochanteric region, and shafts of the femoral and tibia, which are weight-bearing bones.

In addition to delayed menarche and amenorrhea, other risk factors for the development of osteoporosis include an inherited familial tendency to osteoporosis, low dietary calcium intake or lactose intolerance, hypo-estrogenic states, malnutrition, disordered eating behaviors, prolonged exposure to certain medications, such as corticosteroids, excess thyroid replacement, and phenytoin, low lean body mass or muscle mass; and training intensity. Inadequate dietary calcium and vitamin D intake may be a factor in osteoporosis, though research studies have not established the exact relationship of dietary intake to bone mineral density. (Biller, et al., 1989; Carbon, 1995; Erickson & Sevier, 1997; Roberts, 1995; Smith, 1996).

Osteoporosis is potentially more deleterious in younger women because they have not yet attained peak bone mass; and early bone loss, therefore, can negatively affect the rest of their lives. Bone density increases throughout childhood, adolescence and young adulthood, until about 30 years of age (Erickson & Sevier, 1997). A longitudinal study by Recker, et al., in 1992, demonstrated that cortical and trabecular bone mass continues to increase slightly in healthy young women until approximately 28 years of age. Other studies indicate that in the third decade of life trabecular bone

loss may end, but cortical bone may increase or remain constant until the fifth decade (Birkenhager-Frenkel, et al., 1988; Mazess, 1982; Riggs, et al., 1981).

Osteoporosis can cause kyphosis, i.e., abnormally increased convexity in the curvature of the thoracic spine, secondary to vertebral crush fractures, and concomitant back pain (Carbon, 1995; Looker, et al., 1995). Warren, Brooks-Gunn, Hamilton, et al. (1986) surveyed 75 ballet dancers and found 24% with scoliosis. This percentage increased as age at menarche increased. Eighty-three percent of the dancers with scoliosis had experienced a delayed menarche. In addition, the dancers with scoliosis had a slightly higher prevalence of secondary amenorrhea. The incidence for fractures for all the dancers was 61%, and this percentage rose with increasing age at menarche. The researchers concluded that a delay in menarche and prolonged intervals of amenorrhea reflect prolonged hypoestrogenism which may predispose ballet dancers to scoliosis and stress fractures.

The lack of estrogen and other contributing factors, which result in osteoporosis, is well documented. Estrogen replacement therapy in the prevention and treatment of osteoporosis in postmenopausal women is widely accepted, but its effectiveness in treating osteoporosis in female athletes is debatable. Cumming (1996) reported that eight amenorrheic women runners who took hormone replacement had BMD increases of 8% in the lumbar spine and 4% in the femoral neck after 24 to 30 months of hormone replacement therapy. Gulekli, Davies, and Jacobs (1994) found that 17 to 40 years old amenorrheic women treated with either hormone replacement or birth control pills for an average of 19 months increased BMD by 3.5%. Keen and Drinkwater

(1995) reported that younger athletes with osteoporosis who either regained menses or took hormone replacement for up to 9 years did not significantly improve bone density. They reported improvements of 6% of BMD over a 24-month period, but slowed to 3% the next year and ceased during the next 2 years. This finding suggests that bone loss is irreversible.

Since the Female Athlete Triad syndrome, disordered eating, amenorrhea and osteoporosis have interrelated pathogenesis and varied presentations of components of the Triad, prevention, identification, and treatment are important steps in ensuring the health and safety of young female athletes participating in sports activities. Female athletes with one Triad component should be screened for the other components (Johnson, 1992; Pomeroy & Mitchell, 1992; Shangold, Rebar, Wentz, & Schiff, 1990). Many feel that the best way to prevent many injuries and screen for the Triad is with a well-planned and properly executed preparticipation health examination (Abamkin, 1978; Allman, 1974; Allman, 1977; American Medical Association, 1976; Linder, et al., 1981; Otis, et al., 1997; Shaffer, 1978; Sullivan, 1979). The preparticipation evaluation is the first and foremost step in ensuring the health and safety of young athletes (Smith, 1994).

PREPARTICIPATION EXAMINATION

The preparticipation examination (PPE) is suggested as the ideal situation where the recognition, evaluation, treatment, and clearance for athletic participation in sports for the Female Athlete Triad should take place (Otis, et al., 1997). The PPE should be

used to assess the associated injuries of the Female Athlete Triad such as stress fractures, knee injuries, sport-related musculoskeletal injuries, disordered eating behaviors, amenorrhea, and osteoporosis (Johnson, 1992; Smith, 1994). The PPE provides information concerning an athlete's ability to participate safely in sports by detecting physical abnormalities serious enough to limit athletic participation (Carek, & Futrell, 1999; Goldberg, et al., 1980; Johnson, 1992; Kibler, Chandler, Uhl, & Maddux, 1989; Linder, et al., 1981; McKeag, 1989; Risser, et al., 1985; Tennant, Sorenson, & Day, 1981; Thompson, Andrish, & Bergfeld, 1982).

Those involved in screening athletes must set clear goals and objectives for the PPE. The following objectives and goals are commonly accepted by sports medicine teams, i.e. physicians, athletic trainers, sports psychologists, etc., (a) to detect conditions that may limit participation, (b) to detect conditions that may predispose to injury, (c) to meet legal and insurance requirements, (d) to determine general health, (e) to counsel on health-related issues, (f) to assess maturity, and (g) to assess fitness level and performance (American Academy of Family Physicians, American Academy of Pediatrics, American Medical Society of Sports Medicine, American Orthopaedic Society of Sports Medicine, & American Osteopathic Academy of Sports Medicine, 1992; Smith, 1994). The first 3 are considered primary objectives that should be met in all preparticipation evaluations. The last 4 objectives are ideal objectives, which may be completed depending on available time, resources, and interest (Johnson, Kibler, & Smith, 1993; Smith, 1994). These broad objectives and goals are generally accepted,

yet the content of the PPE is not standardized causing considerable confusion and disagreement (Glover, Maron, & Matheson, 1999).

STANDARDIZED APPROACHES

Even though the PPE has become the standard of care for athletes as they prepare for athletic participation, there are problems in meeting the above goals (Carek & Futrell, 1999). There are no standardized, systematic approaches in performing the PPE that require adherence to comprehensive, nationally derived standards of care. The scope of the medical problems addressed is often vague and controversial, and standardized criteria are lacking for identification of injuries, health problems, and illnesses that preclude participation in vigorous sports (Glover, Maron, & Matheson, 1999). Existing PPEs represent a “diversity of procedures, protocols, and requirements” (Herbert, 1997, p. 117) which are the result of not having required national standards for the PPE for competitive athletics in high schools or colleges (Glover, et al., 1999; Herbert, 1997).

EXAMINERS' QUALIFICATIONS

In addition to the absence of a standard approach, another problem area for PPE effectiveness is a lack of standardization of the qualifications required of the examiners to perform the PPE. Preparticipation examinations are performed by a wide variety of health care workers with vastly different levels of training and expertise (Maron, 1998).

States certify which practitioners are qualified to perform the PPE, and many states allow health care professionals other than physicians to perform the evaluation. Twenty-one states permit nurses or physician assistants to administer examinations,

and eleven states specifically identify chiropractors and naturopathic clinicians to administer the examinations (Maron, 1998).

At the collegiate level, the respective athletic governing bodies may determine who performs the PPE (American Academy of Family Physicians, et al., 1992, American Academy of Family Physicians, et al., 1997). Presently, there are no systematic training or accreditation criteria required to provide assurance that designated health care workers achieve a satisfactory level of expertise (Glover & Maron, 1998).

FREQUENCY OF PREPARTICIPATION EXAMINATION

Controversy also exists as to the frequency of the PPE evaluation, which varies as to how often the athlete needs to receive a complete evaluation or an interim brief re-evaluation. An optimal frequency for administering the PPE has not been established. There are recommendations for a full PPE six weeks prior to preseason practice when the student enters a new sport (Lombardo, 1984; McKeag, 1985). The Committee on Sports Medicine and Fitness, American Academy of Pediatrics (1991) recommends biennial PPE, with an interim history and limited physical exam performed annually. Yet another recommendation is that a PPE should be performed prior to every sport season, which would require multiple examinations per year for athletes in multiple sports (Johnson, Kibler, Smith, 1993; Myers & Sickles, 1998).

In 1996, the American Heart Association (AHA) published a statement, which included recommendations that the PPE be performed before participation in organized collegiate sports and be repeated every two years. In intervening years an interim

history and blood pressure should be obtained. Due to concerns by the NCAA, the AHA amended its recommendation in 1997 to a PPE in the first year of entering sports, and then an interim history and blood pressure the 3 or 4 following years (American Heart Association, 1998; Maron, Thompson, et al., 1998).

Another recommendation is a comprehensive examination PPE at entry into sport participation followed by a limited history only annual reevaluation focusing more formally on interim medical problems and injuries. An annual comprehensive PPE is recommended only when continuity of care is in question, or there are no previous records to demonstrate prior normal examination (American Academy of Family Physicians, et al., 1997; Myers & Sickles, 1998).

The frequency of the PPE and interim evaluations varies according to state law, requirements of the institution, and other considerations. Some of the considerations for examination frequency are the degree of risk of the sport, the availability of qualified personnel, and cost, especially as it relates to direct expenses for students, since this could be a barrier for participation (American Academy of Family Physicians, et al., 1997). Many schools and states have their own requirements for athletic participation, which guide the frequency of the examinations for their jurisdiction (Myers & Sickles, 1998).

SETTING FOR PREPARTICIPATION EXAMINATION

Controversy and lack of standardization are also present as to how the PPE should be performed. The PPE is either performed in a physician's office by the physician or as a station-based screening with many practitioners providing the

screening. An advantage of an office-based examination is the ease of establishing a relationship between physician and student-athlete, which facilitates continuity of care. The office-based examination provides an environment that is more conducive for counseling on sensitive health-related issues (Johnson, 1992; Lombardo, 1984; McKeag, 1985; Myers & Sickles, 1998).

There are some disadvantages for the office-based examination. First, there is a potentially greater cost to the student or family for this type of examination. Second, there may be more difficulty with communication between physician and coaches or athletic trainers with an office-based evaluation. Third, many primary care physicians lack expertise in sports medicine and may feel inadequately prepared to do an appropriate PPE. Finally, the physician may have difficulty in making the determination of eligibility for an athlete with a particular problem or difficulty detecting conditions that may predispose an athlete to injury (Lombardo, 1984; McKeag, 1985; Myers & Sickles, 1998; Johnson, 1992).

A major advantage of the station-based mass screening examination is the use of specialized personnel who are interested in athletes and sports medicine. Station-based mass screening examinations are cost-effective and efficient for evaluating large numbers of athletes. Non-specialized personnel are utilized for stations such as signing in, weight and height measurements, and vision checks. The remaining stations, vital signs, history, physical examination including medical, musculoskeletal, flexibility, performance testing, nutrition and dental evaluations, are divided among specialized personnel, such as physicians, athletic trainers, physical therapists, exercise

physiologists, nutritionists and dentists (Johnson, 1992; Lombardo, 1984; McKeag, 1985; Myers & Sickles, 1998).

Since coaches, athletic trainers, and other school personnel often participate in the station-based mass screening process, studies indicate that there typically is an increase in communication with the athletic staff regarding potential problems in specific athletes. Station-based mass screening examination settings also provide the opportunity for performance testing evaluation, which is not available in most physicians' offices (Johnson, 1992; Lombardo, 1984; McKeag, 1985; Myers & Sickles, 1998).

The disadvantages of the station-based mass screening examinations may include inadequate number of personnel relative to the number of athletes, and inadequate facilities for performing private examinations in a relatively quiet setting. Communication problems due to the setting may exist between the physician and the athlete, making detection of psychosocial problems difficult. Continuity of care on problems that are discovered during the examination may be more difficult to follow, since the athlete's primary physician is not usually part of the process (Johnson, 1992; Lombardo, 1984; McKeag, 1985; Myers & Sickles, 1998).

LABORATORY SCREENING TESTS

Another area concerning the PPE, which is not standardized, is routine laboratory screening tests such as urinalysis, complete blood count, chemistry profile, lipid profile, ferritin level, or sickle cell trait test. Screening tests are often considered controversial in asymptomatic athletes. The value of a screening test is its ability to

reduce morbidity and/or mortality. To be valuable the screening test or procedure must also be cost-effective, which is affected by the prevalence of the condition in the population being screened and the cost of the test. (American Academy of Family Physicians, et al., 1997).

Although some institutions use laboratory screening tests as a part of their PPE, studies have not supported the use of routine laboratory screening tests based on cost-effectiveness and prevalence of the condition criteria (American Academy of Family Physicians, et al., 1992; Dodge, West, Smith, Brunce, 1976; Peggs, Reinhardt, & O'Brien, 1986; Taylor & Lombardo, 1990; Vehaskari & Rapola, 1982). Similarly, cardiopulmonary testing, such electrocardiogram, echocardiogram, exercise stress testing, or spirometry, are not recommended for the PPE. This recommendation is based on studies using the criteria of cost-effectiveness and prevalence of condition (Ades, 1992; Epstein & Maron, 1986; Feinstein, Colvin, & Oh, 1993; Lewis, Maron, Diggs, Spencer, Mehrotra, & Curry, 1989; Maron, Bodison, & Wesley, Tucker, & Green, 1987; Rupp, Guill, & Brudno, 1992).

CARDIOVASCULAR SCREENING TESTS

Even though many practitioners do not recommend noninvasive tests such as the 12-lead electrocardiogram and echocardiogram for the PPE, other practitioners feel that cardiovascular screening tests could increase the likelihood of identifying many cardiovascular abnormalities. The occurrence of non-traumatic sudden death in young athletes due to unsuspected cardiovascular disease is uncommon, but always disturbing (Maron, 1993; Maron, Mitten, Quandt, & Zipes, 1998; O'Connor, Kugler, & Oriscello,

1998). Sudden death is defined as death within 24 hours of the onset of symptoms (Winget, Capeless, & Ades, 1994). Most sudden deaths in athletes result from previously unsuspected cardiovascular disease resulting in sudden collapse, or by deaths from nonpenetrating chest impact leading to sudden death from cardiac arrest (Burke, Farb, Virmani, Goodin, & Smialek, 1991; Corrado, Thiene, Nava, Rossi, Pennelli, 1990; Estes, 1995; James, Froggatt & Marshall, 1967; Libberthson, 1996; Maron, Epstein, & Roberts, 1986; Maron, Poliac, Kaplan, & Mueller, 1995; Maron, Roberts, McAllister, Rosing, & Epstein, 1980; Maron, Shirani, et al., 1996; Maron, Strasburger, et al., 1997; O'Connor, Kugler, et al., 1998; Thiene, Nava, Corrado, Rossi, & Pennelli, 1988; Thiene, Pennelli & Rossi, 1983; Topaz & Edwards, 1985; Tsung, Huang, & Chang, 1982). These sudden death catastrophes have stimulated considerable interest in the cardiac screening requirements of the PPE (Pfister, Puffer, & Maron, 2000; Smith & Laskowski, 1998).

The customary practice for preparticipation screening for cardiovascular disease is a history and a physical examination. If performed optimally, the preparticipation screening can potentially identify cardiovascular abnormalities such as Marfan syndrome, systemic hypertension, and diseases with systolic heart murmur, i.e., hypertrophic cardiomyopathy (Corrado, Basso, & Schiavon, 1998; Kaplan, Deveraux, Miller, 1994; Maron, Moller, et al., 1998; Thiene, Nava, et al., 1988).

Evidence suggests, however, that the customary screening process for cardiovascular disease in athletes may be largely inadequate (Maron, 1998). One retrospective study indicates that cardiovascular abnormalities suspected by history and

physical examination identifies only 3% of the high school and college athletes who die suddenly of cardiac disease and that only 1% receive an accurate diagnosis (Glover & Maron, 1998; Maron, Shirani, et al., 1996).

Problems in identifying athletes at risk for cardiovascular catastrophe include practicality and utility of the screening process, infrequent occurrence of the cardiovascular catastrophe, i.e., occurring in about 1/200,000 to 1/300,000 athletes per academic year, and the large size of the competitive athletic population (Maron, 1998; Maron, Gohnman, & Aeppli, 1998; Maron, Poliac, et al., 1995; Maron, Stead, & Aeppli, 1996; Van Camp, Bloor, Mueller, Cantu, & Olson, 1995). Several studies of large athletic populations using echocardiography and electrocardiography demonstrate these problems resulting in a low yield of identifiable cardiovascular disease (Fuller, et al., 1989; Lewis, et al., 1989; Liberthson, 1996; Maron, Bodison, Wesley, Tucker, & Green, 1997; Maron, Thompson, et al., 1996).

Cost of the electrocardiogram and echocardiogram tests is another factor when considering the infrequency of sudden cardiac death for student-athletes.

Weidenbener, Krauss, Waller, & Taliercio (1995) studied echocardiograms for use in the PPE, and reported that the echocardiographic screening procedure provides valuable information efficiently and economically for screening athletes at risk for cardiovascular catastrophe. They were able to perform inexpensive echocardiograms by using donated equipment and free cardiologists' interpretations. Although these investigators state that the echocardiographic screening procedure provided valuable

information, of the 2,997 examinations performed, no abnormalities were identified that precluded athletes' participation in sports.

In a similar study over a 3-year period, investigators found 22 young athletes with serious or potentially serious cardiovascular abnormalities, as defined by the 16th Bethesda Conference, when utilizing the echocardiogram as part of the PPE (Fuller, et al., 1997; Mitchell, Maron, & Epstein, 1985; Mitchell, Maron, & Raven, 1996). The 5,615 high school athletes were screened by history and physical exam for abnormalities, and when found to have cardiovascular abnormalities, the athletes were screened using echocardiography. The cost of the echocardiography screening was not discussed.

The cost of an echocardiographic test ranges from \$400 to \$2000 per case with the average cost of \$600. The vast majority of administrative bodies such as schools or universities can not afford to screen large athletic populations given this cost (Epstein & Maron, 1986; Feinstein, Colvin & Oh, 1993; Murry, Cantwell, Heath & Shoop, 1995; Risser, Hoffman, Bellah, & Green, 1985; Weidenbener, et al., 1995). Studies support that the echocardiography is not cost-effective in identifying athletes at risk for sudden death (Epstein & Maron, 1986; Feinstein, et al., 1993; Lewis, et al., 1987).

The 12-lead electrocardiogram is proposed as a more practical and cost-efficient alternative to routine echocardiography for population-based screening (LaCorte, et al., 1989; Maron, Bodison, et al., 1987). In preparticipation screening the electrocardiogram compares unfavorably with the echocardiogram because of its relatively low specificity. If abnormalities are found with the electrocardiogram, then

athletes have to be referred for echocardiography to determine structural cardiovascular malformations (Maron, Thompson, et al., 1996).

The largest screening effort involving electrocardiography for the detection of cardiovascular abnormalities has been ongoing in Italy since 1982 as part of a national evaluation program for competitive athletes (Corrado, Basso, & Thiene, 1997; Pelliccia & Maron, 1995). Corrado, Basso, Schiavon, and Thiene (1998) prospectively studied sudden deaths among athletes and non-athletes in Italy from 1979 to 1996. The investigators compared the causes of sudden death in both populations. The pathological findings in the athletes were related to their clinical histories and electrocardiograms. The focus of the study was to determine the effects of utilizing the electrocardiography in the prevention of sudden death from hypertrophic cardiomyopathy. Hypertrophic cardiomyopathy is the most common cardiovascular cause of sudden death in young athletes, accounting for about one third of fatal cases in the United States (Burke, et al., 1991; Libberthson, 1996; Maron, 1998; Maron, Epstein, et al., 1986; Maron, Roberts, et al., 1980; Maron, Shirani, et al., 1996; McCaffrey, Braden, & Strong, 1991; O'Connor, Kugler, et al., 1998; Van Camp, et al., 1995).

Of the 33,735 athletes initially screened, 3016, 8.9 %, had abnormalities detected in their physical examination, history, or electrocardiograph and were referred for echocardiographic evaluation. Hypertrophic cardiomyopathy was detected in 22 athletes, 0.07 %, at preparticipation screening and accounted for 3.5 % of the cardiovascular reasons for disqualification. Hypertrophic cardiomyopathy caused only one death (2%) among the athletes in Italy screened in this manner from 1979 through

1996. This figure is much lower than the frequency percentage (24%) found in the United States. Results demonstrate that a screening program based largely on a standard 12-lead electrocardiogram is an efficient means of detecting hypertrophic cardiomyopathy (Corrado, Basso, Schiavon, et al., 1998). Even though the athletes' lives may be saved by electrocardiography/echocardiography, the cost effectiveness of early identification of cardiovascular abnormality by screening other than by history and physical exam is still controversial (Corrado, Basso, Schiavon, et al., 1998; Maron, Thompson, et al., 1996).

EXERCISE CHALLENGE TESTS

Another area of controversy is PPE screening athletes for exercise-induced asthma (EIA), i.e., exercise induced bronchospasms, by use of exercise challenge tests. Screening for EIA is important in the PPE with the prevalence of undiagnosed EIA in high school, collegiate, and Olympic athletes estimated at 3% to 14% (American Academy of Family Physicians, et al., 1997; Rice, Bierman, Shapiro, Furukawa, & Pierson, 1985; Rupp, Guill, & Brudno, 1992; Shield, Wang-Dohlman, 1991; Voy, 1986). Exercise-induced asthma is difficult to detect since it may subside in 15 to 30 minutes. The coaches, athletic trainers, physicians and the athletes themselves may not be aware of this exercise-related physical condition (Rice, et al., 1985). Studies show that history and physical examinations are not reliable in identifying athletes who have EIA (Feinstein, LaRussa, Wang-Dohlman, & Bartolucci, 1996; Rice, et al., 1985; Rupp, Brudno, & Guill, 1993; Rupp, Guill, & Brudno, & Kalish, 1993; Rupp, Guill, & Brudno, 1992; Shield & Wang-Dohlman, 1991; Voy, 1986). Studies show that exercise

challenge tests are effective in identifying this disorder (Feinstein, et al., 1996; Rupp, Brudno, & Guill, 1993; Rupp, Guill, & Brudno, 1992). Due to lack of large, reproducible population studies with cost-benefit analysis, national organizations do not currently recommend the use of routine screening exercise challenge tests as part of the PPE (American Academy of Family Physicians, et al., 1997).

HISTORY AND PHYSICAL FORMS

Currently uniformity and standardization are lacking in PPE history and physical examination forms. Thirty years ago, the first-generation PPE forms used by health providers were developed primarily to provide liability protection for the institution and required only a physician's signature for clearance (Glover & Maron, 1998). The examination could be characterized as "the triple H": *How* are you doing? Check the *heart* and check for *hernia*. The focus of these examinations was on detecting functional heart murmurs and asymptomatic hernias, which likely caused unnecessary disqualification of the athletes (Glover, Maron, & Matheson, 1999).

The second-generation PPE form included additional components listed on a typical 5x7-inch card. The additional components included a urinalysis, a limited physical exam, a sports-clearance statement for the physician to sign, and the question: "Have you experienced significant past medical problems?" (Glover, Maron, & Matheson, 1999).

The PPE form today is more extensive and often includes content not directly related to sports participation. There is considerable confusion and disagreement among practitioners concerning non-standardized content of the PPE (Glover, Maron,

& Matheson, 1999). Much of the content disagreement and confusion is related to the multiple origins and objectives for which the PPE forms were devised. Different groups for purposes pertinent to themselves developed PPE forms that are currently used. These groups include governing bodies of the university/institutions, sports medicine committees, medical associations, state health departments, state legislatures, and state education departments (Glover, Maron, & Matheson, 1999).

Due to the development of PPE forms by a variety of groups, clear purposes and objectives are lacking. Identifying standards of care, unless there is clarity of the PPE objectives, is difficult. Some of the objectives of the PPE are documenting athletic eligibility, collecting basic medical data for use in emergencies, and improving athlete performance (Glover, Maron, & Matheson, 1999). Others report that the primary objectives of the PPE to be detection of medical and orthopedic conditions that may predispose an athlete to injury, detection of life threatening or disabling conditions, and legal and insurance requirements for institutions and sports governing bodies. Some practitioners suggest that secondary objectives of the PPE to be determination of general health, provide information for counseling on health-related issues and assessment of fitness level for specific sports (Allman, 1974; American Academy of Family Physicians, et al., 1997; Carek & Futrell, 1999; DuRant, Seymore, Linder, & Jay, 1985; Goldberg, et al., 1980; Linder, et al., 1981; Lombardo, 1984; McKeag, 1985; McKeag, 1989; Myers & Sickles, 1998; Shaffer, 1978; Smith, Lombardo, & Robinson, 1991; Tanji, 1990; Tanner, 1994; Turner, Rogers, Lindberg, Pleck, & Sonenstein, 1998).

A recent objective of the PPE is assessment of lifestyle behaviors that are amenable to intervention (Matheson, 1998). Some of the risks that could be evaluated include heat-related illness, use of protective eye wear and equipment, use of seat belts, tendency toward violence, suicide risk, substance abuse, alcohol use, smoking, and sexually transmitted diseases (Carek & Futrell, 1999; Johnson, 1992). Previous data demonstrate that the majority of athletes use the PPE as their only health maintenance contact with a physician or other health care provider (Department of Pediatrics, Bowman Gray School of Medicine, Wake Forest University, 1995; Glover, Maron, & Matheson, 1999; Goldberg, et al., 1980; Johnson, 1992; Myers & Sickles, 1998; Nattiv, Puffer, & Green, 1997; Risser, Hoffman, & Bellah, 1985). The PPE assessment of lifestyle behaviors is proposed as a primary preventive tool, and a way to identify modifiable risk factors (Glover & Maron, 1998; Johnson, 1992; Koester, 1995). For the collegiate student-athlete who is at high risk for many unhealthy behaviors, the PPE serves as one of the potentially few times when many of these risk factors might be uncovered and addressed (Carek & Futrell, 1999; Krowchuk, et al., 1996). Information gained from the PPE form could provide an excellent opportunity for educating athletes about the numerous preventive health related issues affecting their lives (DuRant, et al., 1985; Goldberg, et al., 1980; Matheson, 1998; McKeag, 1989; Myers & Sickles, 1998; Smith, Lombardo, et al., 1991; Tanji, 1990; Tanner, 1994).

GUIDELINES FOR PREPARTICIPATION EXAMINATION

The PPE objectives/content issue causes more confusion and controversy than any other issue concerning the preparticipation examination (Glover, Maron, &

Matheson, 1999). To reduce some of the confusion and provide some guidelines for the PPE objectives, five national organizations, the American Academy of Family Physicians, American Academy of Pediatrics, American Medical Society for Sports Medicine, American Orthopedic Society for Sports Medicine, and American Osteopathic Academy of Sports Medicine, published a monograph *Preparticipation Physical Evaluation* (Lombardo, Robinson, & Smith, 1992). This monograph became the third-generation PPE, and provides history and medical physical examination forms (Glover, Maron, & Matheson, 1999).

The five national organizations' monograph history and physical examination forms were widely acknowledged as useful tools for the PPE. Unfortunately the monograph history and physical examination were not extensively used for the PPE. Glover and Maron (1998) found that only 8 states were utilizing *Preparticipation Physical Evaluation* (1992) screening forms for their high school athletic PPE.

A further step in providing guidelines and clarifying the objectives of the PPE came in 1996, when the American Heart Association (AHA) developed recommendations specifically concerning cardiovascular screening to be included in the PPE (Maron, Thompson, Puffer, et al., 1996). The development of the AHA recommendations was in response to national public awareness of sudden cardiac death in competitive athletes. Athletic field catastrophes stimulated considerable interest in the role and efficacy of preparticipation screening (Corrado, Basso, & Thiene, 1997; Fuller, et al., 1997; Lewis, et al., 1989; Maron, Bodison, et al., 1987; Maron & Mitchell,

1994a, 1994b; Maron, Thompson, et al., 1996; Smith, Kovan, Rich, & Tanner, 1997; Tanji, 1990).

Even though sudden and unexpected cardiovascular deaths occurring in young athletes during organized competitive sports are generally acknowledged to be uncommon, the American Heart Association consensus panel supported the principle of preparticipation cardiovascular screening for young competitive athletes on both medical and ethical grounds. The American Heart Association panel, composed of cardiologist specialists, other experienced physicians, and a legal expert, made recommendations which were published in *Cardiovascular Preparticipation Screening of Competitive Athletes* (Maron, Thompson, et al., 1996). This is considered a major step forward in that a leading national subspecialty association achieved consensus on specific recommendations to improve the detection of cardiovascular abnormalities during the PPE (Glover, Maron, & Matheson, 1999).

These AHA recommendations for the PPE form include 13 items (see Appendix A and Appendix B). These recommendations include questioning and/or testing for: (a) family history of premature sudden death, (b) history of heart disease in surviving relatives, (c) personal history of heart murmur, (d) systemic hypertension, (e) excessive fatigability, (f) fainting, (g) labored breathing upon exertion, (h) chest pain upon exertion, (i) parental verification of the history, (j) physical examination for heart murmur, (k) femoral pulses, (l) indication of Marfan syndrome, (m) and blood pressure. The AHA panel also identifies the need for a national standard for preparticipation

medical evaluation (Herbert, 1997; Maron, Thompson, et al., 1996; Martin, Schlabach, & Shibinski, 1998).

Glover and Maron (1998) studied the PPE history and physical forms utilized by high schools in various states and compared them to the AHA recommendations for cardiovascular screening. They found that 5 states did not require a PPE. Thirty-two states have no standard history or physical examination forms. Of the forty-two states that do have standard history and physical examination forms, questions deemed essential for detecting cardiovascular abnormalities were missing from half of the history forms and more than 60% of the physical examination forms. Only twenty states had incorporated the majority of 1996 AHA recommendations, and none of the states had a PPE form that included all 13 of the AHA recommended items (Glover, Maron, & Matheson, 1999; Maron, Thompson, et al., 1996).

Martin, Higgins, Radovan, and Streff (1999) reviewed high school PPE history and physical forms in 21 states in the Southeast and Northeast comparing them to the AHA recommendations for cardiovascular screening. The investigator's findings were similar, with only one state employing as much as 88% of the AHA suggested cardiovascular screening questions.

Another study evaluating the use of AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) guidelines found of the 254 high schools surveyed in 50 states and the District of Columbia, only 17% of the PPE forms contained all components of the recommended cardiac screening history (Gomez, Lantry, & Saathoff, 1999). These findings support the concern that there are

discrepancies between recommended guidelines for preparticipation screening and actual screening practices.

A recent study by Pfister, Puffer, & Maron (2000) evaluated preparticipation cardiovascular screening practices between 1995 and 1997 of NCAA member colleges and universities by comparing history and physical PPE forms to AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (Maron, Thompson, et al., 1996) guidelines. Other aspects of the study included evaluating if PPE screening was a requirement, where the examination was performed, the frequency of the PPE meeting the AHA screening guidelines, and which medical personnel are responsible for the PPE examinations. A total of 879 NCAA Division I, II, and III schools responded to the survey questionnaire. The PPE screening was a requirement at 97% of the schools. Most of the schools, 81%, performed PPE examinations on campus. The PPE was performed only annually at 51% of the schools. Team physicians were responsible for performing the examinations at 85% of the schools. Nineteen percent of the schools approved nurse practitioners to perform the PPE examination independently and 34% allowed athletic trainers. Seventy-one percent of the schools that responded to the questionnaire sent their history and physical forms for evaluation. Of these, only 26% of the schools' forms had forms that contained at least 9 of the recommended 12 AHA screening guidelines and 24% of the schools' forms had 4 or less of the screening guidelines on their forms. Larger Division I schools were more likely to have adequate screening forms. Thirty percent of Division I schools had adequate forms, defined as having 9 of the 12 items, versus 14% of Division II and Division III schools. The

authors concluded that PPE screening process may lack the potential to detect cardiovascular abnormalities capable of causing sudden death in competitive student-athletes.

In 1997, the five national organizations published an updated monograph, *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997). The monograph *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) publication on sports physicals continues to be the only publication endorsed by five major medical societies. The primary changes in the second edition for the PPE are improvements to the history and physical examination forms, including history questions that address the Female Athlete Triad syndrome (see Appendix E, questions 13 and 16). The monograph provides an in-depth discussion on the guidelines for each parameter on the PPE history and physical examination. In comparison, the actual forms provide a very brief picture of the recommended guidelines (see Appendix F and Appendix G). The organizations attempted to set a standard for the PPE history and physical examination, and the monograph is a widely accepted guide for the athletic PPE (Glover, Maron, Matheson, 1999; Herbert, 1997; Lombardo, et al., 1992).

The *NCAA Sports Medicine Handbook* provides general guideline recommendations regarding the content of the PPE evaluation process for member institutions. The NCAA does not require specific examination protocols or standards of care, preferring to leave these in the hands of each member institution. The *NCAA Handbook* addresses many pertinent medical issues with the sources for the medical

evaluation section including both the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (Maron, Thompson, et al., 1996), and the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997). The Female Athlete Triad components, eating disorders and amenorrhea are addressed as separate sections in the NCAA Handbook with some suggestion for follow-up if these disorders are detected through the PPE. The NCAA makes clear that guidelines in the handbook are only recommendations for institutions to consider for development of their sports' medicine policies, not standards of care (Dick, 1997).

Many experts propose that uniform guidelines/standards of care be established nationwide for the PPE (Epstein & Maron, 1986; Herbert, 1997; Maron, 1997; Maron, Shirani, Poliac, et al., 1996; Maron, Thompson, et al., 1996;). The American Academy of Pediatrics, American Academy of Family Practice, et al., (1997) endorses the use of the PPE form that contains the key elements of the cardiovascular screening history recommended by the AHA (1996). Despite this endorsement for the AHA guidelines and despite wide acceptance of the guidelines of the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997), there seems to be a discrepancy between what is recommended and actual screening practices.

The previous studies evaluate the use of screening practices for the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (Maron, Thompson, et al., 1996) guidelines, evaluating the history components primarily. Glover & Maron (1998) evaluated if the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1992) guidelines were being used, and none evaluate the

actual item use for screening practices for the Preparticipation *Physical Evaluation*, 1992 or 1997, guidelines. Evaluation of usage of items recommended seems important, since these guidelines were developed by five national medical organizations to detect medical or musculoskeletal conditions that may predispose an athlete to injury or illness. Since training regimens at the collegiate level are intense, demanding, and weight control through diet is emphasized, the screening practices are important for the health of the student-athlete. As demonstrated by the Pfister, Puffer, and Maron, (2000) study, compliance is low at the universities for including the screening components of the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) guidelines on the PPE; therefore, it is important to continue to assess the effectiveness of the PPE meeting these recommendations.

STATEMENT OF PURPOSE

Injuries and health risks in sports participation questions the efficacy of the PPE for prevention and safety of the young athletes. Questions of the adequacy of the screening practices to prevent knee injuries, stress fractures and the long-term affects of the Female Athlete Triad components for female athletes were of particular interest.

Realizing that knee injuries can be serious enough to cause the student-athlete's season to end early, end athletic careers, and lead to future knee problems, prompted questions concerning the type of screening practices universities utilize to identify potential weaknesses during the musculoskeletal examination. The high incidence of

stress fractures in many sports, especially for females, was another factor of concern about the screening practices during the musculoskeletal examination.

Concerns about the Female Athlete Triad syndrome causing irreversible bone loss and osteoporosis, and even death, reported as going largely unrecognized, questioned if universities were addressing these issues through their screening practices. These are important issues, especially since early detection can prevent these outcomes if treated early enough.

The PPE evaluation should be the first and foremost step in ensuring the health and safety of athletes. Yet, due to controversy about what the PPE should include and the actual PPE process, questions of its efficacy need to be addressed. There are no nationally derived PPE standards of care or systematic approaches to the PPE. Diversity of procedures, protocols, requirements, health care workers, settings, resources, screening tests, and the forms themselves which guide the actual PPE examination provide controversy and concern of PPEs.

The purpose of this study was to identify and assess screening practices commonly used to detect medical and musculoskeletal conditions and potential cardiovascular diseases that may predispose female student athletes to injury or illness during training or competition. This study identified and described the screening parameters that are presently being used for the PPE at NCAA Division I Institutions that have female basketball programs. Preparticipation examination forms from NCAA Division I Institutions were compared to the *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) recommendations and to the parameters in the

monograph *Preparticipation Physical Evaluation* (1997) developed by five national medical organizations. In addition, other relevant information was identified concerning issues relevant to the PPE and female athletes.

Specifically the study addressed the following research questions:

1. How many and which of the screening components from the history and physical assessment guidelines of the *Cardiovascular Preparticipation Screening of Competitive Athletes* (AHA, 1996) were being used as a part of the preparticipation examination?
2. How many and which of the screening components from the history and physical assessment guidelines of the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) were being used as a part of the preparticipation examination?
3. Who determined the screening components for the preparticipation examination for sports participation?
4. What percent of the universities utilized *Cardiovascular Preparticipation Screening of Competitive Athletes* (AHA, 1996), *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997), and NCAA Guidelines?
5. Who performed the preparticipation examinations for sports participation?
6. What professional personnel were utilized for health care for female student athletes?
7. Were the professional personnel who were utilized for health care for female student athlete's university employees or outside consultants?

8. After the initial PPE, how often was screening repeated for sport participation?
9. Did the PPE include each of the following tests: flexibility, muscular strength, muscular endurance, cardiovascular fitness, body composition, and exercise challenge for sport participation?
10. What percent of the universities provide a post-season interim PPE evaluation?
11. How was PPE screening provided: (a) office-based (the physician providing most of the examination), (b) station-based mass screening (more than one professional provided parts of the examination), or (c) school-based (on campus) or community based?
12. How adequate were the forms utilized by the NCAA Division I universities based on the percent of screening practices recommended by the AHA and/or the 5 national medical organizations for the PPE?
13. Are there significant differences between the utilization of services of different professional personnel (team physician, gynecologist, sports psychologist, athletic trainer, etc) for health care and the adequacy of the forms?
14. Are there significant differences in who performed the PPE examination and the adequacy of the forms?
15. Are there significant differences in the number of athletic trainers utilized for medical follow-up for female athletes and the adequacy of the forms?
16. Are there significant differences in the adequacy of the forms for universities that utilized *Cardiovascular Preparticipation Screening of Competitive Athletes* (AHA,

1996), *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997), or those using NCAA Guidelines?

17. Are there significant differences in the adequacy of forms for universities that included screening questions related to the Female Athlete Triad?
18. Are there significant differences in the adequacy of forms for institutions that required repeated screening for sport participation?
19. Are there significant differences in the adequacy of forms for institutions that had school-based health screening/follow-up programs vs. community-based programs?
20. Are there significant differences in the adequacy of forms for institutions that provided screening office-based vs. station-based mass screening?
21. Are there significant differences in the adequacy of forms for institutions that provided for flexibility, muscular strength, muscular endurance, cardiovascular fitness, body composition, or exercise challenge testing for sport participation?

DELIMITATIONS

1. Division I universities without female basketball programs and Division II and Division III universities were excluded.
2. Only those universities whose Athletic Trainers agreed to participate in the study were included.
3. The findings reflect the NCAA conferences that participated, but the percent of universities that participated within a conference varied. Some conferences only had one university to respond to the survey; other conferences had a 100% response.

4. PPE screening practices were limited to the *Cardiovascular Preparticipation Screening of Competitive Athletes* (AHA, 1996), and the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997).
5. Responses to the survey may indicate a lack of knowledge or a misperception by the Athletic Trainer respondent on some of the athletic preparticipation health screening practices of the university.
6. Respondents may misrepresent information on self-reported survey responses.
7. The researcher's own values and experiences may affect the data interpretation. Data were interpreted in a broad sense, giving credit to the university as having a screening component when it did not precisely reflect the AHA or the five national medical association's exact wording of the screening question. An example is "Do you have seasonal allergies that require medical treatment?" was interpreted as positive if that question was present on the university screening forms, or if "hayfever" or "allergies to pollen", which are seasonal allergies, were listed. Attempts were made to further counter this delimitation as participants were telephoned to ensure clarity and understanding when problems were found in the data.

METHODOLOGY

INTRODUCTION

This chapter describes the methods and procedures that were used to acquire detailed information regarding the administration and scope of preparticipation screening for female athletes. Survey questionnaire and preparticipation evaluation (PPE) forms were used to obtain data for the study. The study was performed primarily to evaluate the forms' contents and compare the PPE forms to the 14 components of AHA (1996) recommendations for cardiovascular screening and the 83 components of the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations. Descriptions of the sample, instrumentation, data collection procedures, and data analysis are included.

SAMPLE

History and physical assessment evaluation forms and a survey questionnaire were utilized for the sample in order to identify screening practices. The assessment form's content represents a guide to examiners and is the basis for screening at universities. The questionnaire was used to gain additional information of screening practices and processes.

Criteria for inclusion in study: Forms and questionnaire surveys were limited to universities that were NCAA Division I having a female basketball team. All forms and questionnaires that were returned were included in the sample.

Requisition of sample forms and questionnaires: *The 1998-99 National Directory of College Athletics (Women's Ed)* (National Association of Collegiate Directors of Athletics, 1998) was utilized to identify universities that met the above criteria. A cover letter and a questionnaire were sent to Athletic Trainers at universities identified as meeting sample criteria.

Characteristics of sample: All forms and questionnaire surveys came from universities where screening practices for preparticipation could be identified for both genders. The study is represented by a large sample, 318 universities having NCAA Division I women's basketball programs.

INSTRUMENTATION

Cover letter: A cover letter was used to obtain forms and request participation by the Athletic Trainer (ATC) to complete the survey questionnaire. The cover letter explained one purpose of the survey and requested a sample of PPE forms that are presently in use. In the cover letter, the ATCs were told that the institution forms will be compared to other NCAA Division I universities having female basketball teams. To insure an unbiased response, the letter did not mention that the study was performed primarily to evaluate the content and compare the PPE forms to the 14 components of AHA recommendations for cardiovascular screening and the 83 components of the five national organizations (1997) recommendations (see appendix A).

Questionnaire survey: A brief questionnaire was designed to gather demographic information and other information related to the PPE process. The demographic information collected included the number of female student athletes, and

the type of sports in which female students participate in the institution's athletic program. Other questions on the survey related to the administration of the PPE and the PPE process. Questions that relate to the administration of the PPE concern the number of ATCs who provide follow-up care, who determine the components of the PPE requirements, and what resources are used for the PPE. Several questions were designed to provide information related to the PPE examination process. These questions include information on who decides the PPE requirements, types of professional personnel available to the athletic program, types of healthcare personnel performing the PPE exam, frequency of examination, and site of evaluation and follow-up care. The question on screening frequency is designed to provide information to evaluate the extent to which the *Preparticipation Physical Evaluation* guidelines are being used for follow-up screening (see appendix B).

PROCEDURE

Prior to conducting the study, approval from the Institutional Review Board of Middle Tennessee State University was obtained. A mail survey was conducted of the 318 universities having a NCAA Division I Women's Basketball Program.

A cover letter with a questionnaire survey was mailed to the basketball certified athletic trainer (ATC) at each university. Each basketball ATC was asked to return by mail, e-mail or fax a copy of the medical history and physical examination forms used for the PPE at her/his university. This might include the medical history forms, physical examination forms, laboratory tests forms, referral forms and other request forms that the university utilizes for screening purposes. The ATCs were also requested to

complete and return a brief questionnaire survey. A self-addressed stamped envelope was provided for all the surveys.

Basketball ATCs who did not respond to the first survey were mailed a second survey. Missing data were obtained by telephone contact with the respective basketball ATC. Basketball ATCs did not receive compensation for responding to the survey. Basketball ATCs who requested the results were e-mailed an abstract which provided information on the overall performance of how PPE forms matched the medical organizations' guidelines.

Each university's anonymity was protected by assigning each university a number (1-318). Numbers were assigned in a random manner so institutional identity could not be ascertained. The key to the number assignment was kept in a secure place and only shared with the committee members if needed. All forms/questionnaire information was coded under that number. Data and descriptive information were organized or grouped by athletic conferences. Universities' results were coded by conferences, which were identified by *The 1998-99 National Directory of College Athletics (Women's Ed)* (National Association of Collegiate Directors of Athletics, 1998).

The screening forms were analyzed for items pertaining to the history and physical examination and were tabulated and compared with the 19 components of the American Heart Association *Cardiovascular Preparticipation Screening Recommendations for Competitive Athletes* (1996), the 84 components of the *Preparticipation Physical Evaluation* of the American Academy of Family Physicians,

American Academy of Pediatrics, American Medical Society for Sports Medicine, American Orthopaedic Society of Sports Medicine, and American Osteopathic Academy of Sports Medicine (1997), and for one item addressing the Female Athlete Triad (see appendices C, D, E).

The items on the forms were considered matching the guidelines of the stated medical organizations if they were more inclusive than exclusive. If the PPE form had a question about chest pain, the question was considered matching the guidelines even if the question did not ask specifically whether the chest pain occurs with exertion. The items considered matching for the Female Athlete Triad item were any questions on the menstrual-cycle, diet, eating behaviors, weight changes, or stress fractures.

The percentages of the number of history questions and physical examination components that matched the AHA and the five national medical organization guidelines, and the Female Athlete Triad were reported by item and by individual NCAA conferences. The extent to which the forms matched history questions and physical assessment components of AHA (1996) and the five medical national organization (1997) recommendations determined the adequacy of the PPE forms. The adequacy of the PPE form was determined by using percentages and dividing the percent of total matching responses into three groups: 1 = lower 1/3 (33.3%), 2 = mid 1/3 (33.3%), and 3= top 1/3 (33.3%). Adequacy of the forms was reported by individual NCAA conferences.

DATA ANALYSIS

Descriptive statistics were generated using commercial statistical software, SPSS. The following are areas analyzed:

1. **Response to survey:** The response to the survey was reported by identifying the total number and percentage of the 318 universities that responded to the survey.
2. **Demographic/PPE process information (see appendix B):**
 - a. Number and percentage of history and medical physical screening evaluation forms.
 - b. Number and percentage of female student-athletes who participated in athletic programs by categories on questionnaire.
 - c. Number and percentage of groups by categories on questionnaire who determine the PPE requirements.
 - d. Number and percentage of Certified Athletic Trainers (ATCs) who are responsible for any necessary medical follow-up for female athletes by number categories on questionnaire.
 - e. Number and percentage of programs that have a team physician, gynecologist, sports psychologist, guidance counselor, nurse practitioner, physician assistant, nurse, and/or nutritionist.
 - f. Number and percentage that have each category of professional personnel on questionnaire who performed the PPE examination.
 - g. Number and percentage of institutions that repeated PPE screening.

- h. Number and percentage of the type of sports offered female student-athletes in the athletic program.
3. **Form utilization:** Form item utilization reported by number and percentage of the following (see appendices C, D, & E):
- a. history items from each AHA (1996) and five national organizations' (1997) recommendations.
 - b. physical assessment components from each AHA (1996) and the five national organizations' (1997) recommendations.
 - c. history and physical assessment components from each, and both the AHA (1996) and the five national organizations' (1997) recommendations.
 - d. additional questions concerning the Female Athlete Triad.
4. **Adequacy of the PPE form:**
- a. history questions
 - b. physical assessment components
 - c. history questions and physical assessment components of each, the AHA (1997) and the five national organizations' (1997) recommendations
5. **Comparison of factors for adequacy:** Factor comparisons for significant differences in adequacy of forms between conferences. The chi-square and one-way ANOVA were used to find if significant differences existed between:

- a. The proportion of adequate PPE forms from institutions having the services of a team physician vs. institutions without a team physician.
- b. The proportion of adequate PPE forms from institutions having the services of a gynecologist vs. institutions without a gynecologist.
- c. The proportion of adequate PPE forms from institutions having the services of a sports psychologist vs. institutions without a sports psychologist.
- d. The proportion of adequate PPE forms from institutions having the services of a massage therapist vs. institutions without a massage therapist.
- e. The proportion of adequate PPE forms from institutions having the services of a nurse practitioner vs. institutions without a nurse practitioner.
- f. The proportion of adequate PPE forms from institutions having the services of a physician assistant vs. institutions without a physician assistant.
- g. The proportion of adequate PPE forms from institutions having the services of a nutritionist vs. institutions without a nutritionist.
- h. The proportion of adequate PPE forms from institutions having the services of a nurse vs. institutions without a nurse.

- i. The proportion of adequate PPE forms from institutions having the services of a physical therapist vs. institutions without a physical therapist.
- j. The proportion of adequate PPE forms from institutions having the services of a chiropractor vs. institutions without a chiropractor.
- k. The proportion of adequate PPE forms from institutions having the services of a dentist vs. institutions without a dentist.
- l. The proportion of adequate PPE forms from institutions that use only physicians to perform the PPE examination vs. institutions that use other professional personnel.
- m. The proportion of adequate PPE forms from institutions that use a dietitian to perform the PPE examination vs. institutions that use other professional personnel.
- n. The proportion of adequate PPE forms from institutions that use a dentist to perform the PPE examination vs. institutions that use other professional personnel.
- o. The proportion of adequate PPE forms from institutions that use a nurse practitioner to perform the PPE examination vs. institutions that use other professional personnel.
- p. The proportion of adequate PPE forms from institutions that use an ATC to perform the PPE examination vs. institutions that use other professional personnel.

- q. The proportion of adequate PPE forms from institutions that use an ophthalmologist to perform the PPE examination vs. institutions that use other professional personnel.
- r. The proportion of adequate PPE forms from institutions that use a physician assistant to perform the PPE examination vs. institutions that use other professional personnel.
- s. The proportion of adequate PPE forms from institutions that use a physical therapist to perform the PPE examination vs. institutions that use other professional personnel.
- t. The proportion of adequate PPE forms from institutions that use a registered nurse to perform the PPE examination vs. institutions that use other professional personnel.
- u. The proportion of adequate PPE forms from institutions that use a chiropractor to perform the PPE examination vs. institutions that use other professional personnel.
- v. The proportion of adequate PPE forms from institutions that use an exercise physiologist to perform the PPE examination vs. institutions that use other professional personnel.
- w. The proportion of adequate PPE forms from institutions that utilize 1 to 3 ATCs for medical follow-up for female athletes vs. institutions that use more ATCs for medical follow-up for female athletes.

- x. The proportion of adequate PPE forms from institutions that utilize 4 to 6 ATCs for medical follow-up for female athletes vs. institutions that use more or less ATCs for medical follow-up for female athletes.
- y. The proportion of adequate PPE forms from institutions that utilize 7 to 9 ATCs for medical follow-up for female athletes vs. institutions that use more or less ATCs for medical follow-up for female athletes.
- z. The proportion of adequate PPE forms from institutions that utilize 10 to 12 ATCs for medical follow-up for female athletes vs. institutions that use more or less ATCs for medical follow-up for female athletes.
- aa. The proportion of adequate PPE forms from institutions that utilize more than 12 ATCs for medical follow-up for female athletes vs. institutions that use less ATCs for medical follow-up for female athletes.
- bb. The proportion of adequate PPE forms from institutions that have questions regarding the Female Athlete Triad vs. institutions that do not have forms with these questions.
- cc. The proportion of adequate PPE forms from institutions that utilize physician office-based vs. institutions that utilize station-based mass screening.

- dd. The proportion of adequate PPE forms from institutions that have school-based health screening/follow-up programs vs. community-based programs.
- ee. The proportion of adequate PPE forms from institutions that utilize as a resource *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1966) vs. the institutions that do not utilize that resource.
- ff. The proportion of adequate PPE forms from institutions that utilize as a resource the *Preparticipation Physical Evaluation* (1997) by the five national medical organizations vs. those institutions that do not utilize that resource.
- gg. The proportion of adequate PPE forms from institutions that utilize as a resource NCAA guidelines vs. institutions that do not utilize that resource.
- hh. The proportion of adequate PPE forms from institutions that utilize as a resource *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1966) vs. the institutions that utilize as a resource the *Preparticipation Physical Evaluation* (1997) by the five national medical organizations.
- ii. The proportion of adequate PPE forms from institutions that provide post-season evaluations vs. institutions that did not provide post-season evaluations.

- jj. The proportion of adequate PPE forms from institutions that provide flexibility tests vs. institutions that do not provide this test.
- kk. The proportion of adequate PPE forms from institutions that provide muscular strength testing vs. institutions that do not provide this test.
- ll. The proportion of adequate PPE forms from institutions that provide muscular endurance testing vs. institutions that do not provide this test.
- mm. The proportion of adequate PPE forms from institutions that provide cardiovascular testing vs. institutions that do not provide this testing.
- nn. The proportion of adequate PPE forms from institutions that provide body composition testing vs. institutions that do not provide this testing.
- oo. The proportion of adequate PPE forms from institutions that provide exercise challenge tests vs. institutions that do not provide this testing.

RESULTS

PARTICIPANTS

Two hundred nine of 318 (66%) NCAA Division I universities with female basketball programs responded to the survey. Certified athletic trainers (ATCs) completed the surveys and sent the requested medical history and physical forms used by the institutions. All respondents completed the questionnaire survey on preparticipation examination practices and related information. The 209 respondents sent 149 (71%) history forms and 145 (69%) of the universities sent physical examination forms. The 209 respondents represented 30 NCAA Division I conferences and included institutions from all but New Hampshire.

DEMOGRAPHIC DATA

The number of female student-athletes who participate in athletic programs varied. One percent of the responding institutions had 26 to 50 female student-athletes, 3% had 51 to 75 female student-athletes, 12% had 76 to 100 female student-athletes, 31% had 101 to 150 female student-athletes, 24% had 151 to 200 female student athletes, 22% had more than 201 to 300 female student-athletes, and 7% had more than 300 female student-athletes (see Figure 1). Sports offered for female student-athletes by the institutions were: basketball (100%), cross country (98%), tennis (97%), volleyball (94%), track and field (outdoors) (89%), track and field (indoors) (88%), soccer (84%), cheerleading (78%), softball (74%), golf (62%), water sports (62%), field hockey (23%), lacrosse (22%), gymnastics (19%), and less than 10% of the schools offered: fencing, crew, rifle, skiing, riding, bowling, rowing, wrestling, baseball, dancing, squash, sailing, rugby, and ice hockey (see Table 1).

FIGURE 1
NCAA Division I Universities
Number of Female Athletes

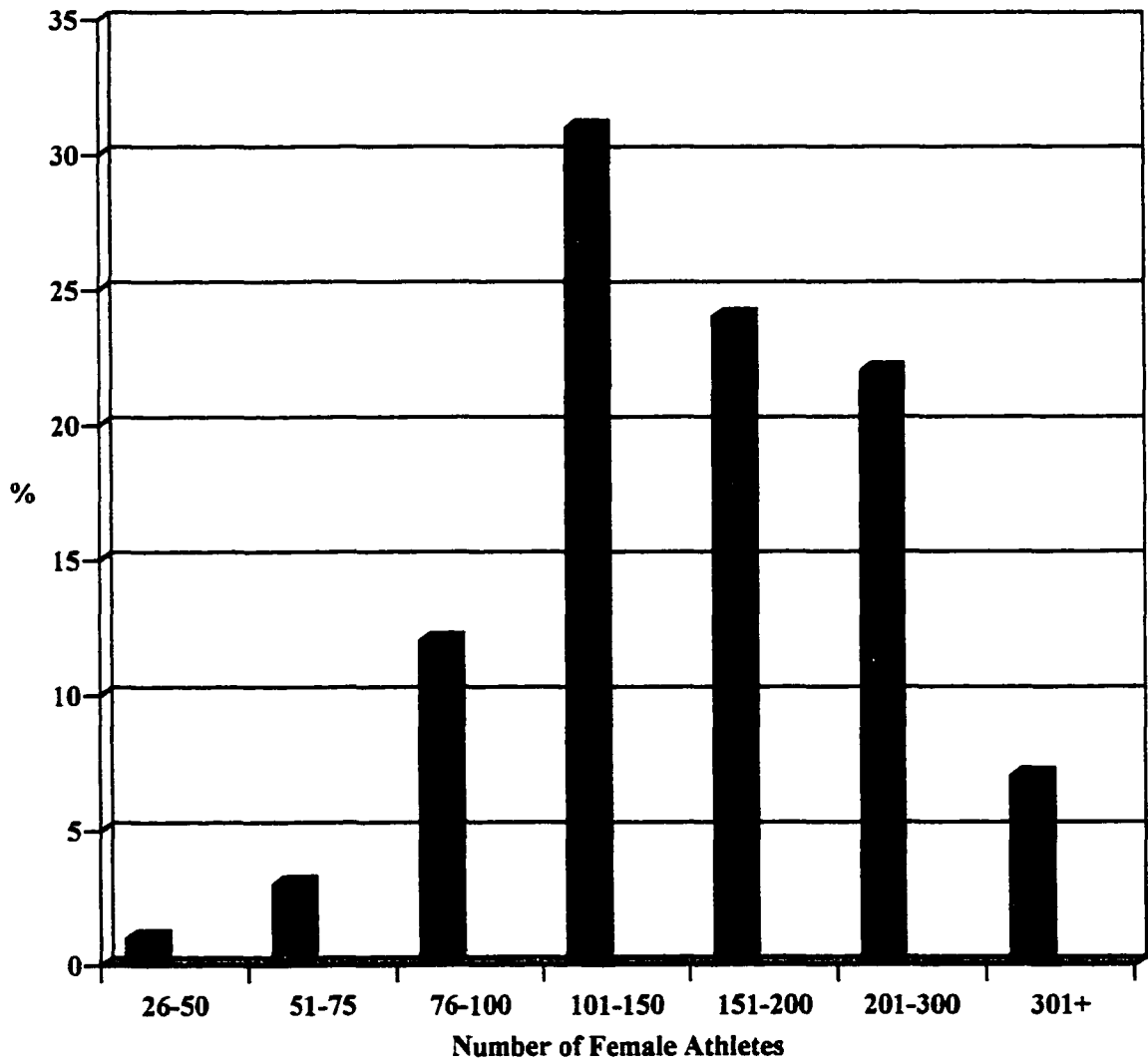


TABLE 1
Major Sports Offered By
NCAA Division I Universities

Sport	Percentage of Schools
Basketball	100%
Cross Country	98%
Tennis	97%
Volleyball	94%
Track and Field (outdoors)	89%
Track and Field (indoors)	88%
Soccer	84%
Cheerleading	78%
Softball	74%
Golf	62%
Water Sports	62%
Field Hockey	23%
Lacrosse	22%
Gymnastics	19%

The number of ATCs who are responsible for necessary medical follow-up for the female student-athletes also varied. Forty-nine percent of the universities have 1 to 3 ATCs, 37% have 4 to 6 ATCs, 11% have 7 to 9 ATCs, 2% have 10 to 12 ATCs, and 1% have more than 10 to 12 ATCs to provide follow-up care for female athletes (see Figure 2).

The components of the PPE are determined by a variety of sources. The most common source for determining components of the PPE is the sports medicine committee (57%). Other sources include: team physicians (17%), ATCs (16%), governing body (9%), medical association (7%), state health department (6%), state legislature (4%), state education department (2%), and the conference officials (2%) (See Table 2). Fifteen percent of the respondents marked "other" and wrote in the following: university health services, sports medicine, medical director, physician assistant, Department of the Air Force, medical staff, NCAA guidelines/requirements, department policy, head ATC, director of sports medicine, orthopedic physicians, dentist, ophthalmologist, university risk management, athletic director, National Athletic Trainers' Association, college health professionals, insurance, university, director of athletic medicine, and athletic department staff.

Fifty-nine percent of the respondents reported using the NCAA Guidelines as a resource for the PPE. The *Cardiovascular Preparticipation Screening of Competitive Athletes* (AHA, 1996) and *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) are used as a resource fairly equally, 21% and 20% respectively (see Figure 3).

FIGURE 2
Certified Athletic Trainers
Usage for Follow-Up Care

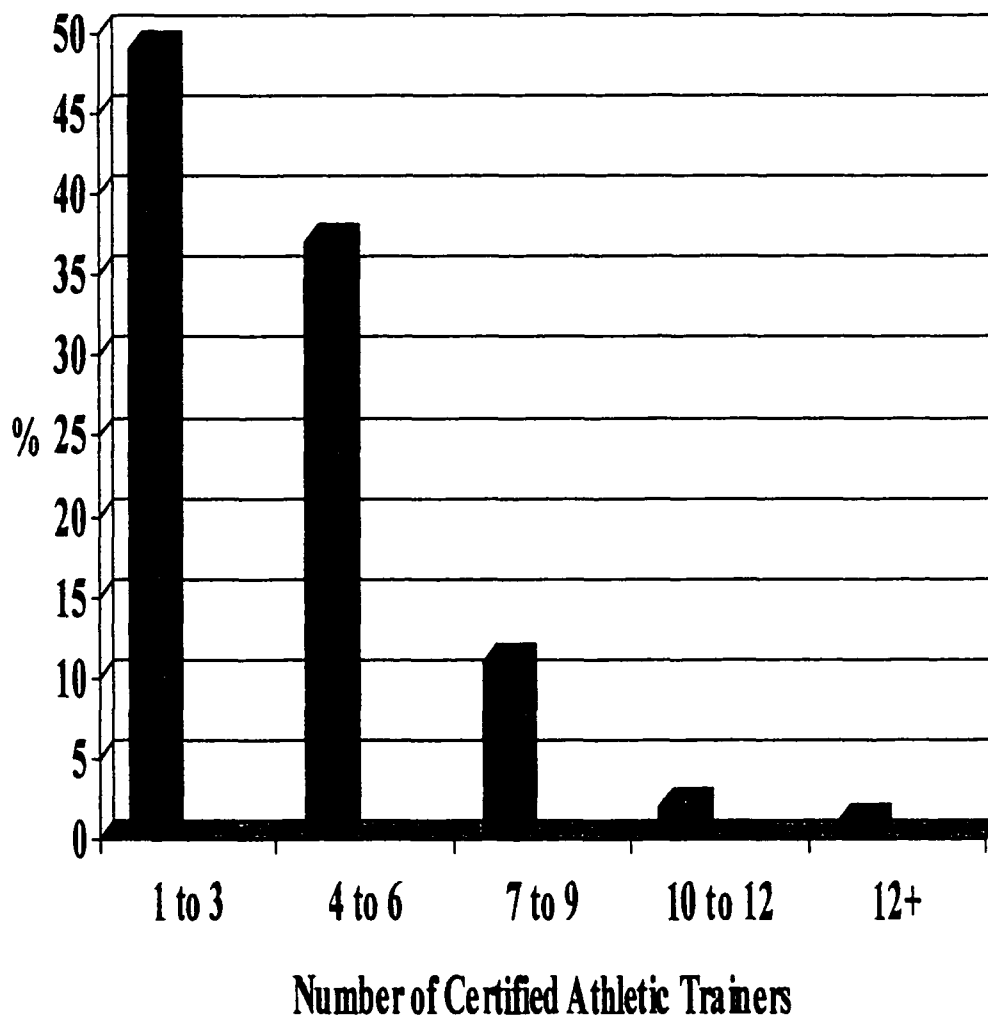
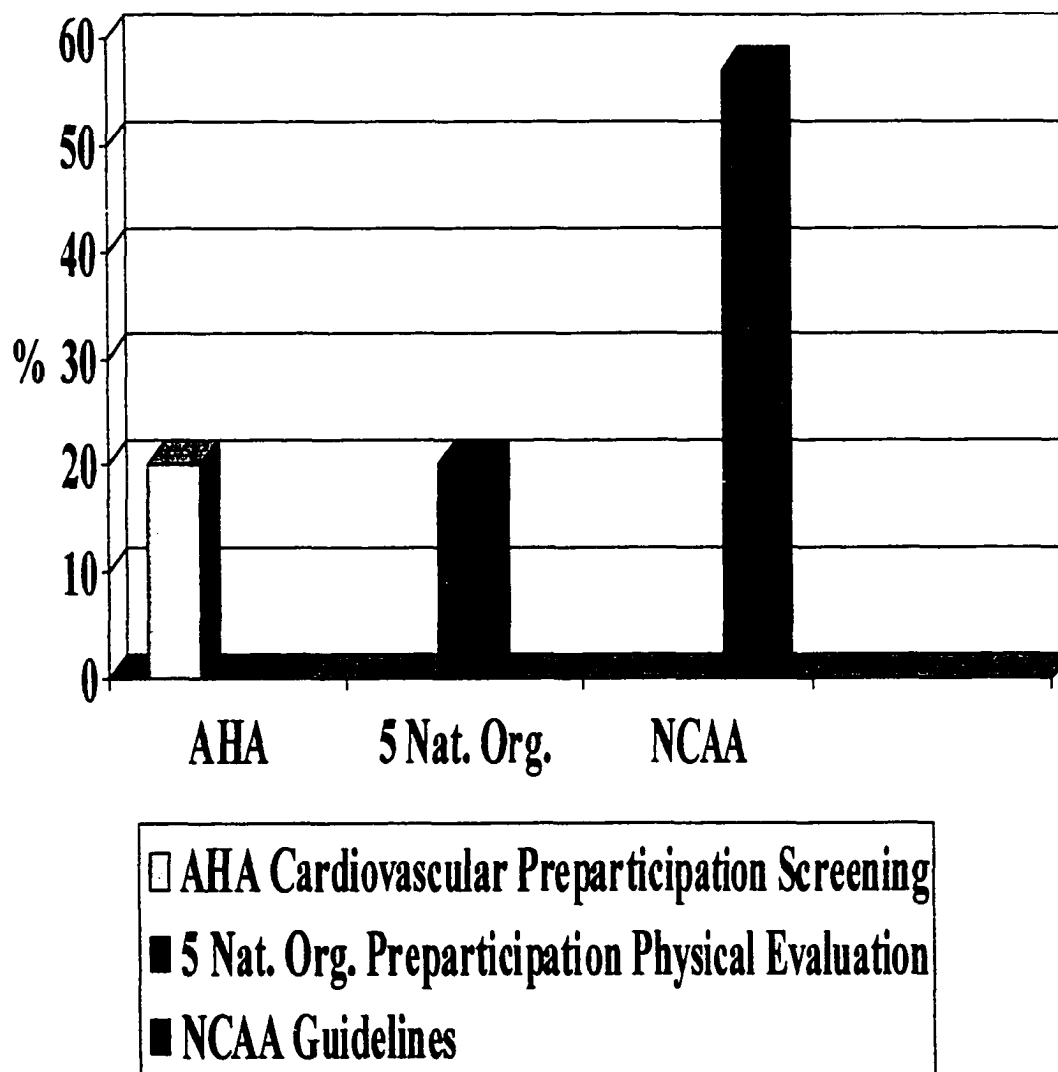


TABLE 2
Sources for Determining PPE Requirements
For NCAA Division I Universities

Source	Percentage of Schools
Sports Medicine Committee	57%
Team Physicians	17%
Certified Athletic Trainers	16%
Others (Variety of Sources)	15%
Governing Body	9%
Medical Association	7%
State Health Department	6%
State Legislature	4%
State Education Department	2%
Conference Officials	2%

FIGURE 3**Resources for Preparticipation Forms**

Practically all the universities utilize a team physician (99.5%) for health care for their programs. Sixty-three percent of the team physicians are outside consultants and 47% are employees of the university, with some universities (10%) having team physicians as employee-based and outside consultants.

Other health care personnel utilized are: dentist (92%), physical therapist (68%), nutritionist (64%), nurse (60%), gynecologist (50%), sport psychologist (48%), nurse practitioner, (43%), chiropractor (38%), physician assistant (33%), and massage therapist (27%). The universities hired these professionals as both university-employee based and as outside consultants, except for the chiropractors who were hired only as outside consultants (see Table 3).

A designated team physician is responsible for performing the PPE at 208 (99.5%) of the 209 universities. Assisting in performance of the PPE are ATCs (n = 164 [79%]), registered nurses (n = 48 [23%]), nurse practitioners (n = 45 [22%]), physician assistants (n= 40 [19%]), ophthalmologists (n = 37 [18%]), dentists (n=37 [18%]), physical therapists (n=30 [14%]), chiropractors (n=5 [2%]), exercise physiologists (n=1 [.5%]), or dietitians (n =1 [.5%]).

The majority of institutions (n=163 [78%]) perform the PPE in a university health care facility on campus. The rest of the institutions report the PPE is performed at community sites (n=25 [12%]). Most institutions provide station-based mass screening (n=125 [60%], with more than one professional providing parts of the examination for sports participation. The remainder (n=72 [34%]) provide office-based PPE screening, with the physician providing most of the examination. Twelve universities (n=12 [6%])

TABLE 3

Professional Personnel Utilized for Health Care for the Student-Athletes

Personnel	Utilization Percent	University-Employee Based Percent	Percent of Outside Consultants
Team Physician	99.5%	47%	63%
Dentist	92%	7%	93%
Physical Therapist	68%	28%	74%
Nutritionist	64%	61%	39%
Nurse	60%	88%	15%
Gynecologist	50%	46%	58%
Sport Psychologist	48%	54%	52%
Nurse Practitioner	43%	88%	14%
Chiropractor	38%	0%	100%
Physician Assistant	33%	39%	61%
Massage Therapist	27%	7%	93%

did not respond whether their PPE is station-based or office-based, and 21 (10%) institutions did not respond if the screening is school (on-campus) or community based.

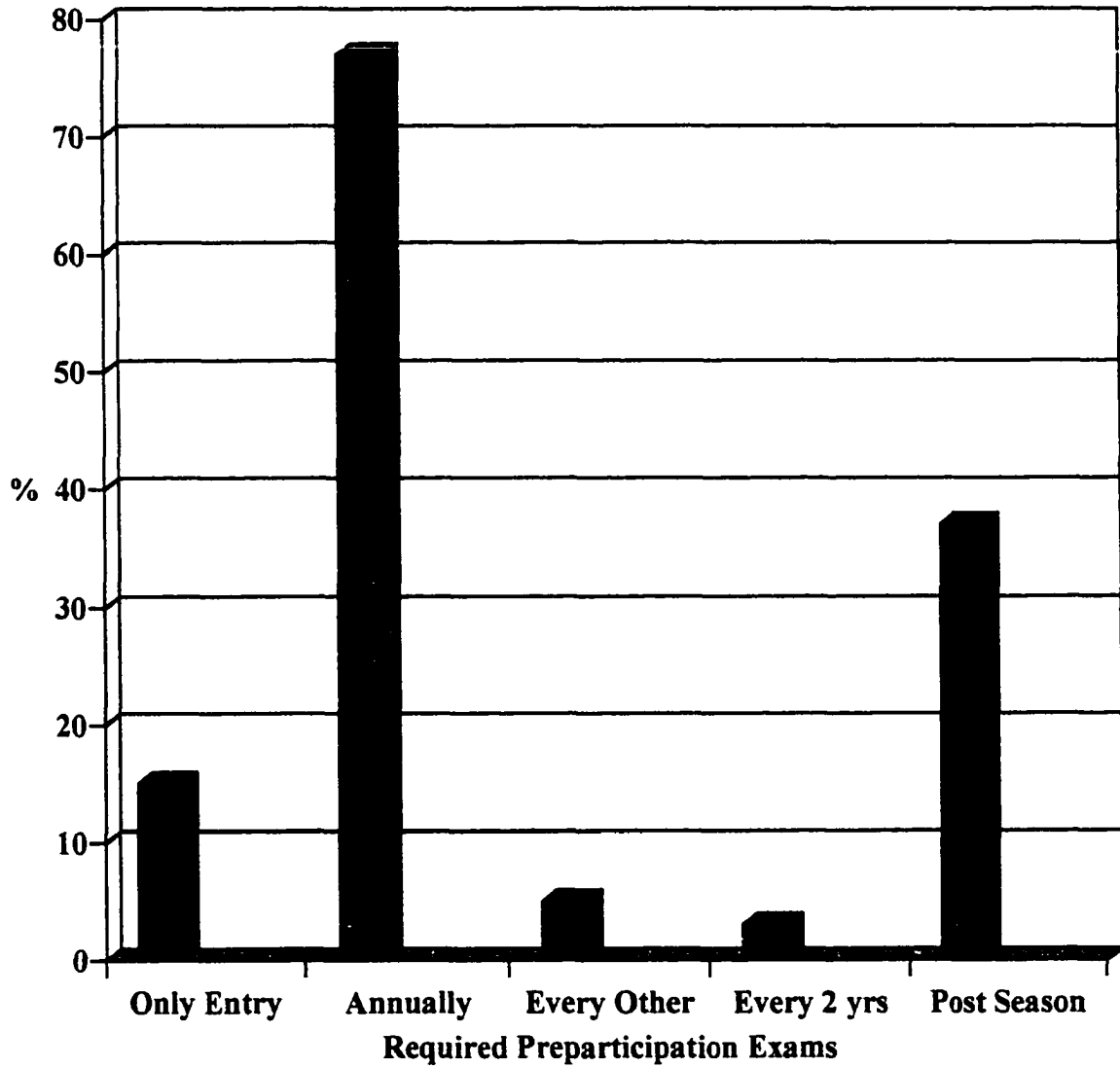
Preparticipation examinations is required annually by 160 (77%) of the universities, whereas 32 (15%) require a PPE only on college entry. Ten (5%) universities require PPE every other year and 7 (3%) universities require PPE every two years. Post season evaluations are provided at 78 (37%) of the 209 universities (see Figure 4).

Information was requested regarding additional testing as part of the university's PPE. The following tests were provided: flexibility (n = 121 [58%]), muscular strength (n = 110 [53%]), muscular endurance (n = 22 [11%]), cardiovascular (n = 75 [36%]), body composition (n = 57 [27%]), and exercise challenge (n = 9 [4%]). Many of the respondents indicated that the sport coaches perform some of these tests after the PPE.

CHARACTERISTICS OF PREPARTICIPATION SCREENING FORMS

The content of the history and physical screening items that are included in the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) recommendations and the American Academy of Family Physicians, et al. *Preparticipation Physical Evaluation* (1997) recommendations are found in Tables 4-7. The number and percent of schools that included each item is found in Tables 4-7.

The American Heart Association recommended history items were included in a range from 2% to 87% of the 149 forms. The item of "high blood pressure" was included in 87% (128) of the forms. Family history of heart disease was included in 65% of the forms, but specific heart diseases such as hypertrophic cardiomyopathy (4%), dilated cardiomyopathy (2%), and long QT syndrome (3%) were not common.

FIGURE 4**Preparticipation Follow-Up Care**

None of the university forms included all of the recommended items (see Table 4).

The frequency of the number of AHA recommended history items utilized by the universities is shown in Figure 5. One university from Southland Conference utilized 12 of the 13 items, and 4 universities, each from different conferences, did not use any of the items. The mean of recommended AHA history items utilized was 6 and the median was 7 items.

The AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) physical recommendations suggest screening for heart murmurs by precordial auscultation in both supine and standing positions, femoral pulses, marfan syndrome screen, and blood pressure (sitting). Only 3% of the schools checked for heart murmurs in supine and standing positions, although 13% included the broader category “heart murmur”. A measurement for brachial blood pressure in a sitting position was included in 92% of the forms. Femoral pulses appeared in 32% of the forms, and the last item, Marfan syndrome screen was included in only 8% of the forms (see Table 5). Five schools (3%) included all the physical assessment components of the AHA recommended items. Most universities (n=90 [62%]) utilized only one item from the AHA physical assessment recommendations. Two items from the AHA physical assessment recommendations were used by 34 (23%) universities, 3 items by 2 (0.6%) universities, and 4 items were utilized by 3 (1%) universities. Eleven (8%) universities utilized none of the items (see Figure 6).

Many of the universities utilized items from the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) history and physical screening recommendations (see Tables 3 & 4). Ninety percent or more of the

TABLE 4
American Heart Association
Cardiovascular Preparticipation History Screening Recommendations

Items	Included in Screening Forms, No. of Schools	Percent of Schools
Exertional Chest Pain	111	75%
Syncope	105	71%
Exertional Shortness of Breath	63	42%
Excessive Fatigue	50	34%
Heart Murmur	126	85%
High Blood Pressure	128	87%
Family History of Premature Death	104	70%
Family History of Heart Disease	97	65%
Hypertrophic Cardiomyopathy	6	4%
Dilated Cardiomyopathy	3	2%
Long QT Syndrome	4	3%
Marfan Syndrome	22	15%
Arrhythmia's	87	58%
Parental Verification	45	30%

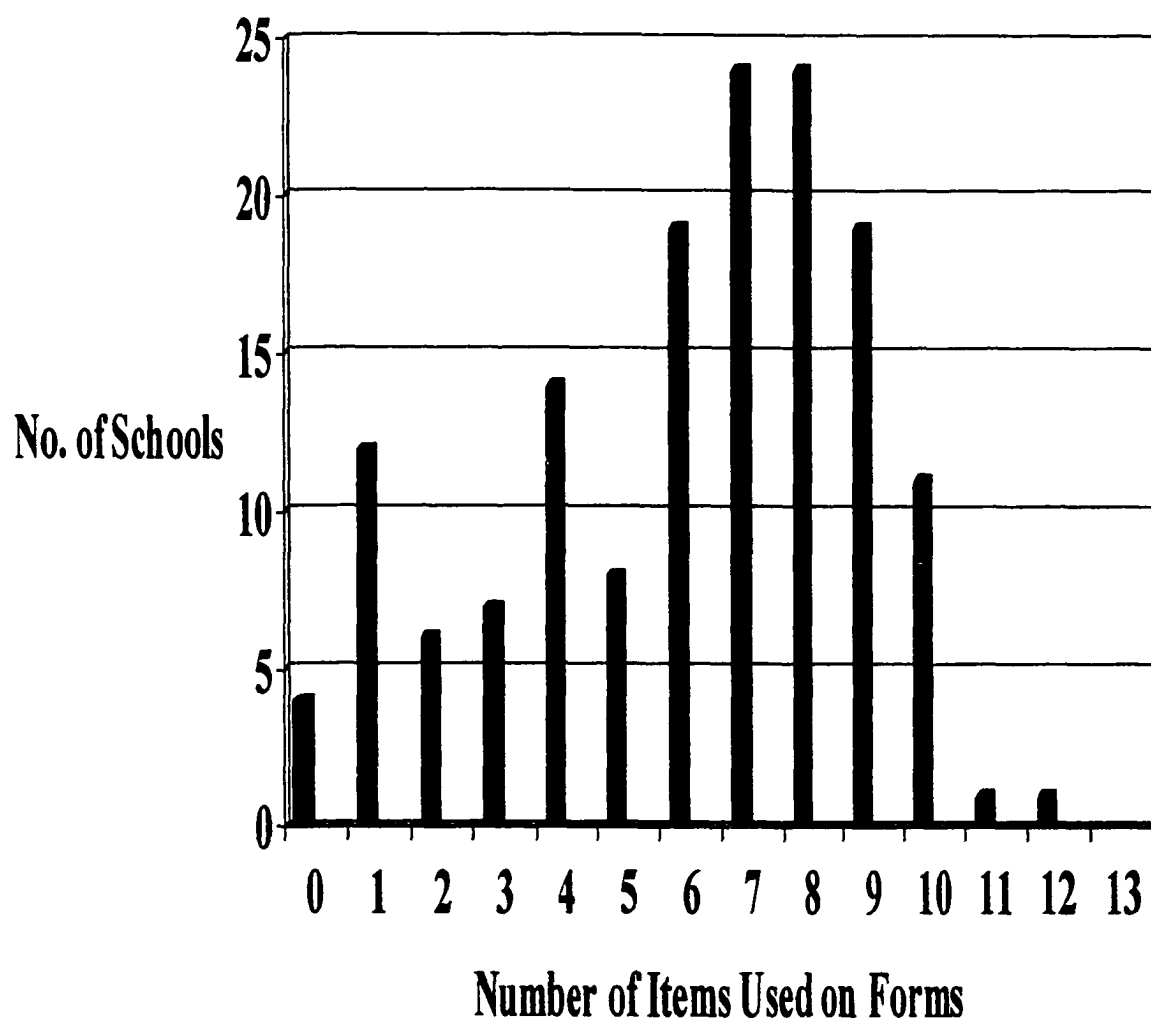
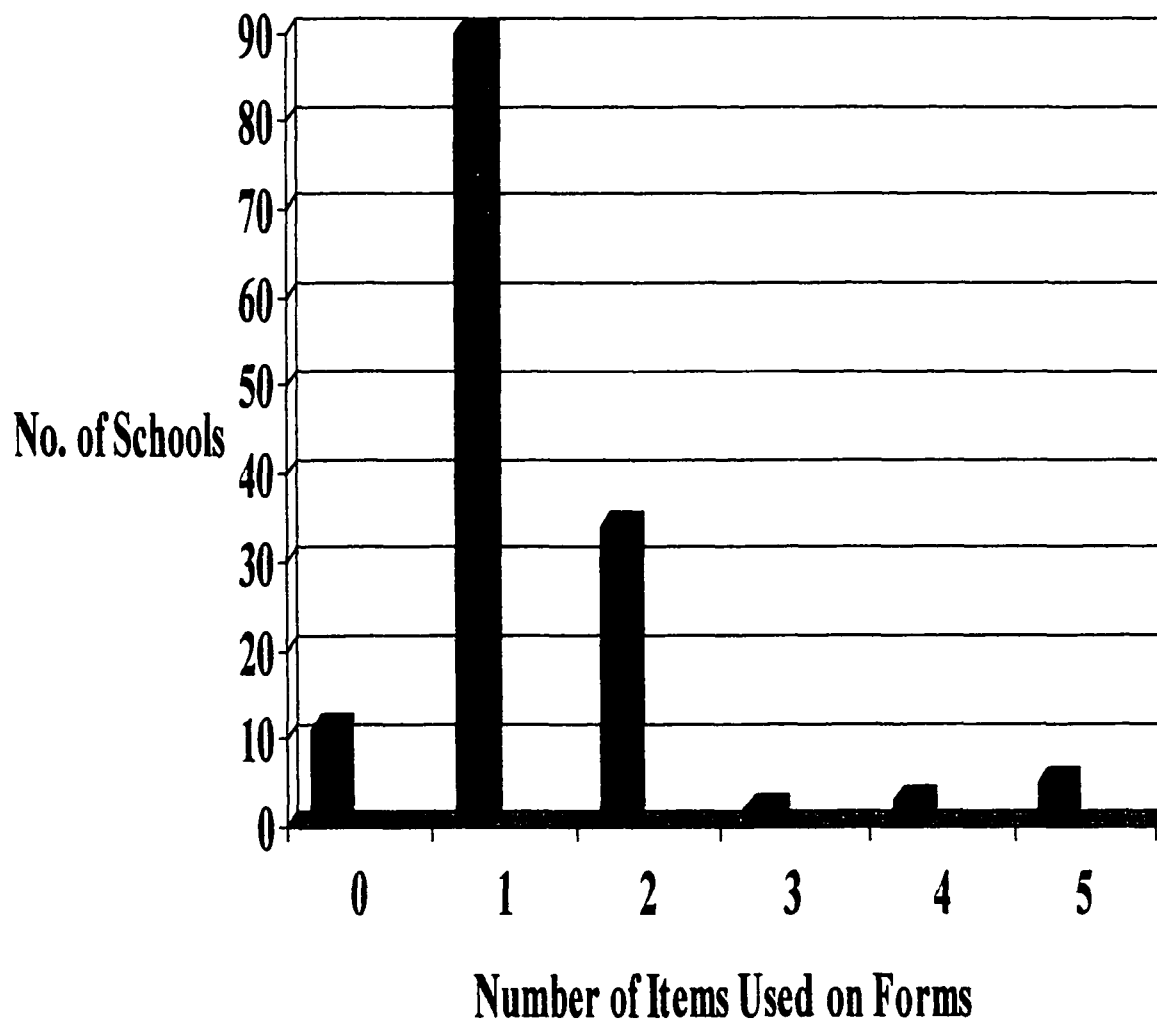
FIGURE 5***AHA Cardiovascular Preparticipation*****History Recommendations Utilization**

TABLE 5
American Heart Association
Cardiovascular Preparticipation Physical Screening Recommendations

Items	Included in Screening Forms, No. of Schools	Percent of Schools
Heart Murmurs (Supine & Sitting Position)	5	3%
Heart Murmurs	19	13%
Femoral Pulses	46	32%
Marfan Screen	11	8%
Blood Pressure (Sitting)	134	92%

FIGURE 6***AHA Cardiovascular Preparticipation*****Physical Recommendations Utilization**

universities used recommended history questions regarding: recent and/ or chronic injury (99%), surgery (96%), allergies (96%), prescriptions/nonprescription medications (95%), head injury or concussion (95%), knocked out/unconscious (91%), broken or fractured bones or dislocated joints (91%), problems with eyes or vision (91%), glasses, contacts, or protective eyewear (90%). Eighty-three percent to 89% of the universities used recommended history item questions regarding: hospitalization (89%), asthma (89%) ongoing and/or chronic illness (87%), high blood pressure (87%), passing out during or after exercise (86%), and heart murmur (83%). Items that were utilized in history questions at more than 50% of the universities, but less than 76%, included: seizure (75%), chest pain (75%), sprain (74%), dizziness (71%), mononucleosis (71%), heat illness (69%), headaches (66%), family member/relative died of heart problems (65%), sudden death before 50 (62%), racing heart (60%), skin problems (60%), stinger, burner, or pinched nerve (60%), coughing or difficult breathing (56%), tetanus immunization (52%) and severe viral infection (51%). Not commonly found (<50%) history question items were: recent menstrual period (47%), seasonal allergies (46%), protective equipment (43%), weight changes (43%), lose weight for weight requirements (41%), Measles immunization (40%), first menstrual period (40%), rash/hives (39%), problems with pain (38%), denied participation in sports (35%), stress (34%), tire more quickly (33%), time from start of period to start of another (33%), supplements/vitamins (32%), numbness in extremities (30%), longest time between periods (29%), Hepatitis B immunization (20%), number of periods in the last year (20%), Chickenpox immunization (17%), and high cholesterol (15%) (see Table 6).

TABLE 6

Five National Medical Associations

Preparticipation Physical Evaluation History Screening Recommendations

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Recent and/or Chronic Injury	147	99%
Surgery	143	96%
Allergies	143	96%
Prescription/ non prescription Medications	141	95%
Had head injury or concussion	142	95%
Been knocked out/unconscious	136	91%
Broken or fractured any bones or dislocated any joints	136	91%
Any problems with eyes or vision	135	91%
Wear glasses, contacts, or protective eyewear	134	90%
Hospitalization	132	89%
Have asthma	132	89%
Ongoing or Chronic Illness	130	87%
High blood pressure	128	87%

TABLE 6
Five National Medical Associations
Preparticipation Physical Evaluation History Screening Recommendations
(Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Pass out during or after exercise	128	86%
Told you have a heart murmur	124	83%
Ever had a seizure	111	75%
Chest pain during or after Exercise	111	75%
Had a sprain, strain, or swelling after injury	110	74%
Dizzy during or after exercise	106	71%
Or mononucleosis within the last Month	106	71%
Become ill from exercising in the heat	102	69%
Had frequent or severe Headaches	99	66%
Any family member/relative died of heart problems	97	65%

TABLE 6
Five National Medical Associations
Preparticipation Physical Evaluation History Screening Recommendations
(Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Or from sudden death before age 50	91	62%
Racing heart or skipped beats	89	60%
Any current skin problems	89	60%
Had a stinger, burner, or pinched nerve	89	60%
Cough, wheeze, or have trouble breathing	84	56%
Had Tetanus immunization	78	52%
Had severe viral infection (Myocarditis)	76	51%
Most recent menstrual period	70	47%
Have seasonal allergies	68	46%
Use special protective or corrective equipment that is not usually needed for sport	64	43%

TABLE 6
Five National Medical Associations
Preparticipation Physical Evaluation History Screening Recommendations
 (Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Weigh more or less than you do now	65	43%
Lose weight regularly to meet weight requirements	61	41%
Had Measles immunization	59	40%
First menstrual period	59	40%
Rash/hives develop during or after exercise	58	39%
Problems with pain or swelling in Muscles, tendons, bones, or joints	56	38%
Denied or restricted from participation in sports due to heart problems	52	35%
Feel stressed out	51	34%
Tire more quickly than others do	49	33%
Period of time from the start of one period to the start of another	49	33%

TABLE 6
Five National Medical Associations
Preparticipation Physical Evaluation History Screening Recommendations
 (Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Supplements/vitamins to gain or lose weight	47	32%
Had numbness/tingling in Extremities	44	30%
Longest time between periods in the last year	43	29%
Had Hepatitis B immunization	29	20%
How many periods in the last Year	30	20%
Had Chickenpox immunization	26	17%
High cholesterol	23	15%

The physical screening recommendations from *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) were utilized more by universities than the AHA's (1996) physical components. Brachial blood pressure was an item in both recommended screening evaluations, and was the most common item performed (92%). The musculoskeletal examination was performed by 91% of the universities. The following musculoskeletal areas were included: knees (75%), shoulders (72%), back (71%), ankles (71%), feet (64%), elbows (59%), hands (57%), hips (57%), wrists (51%), thighs (37%), arms (30%), legs (28%), and forearms (23%). Height (90%), weight (90%), heart exam (90%), lungs (90%), and abdomen exam (90%) were commonly assessed. Over 80% assessed: radial pulse (86%) ears (86%), nose (84%), and throat exam (84%). More than 50% of the universities examined: eyes (79%), genitalia, males only, (79%), skin (70%), vision (70%), neck (67%), and corrected vision (57%). The physical screening recommended items not commonly assessed were evaluation of lymph nodes (44%), pupils (40%), radial and femoral pulses (32%), and general appearance (12%) (See Table 7).

One hundred and seven (43.4%) universities addressed some aspect of the Female Athlete Triad syndrome on their forms. Some forms had many questions (pages); other forms only had only one or two questions.

ADEQUACY OF PREPARTICIPATION SCREENING FORMS

The adequacy of the forms were determined by the extent to which the forms matched history questions and physical assessment components of AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996), and the five national medical organizations monograph *Preparticipation Physical Evaluation*

TABLE 7
Five National Medical Associations
Preparticipation Physical Evaluation Physical
Screening Recommendations

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Brachial BP in sitting position	134	92%
Musculoskeletal	132	91%
Height	131	90%
Weight	131	90%
Heart	129	90%
Lungs	131	90%
Abdomen	130	90%
Radial Pulse	124	86%
Ears	124	86%
Nose	122	84%
Throat	122	84%
Eyes	114	79%
Genitalia (males only)	115	79%
Knees	108	75%

TABLE 7
Five National Medical Associations
Preparticipation Physical Evaluation Physical
Screening Recommendations (Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Shoulders	104	72%
Back	103	71%
Ankles	103	71%
Skin	101	70%
Vision R 20/ L 20/	101	70%
Neck	97	67%
Feet	93	64%
Elbows	86	59%
Corrected vision	83	57%
Hands	82	57%
Hips	82	57%
Wrists	74	51%
Lymph nodes	64	44%
Pupils	58	40%
Thighs	53	37%

TABLE 7
Five National Medical Associations
Preparticipation Physical Evaluation Physical
Screening Recommendations (Continued)

Item	Included in Screening Forms, No. of Schools	Percent of Schools
Radial and Femoral Pulses	46	32%
Arms	44	30%
Legs	41	28%
Forearms	33	23%
Appearance	18	12%

(1997). Analyses were done on the matched item percentages and divided into three categories: 1=lower 1/3 or lower 33% of matched items, 2=mid 1/3 or middle 33% of the matched items, and 3=top 1/3 or top 33% of the matched items. Each conference's results were grouped into the three categories by using these percentages. Adequacies of the forms per conference were analyzed for the history questions and the physical assessment components, and the combination of both.

Analysis of the adequacy of the history forms for the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) recommendations was performed first. Forms that scored in the lower 33% category had 0 to 4 items, the mid 33% had 5 to 8 items, and the top 33% category had 9 to 13 items. The Mid-Continent Conference and the Patriot League Conference (Patriot) had only one university from each conference to send history forms. The Mid-Continental Conference (Mid Cont.) form scored in the lower 33% category and the Patriot League Conference form scored in the top 33% category. Four universities from the Mid-Eastern Athletic Conference (MEAC) sent history forms all scoring in the top 33% category. Most of the other conference results were a combination of the three categories (see Figure 7). Atlantic Coast Conference (ACC) (75%) and the Big Ten Conference (Big Ten) (75%) forms scored more in the top 33% category than in the other categories for adequacy of forms. The Big Sky (67%), Big South (60%), and the Missouri Valley (MVC) (60%) had forms that scored more in the lower 33% than in the other categories for adequacy.

Form adequacy reflecting the AHA *Cardiovascular Preparticipation* physical assessment recommendations results were similar to the history results. Forms that

FIGURE 7

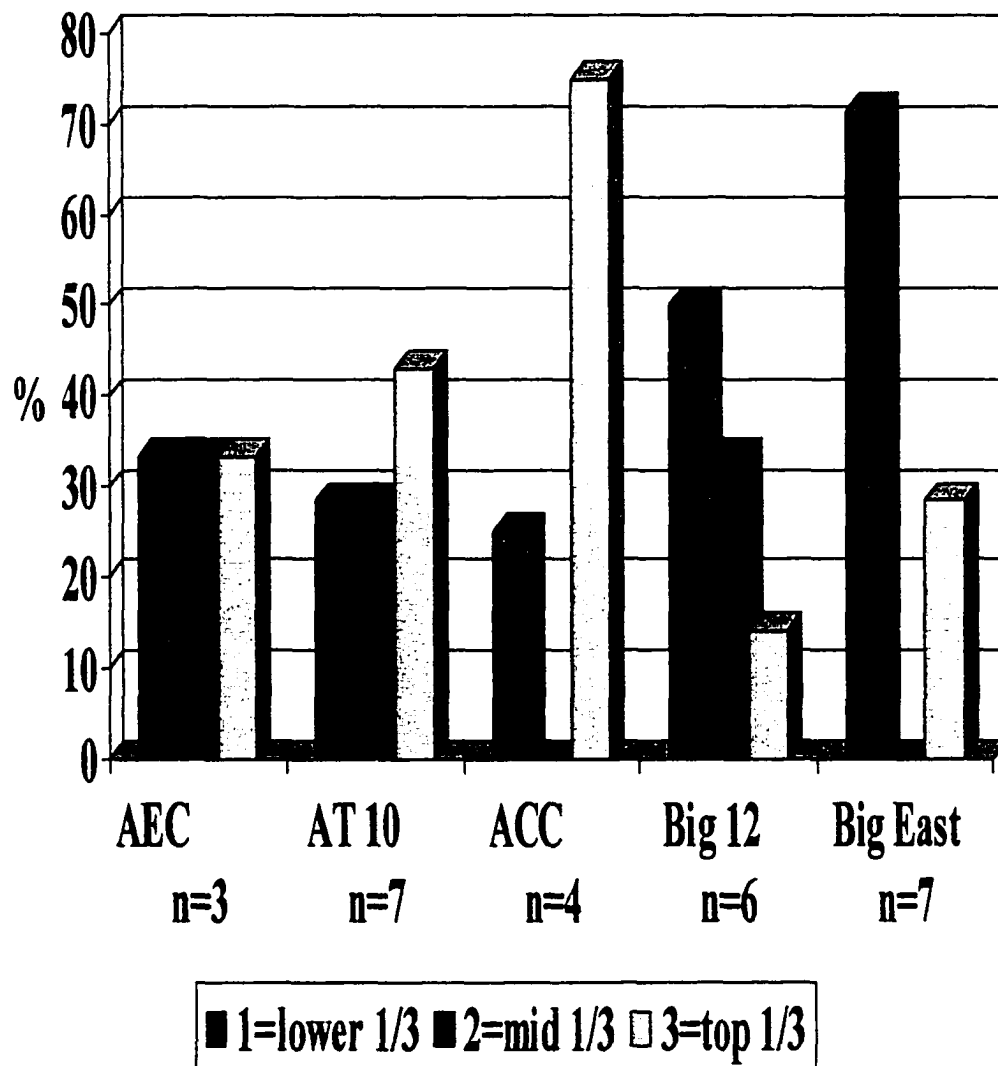
*AHA Cardiovascular Preparticipation History***Recommendations Forms Adequacy Per Conference**

FIGURE 7 (Continued)

AHA Cardiovascular Preparticipation History

Recommendations Forms Adequacy Per Conference

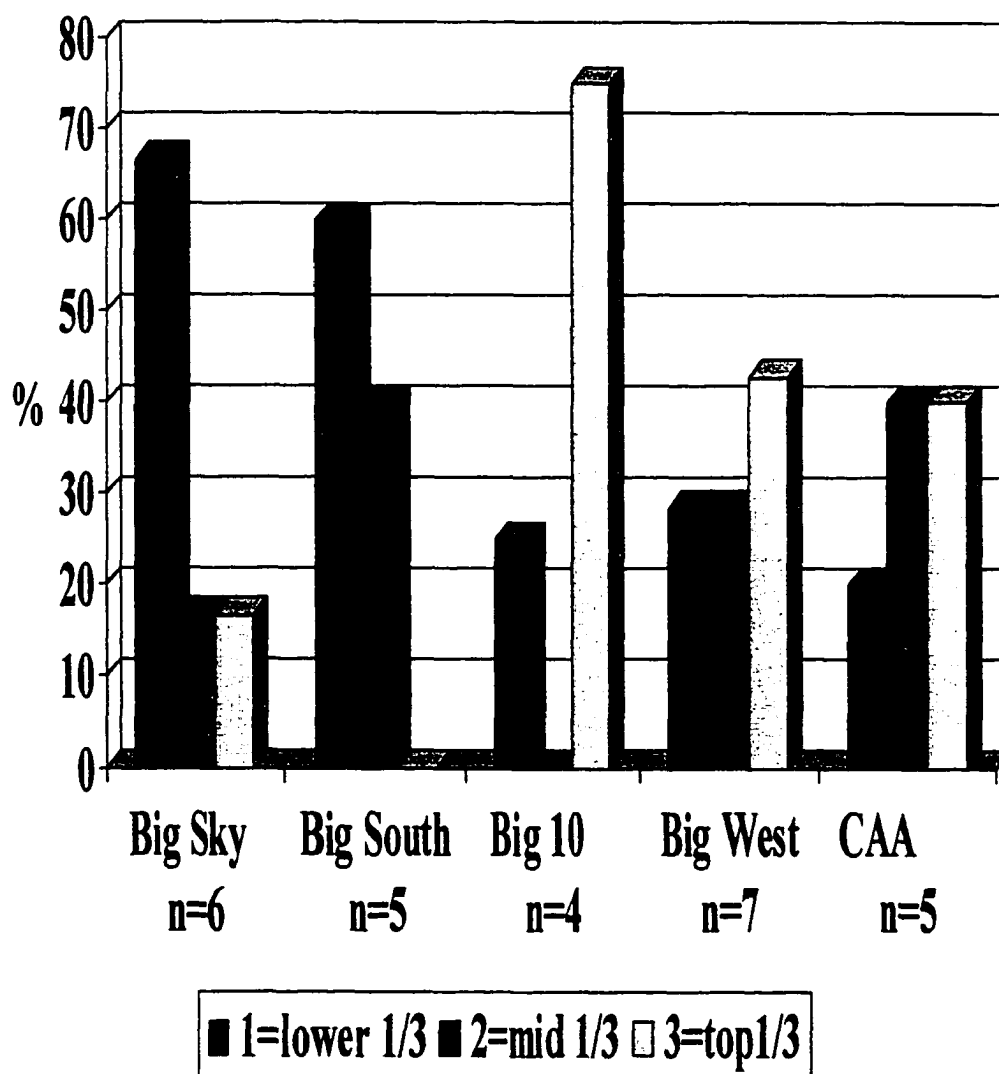


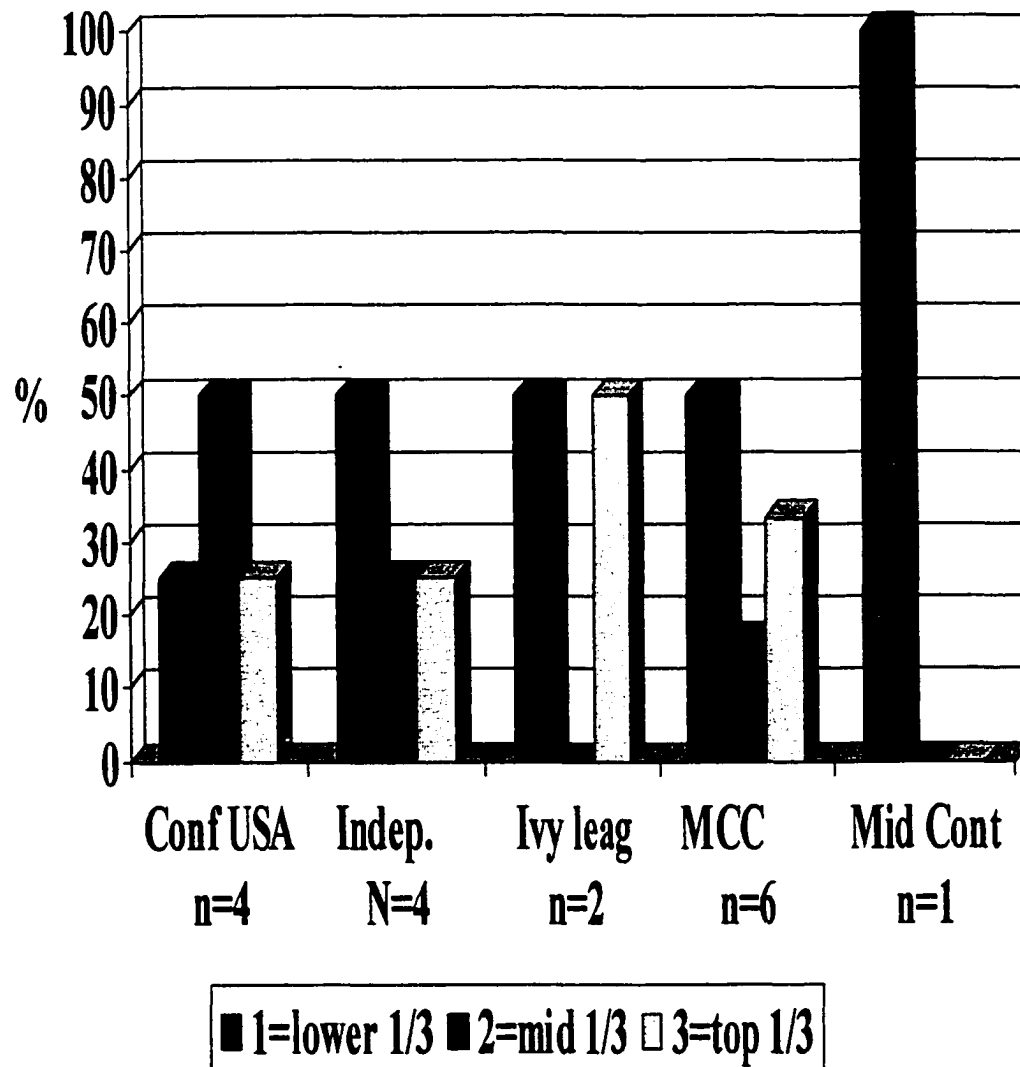
FIGURE 7 (Continued)***AHA Cardiovascular Preparticipation History*****Recommendations Forms Adequacy Per Conferences**

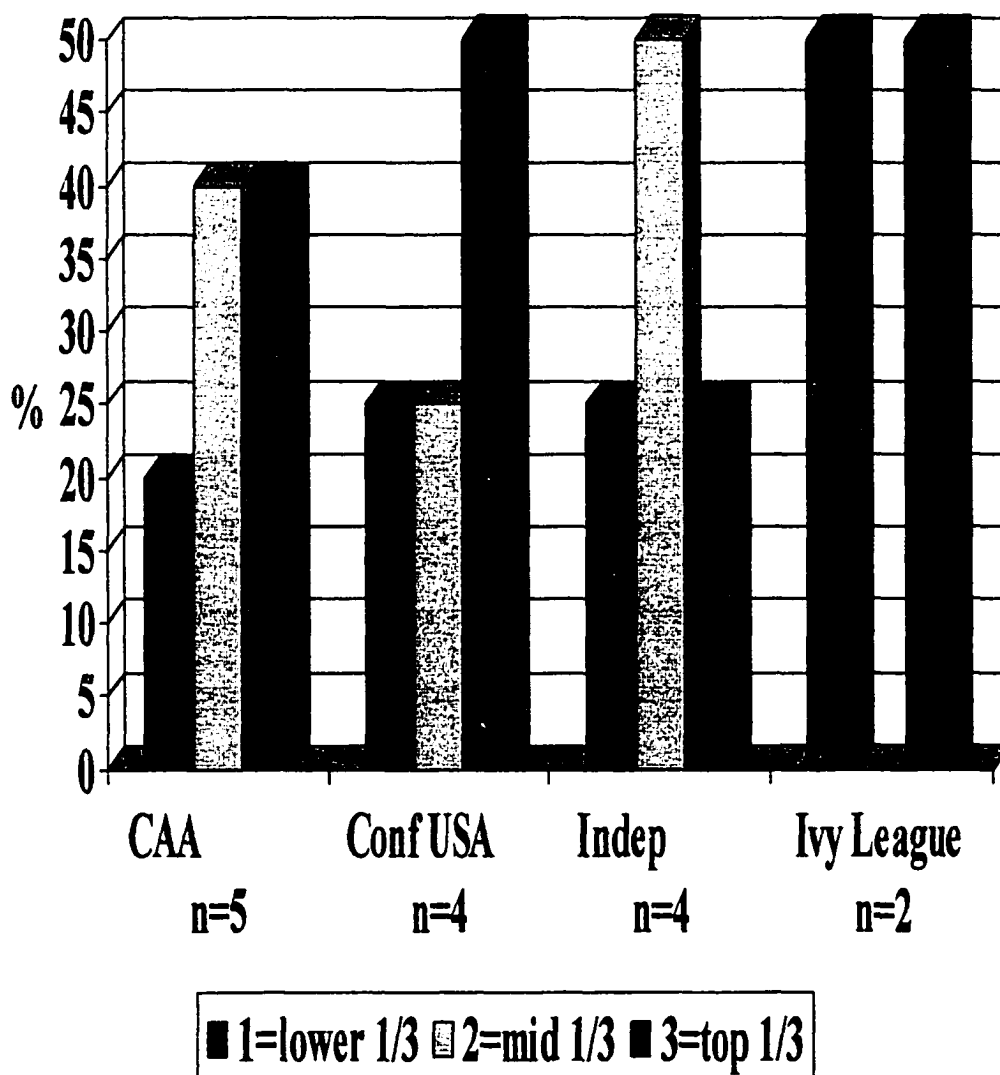
FIGURE 7 (Continued)***AHA Cardiovascular Preparticipation History*****Recommendations Forms Adequacy Per Conferences**

FIGURE 7 (Continued)

AHA Cardiovascular Preparticipation History Recommendations Forms Adequacy Per Conference

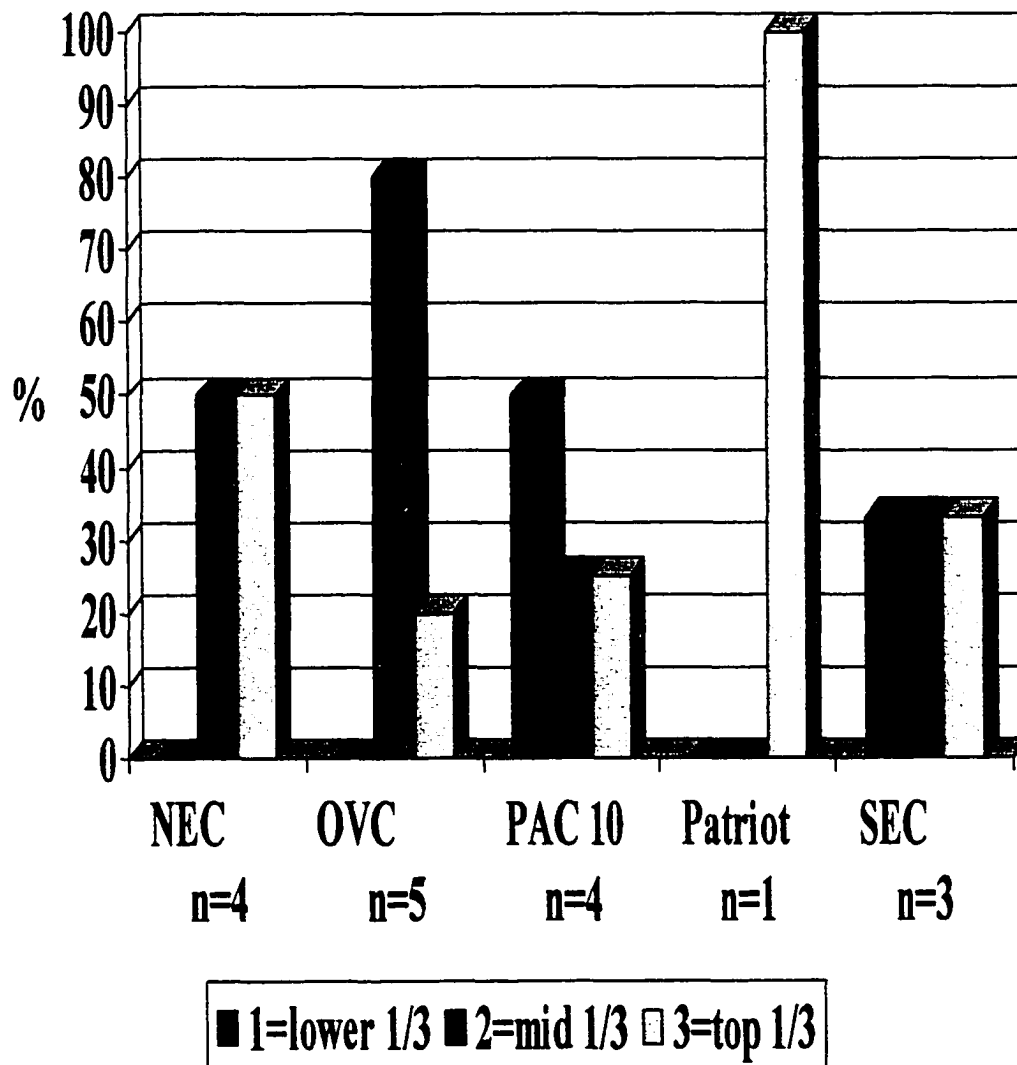


FIGURE 7 (Continued)

AHA Cardiovascular Preparticipation History

Recommendations Forms Adequacy Per Conference

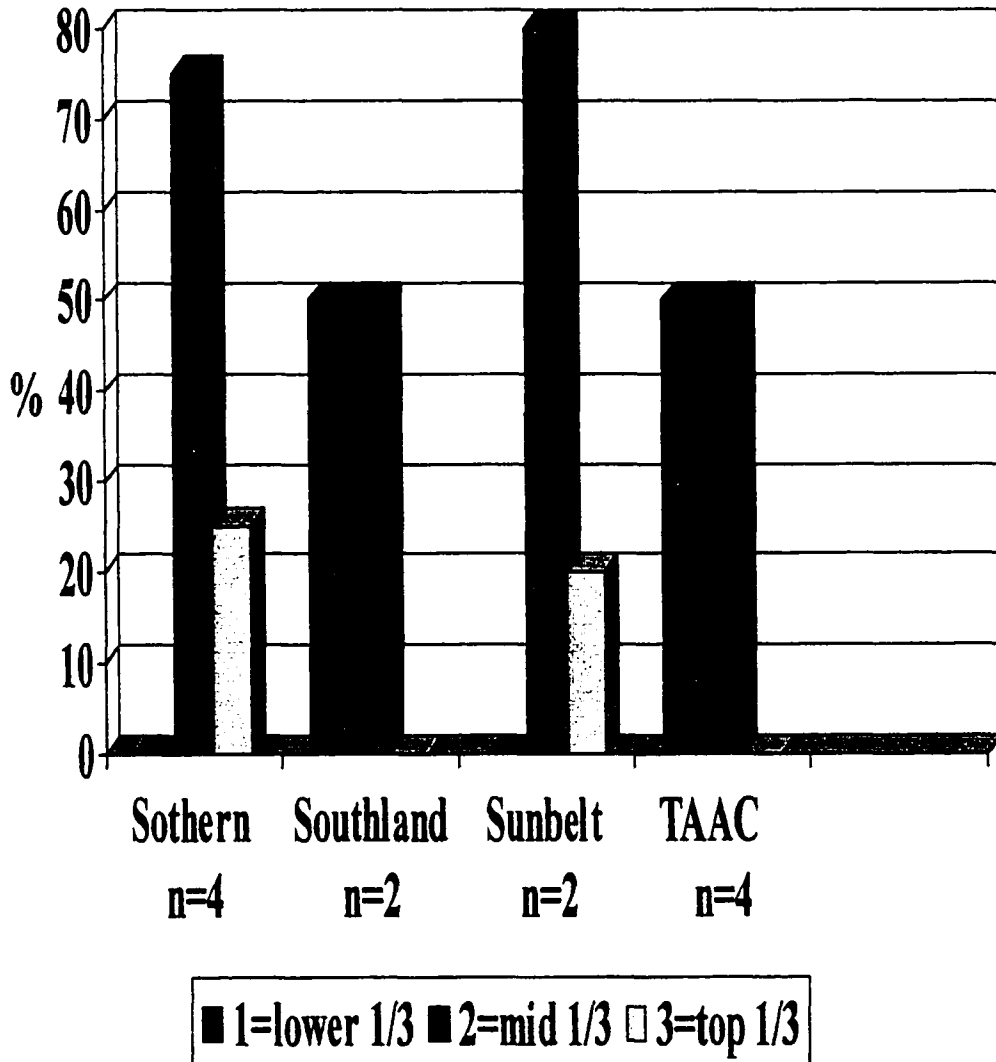
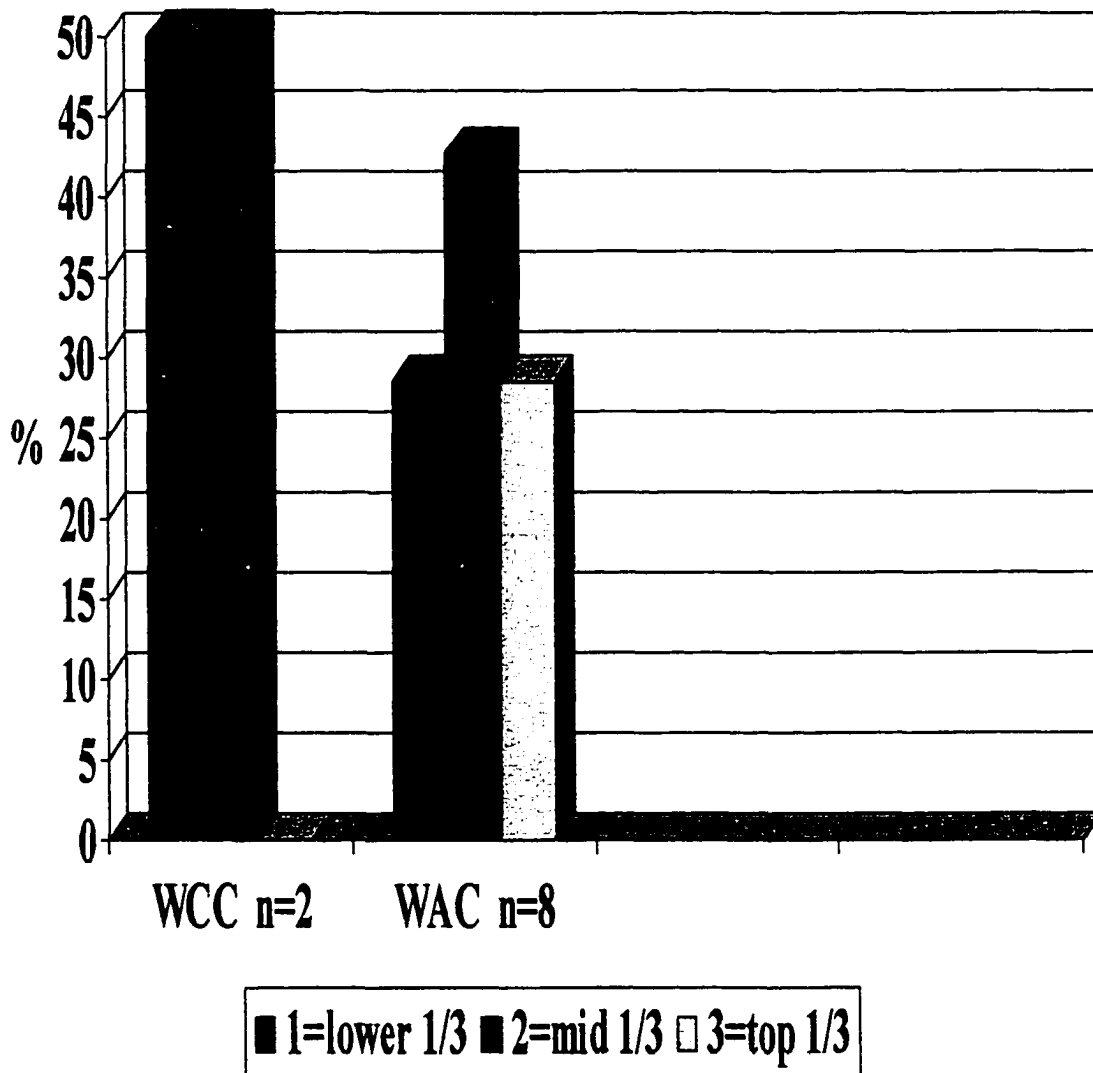


FIGURE 7 (Continued)***AHA Cardiovascular Preparticipation History*****Recommendations Forms Adequacy Per Conference**

scored in the lower 33% category on the physical components had 0 items, the mid 33% had 1 item, and the top 33% category had 2 to 4 items. Most conferences had forms that were a mixture of the three percentage categories (see Figure 8). The Mid-Continent's one university's physical assessment form scored in the lower 33%, and the Sun Belt Conference, which also only had one university send a physical assessment form, scored in the mid 33% percentile. Universities with forms scoring more in the top category were Atlantic East Conference (AEC) (75%), Atlantic Coast Conference (ACC) (75%), and the Southeastern Conference (SEC) (67%). Those universities scoring more in the lower category were Mid-Eastern Athletic Conference (MEAC) (67%) and Southland Conference (80%).

Forms were analyzed for adequacy for the combination of history and physical assessment components of the AHA *Cardiovascular Preparticipation* recommendations. Forms that scored in the lower 33% category had 0 to 6 recommended items, the mid 33% category had 7 to 8 recommended items, and the top 33% category had 9 to 17 recommended items. As before, most conference forms had a mixture of the three categories (see Figure 9). In the Mid-Continent Conference one university's forms scored in the mid 33%, and in the Patriot Conference one university's forms scored in the top 33%. The ACC had 4 universities send history and physical assessment forms that all scored in the top 33%. The AEC (75%), Big Sky (67%), Big 10 (75%), MEAC (75%), Ohio Valley Conference (OVC) (60%), and Trans Atlantic Athletic Conference (TAAC) (75%) had forms scoring more in the top category.

FIGURE 8

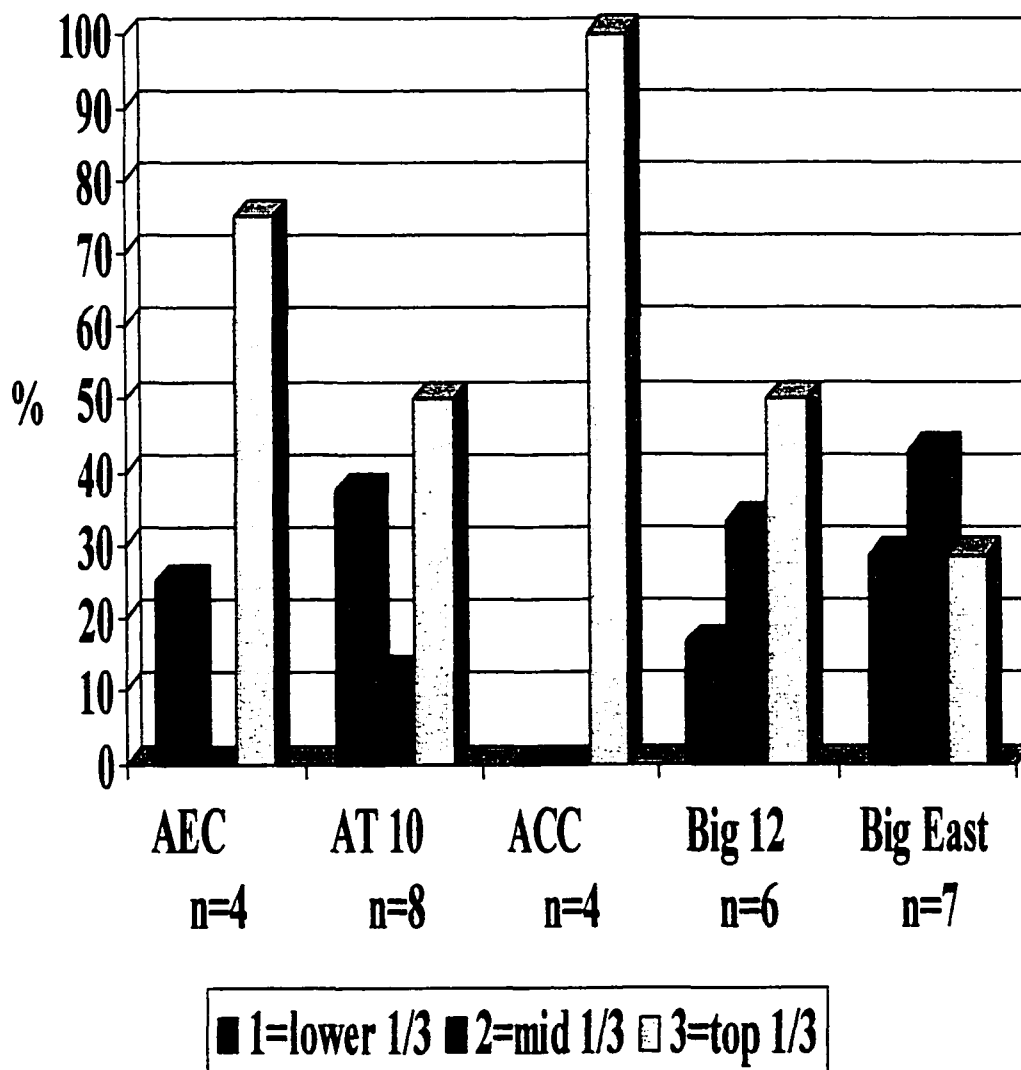
*AHA Cardiovascular Preparticipation***Physical Recommendations****Forms Adequacy Per Conference**

FIGURE 8 (Continued)

AHA Cardiovascular Preparticipation

Physical Recommendations

Forms Adequacy Per Conference

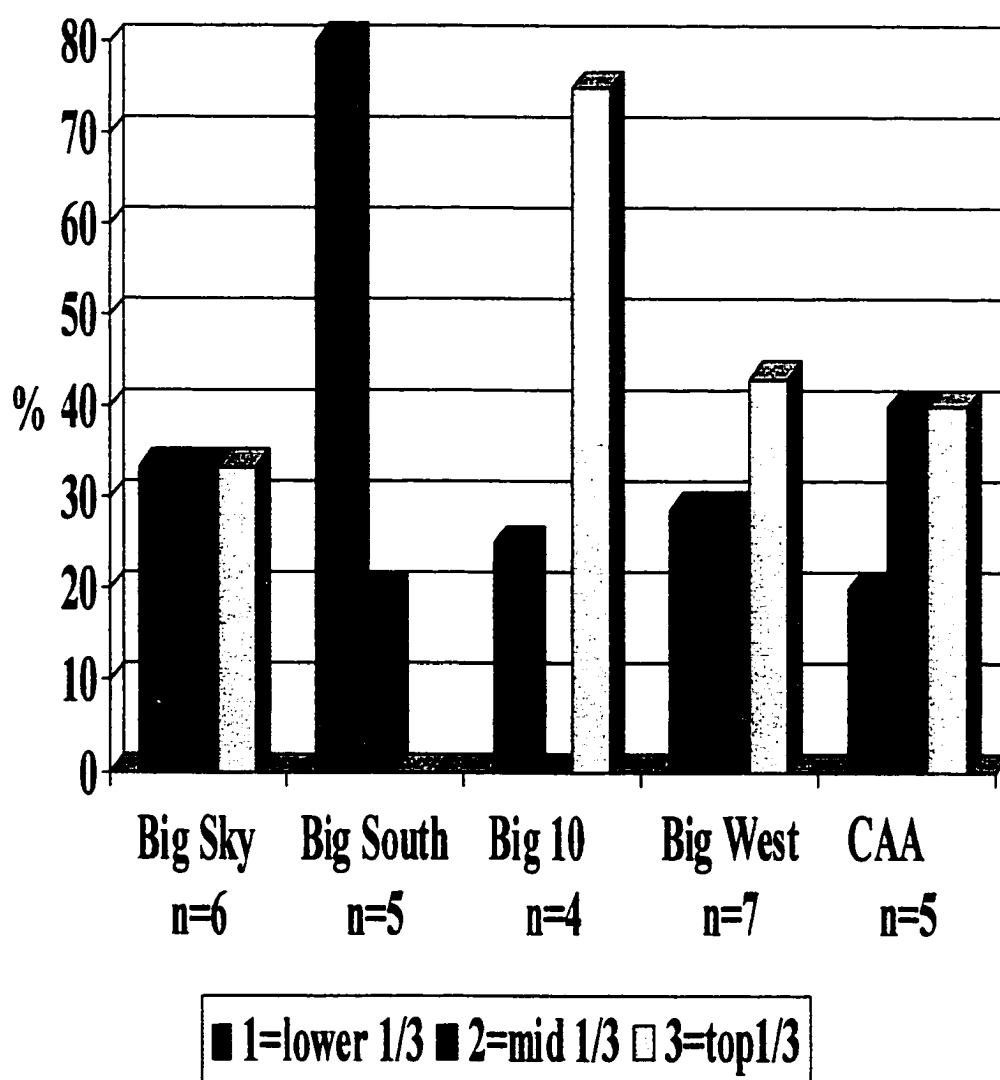


FIGURE 8 (Continued)

AHA Cardiovascular Preparticipation

Physical Recommendations

Forms Adequacy Per Conference

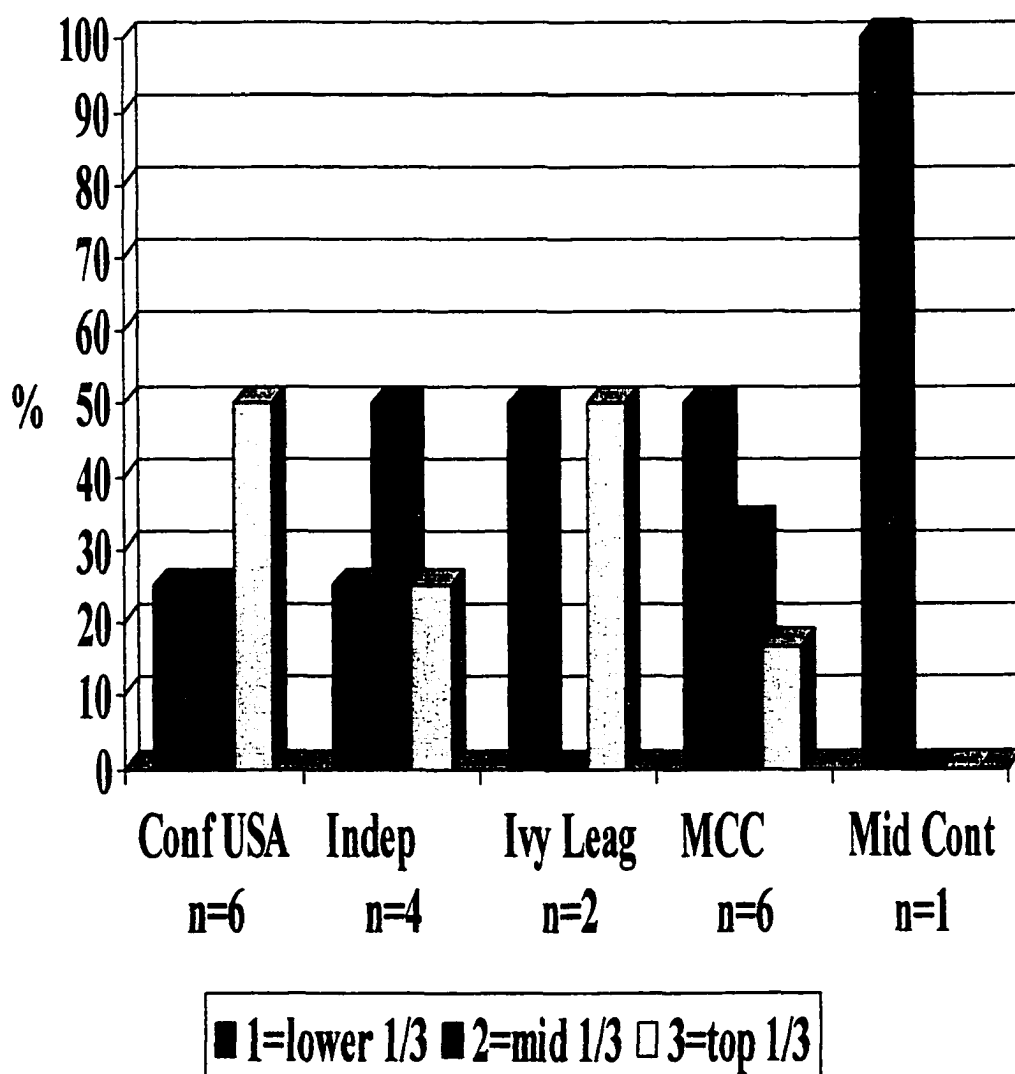


FIGURE 8 (Continued)

AHA Cardiovascular Preparticipation

Physical Recommendations

Forms Adequacy Per Conference

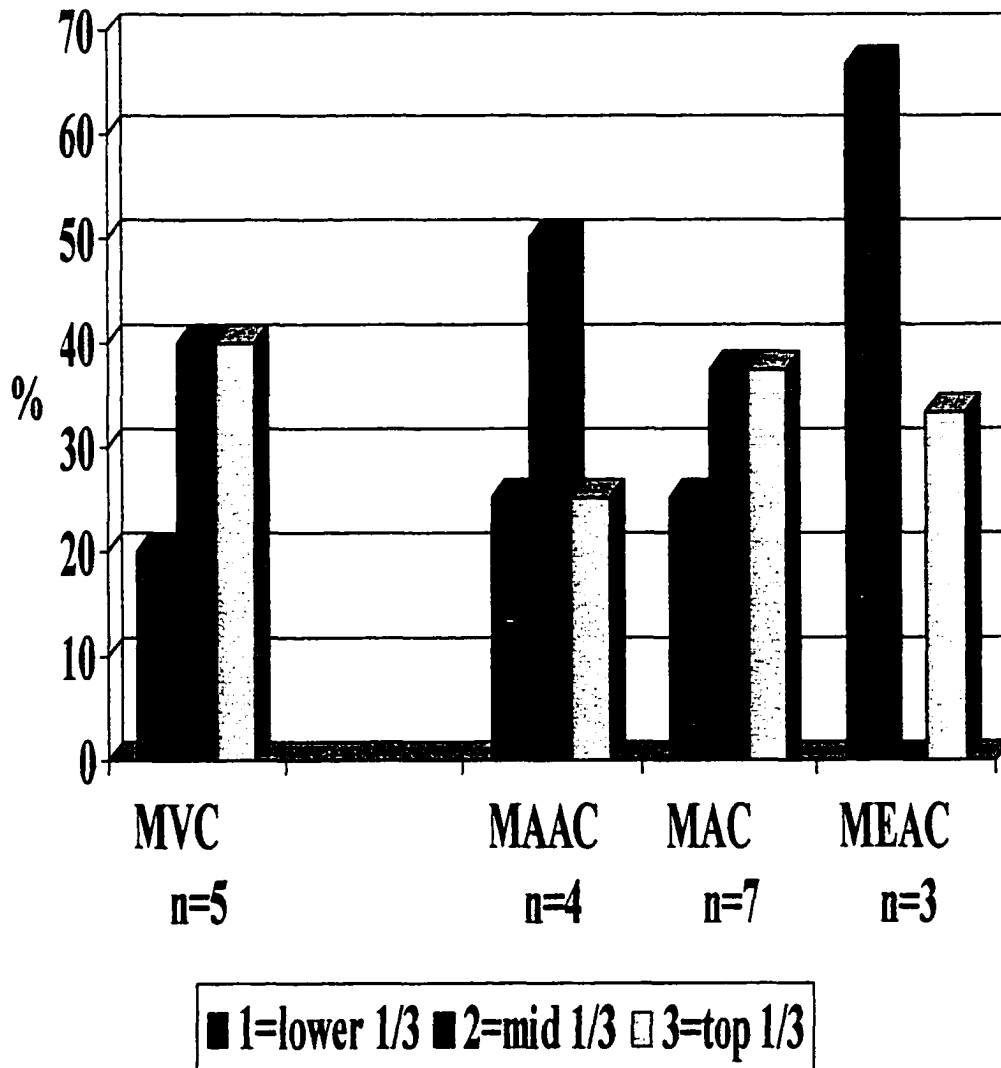


FIGURE 8 (Continued)

AHA Cardiovascular Preparticipation

Physical Recommendations

Forms Adequacy Per Conference

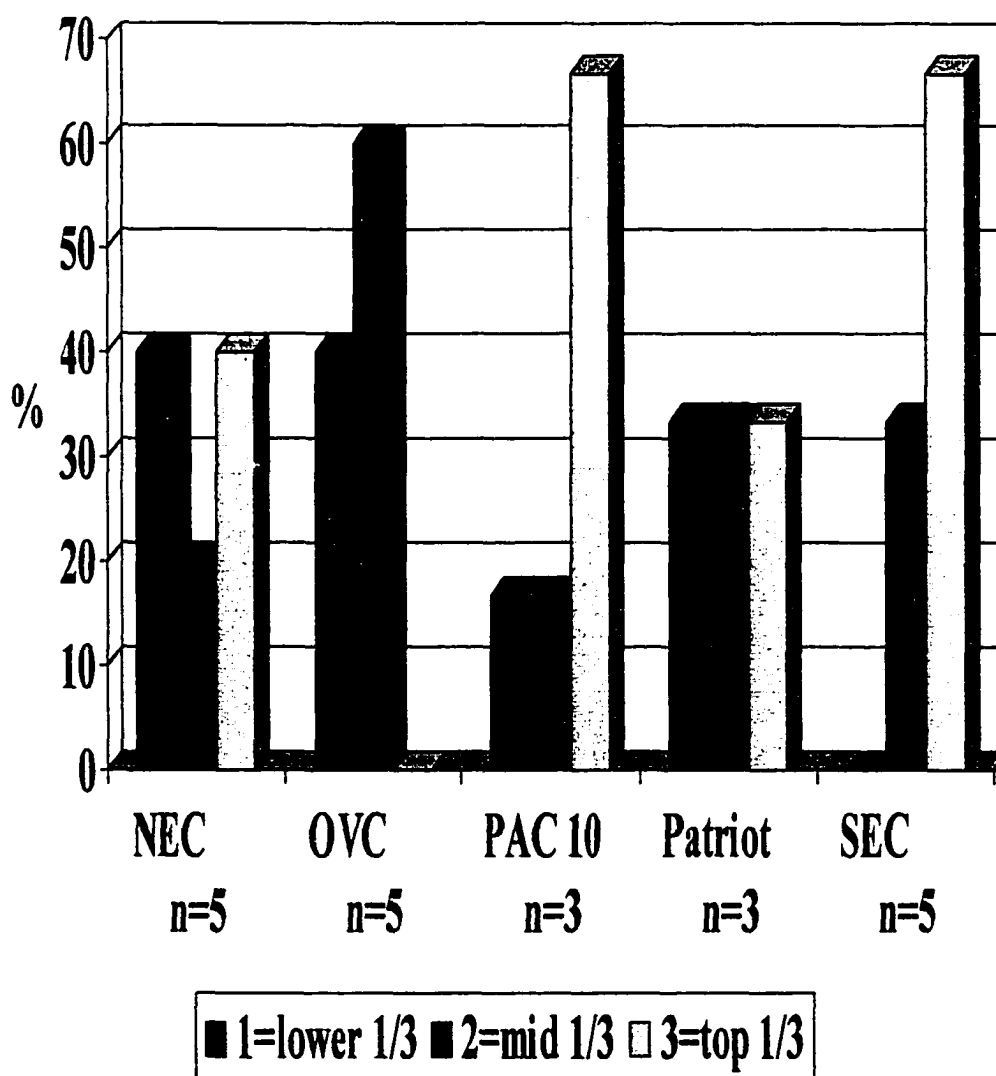


FIGURE 8 (Continued)

AHA Cardiovascular Preparticipation

Physical Recommendations

Forms Adequacy Per Conference

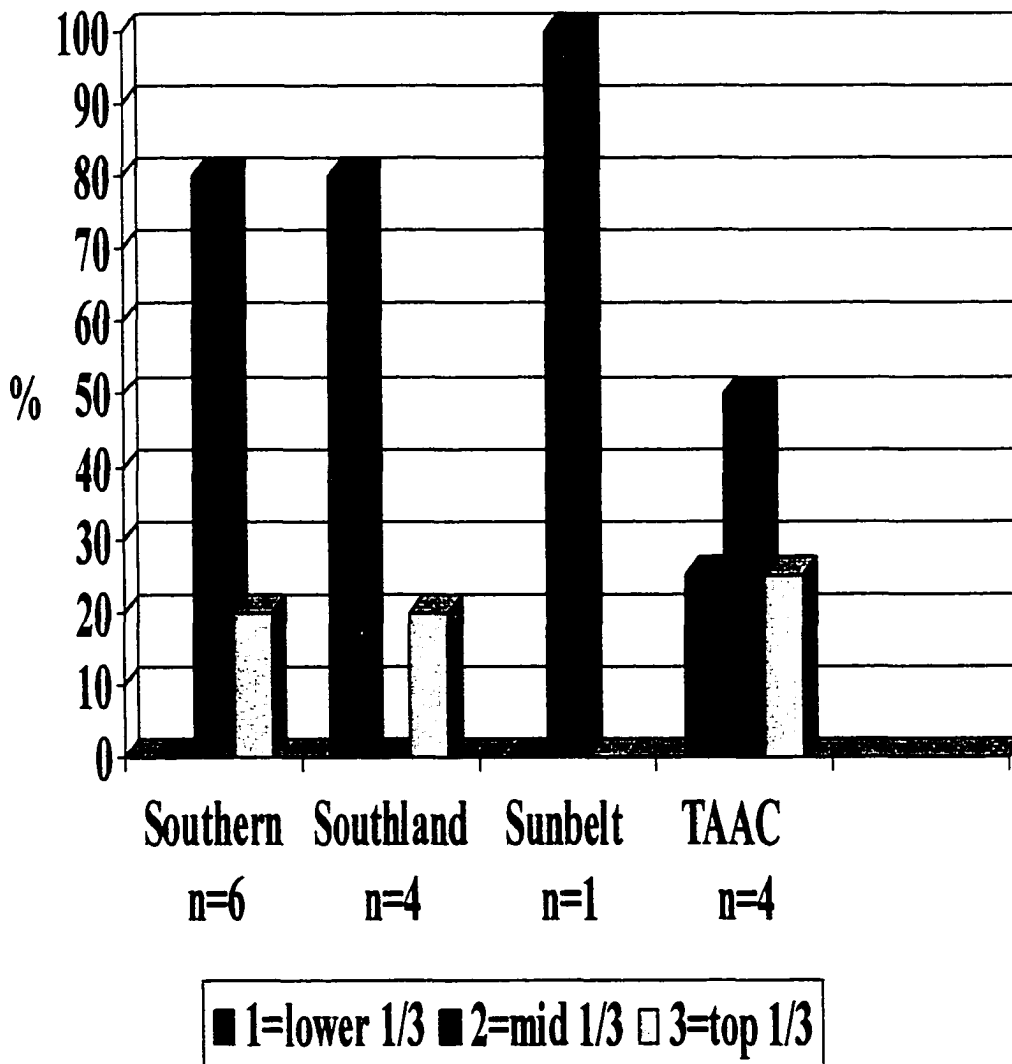


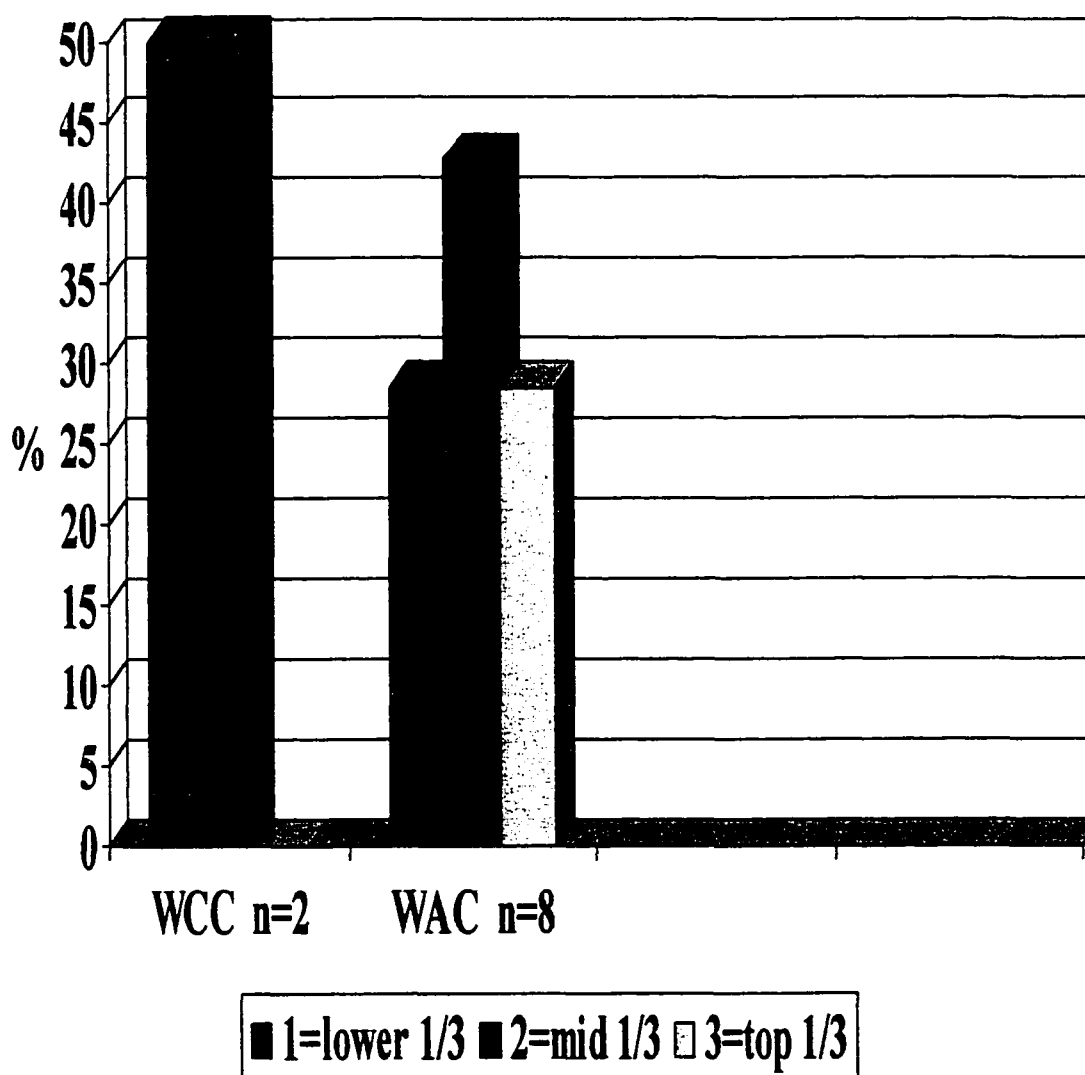
FIGURE 8 (Continued)***AHA Cardiovascular Preparticipation*****Physical Recommendations****Forms Adequacy Per Conference**

FIGURE 9

AHA Cardiovascular Preparticipation History and Physical Recommendations Forms Adequacy Per Conference

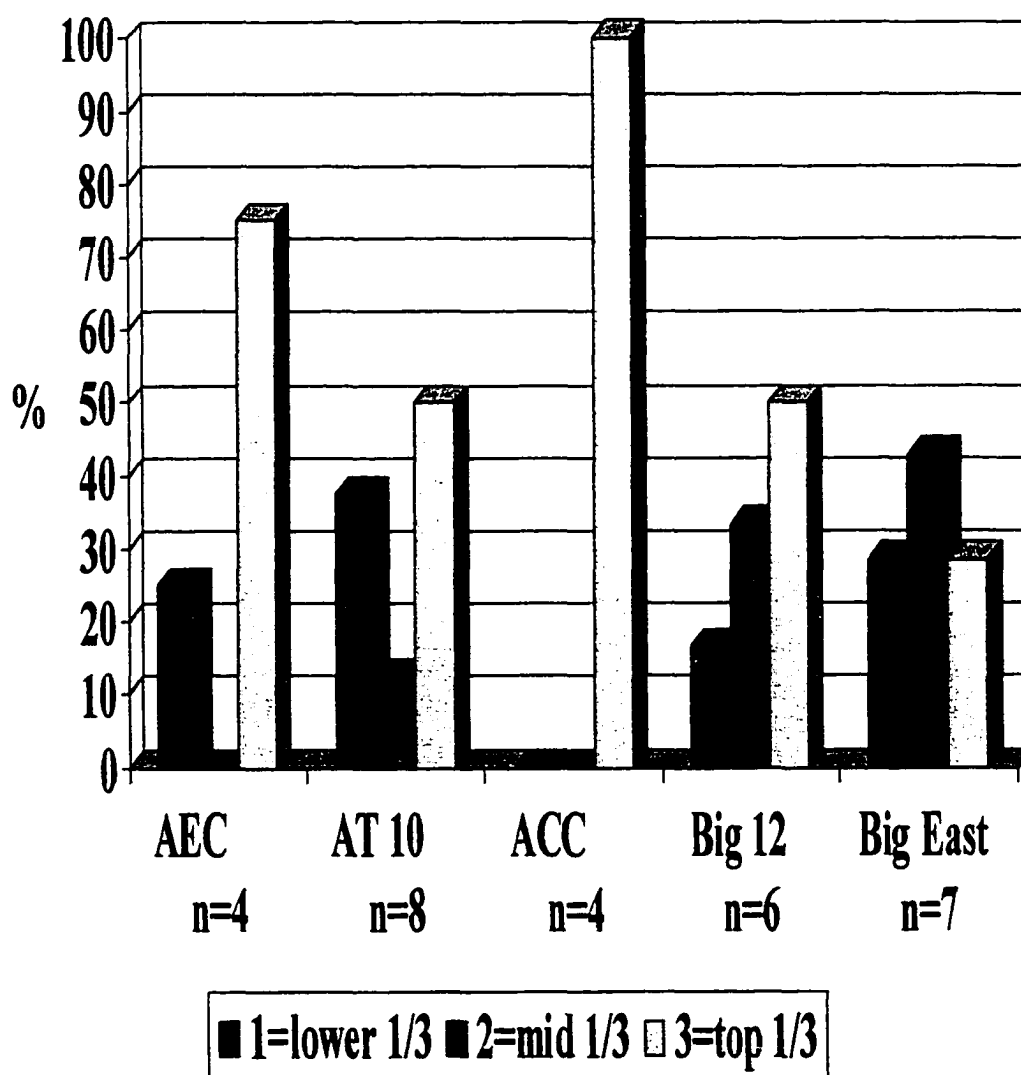


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference

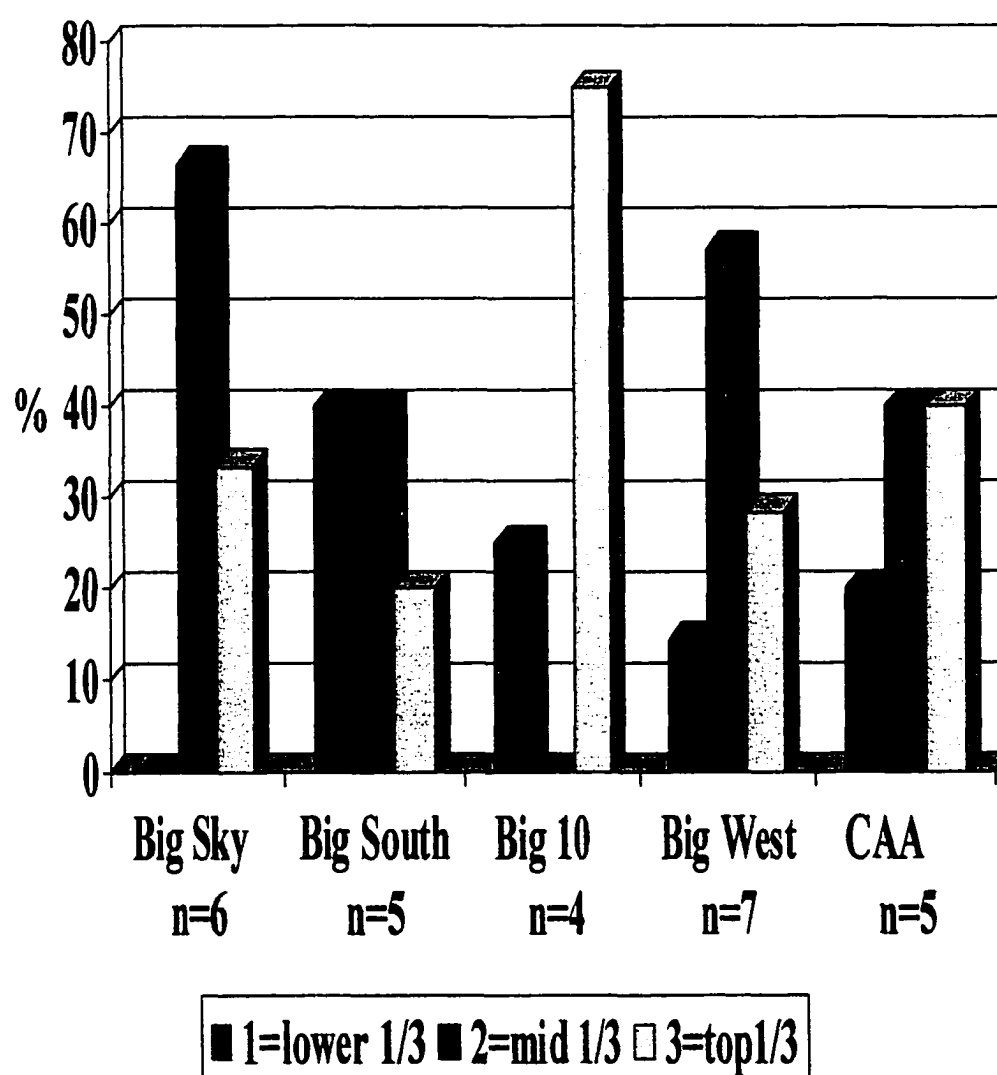


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference

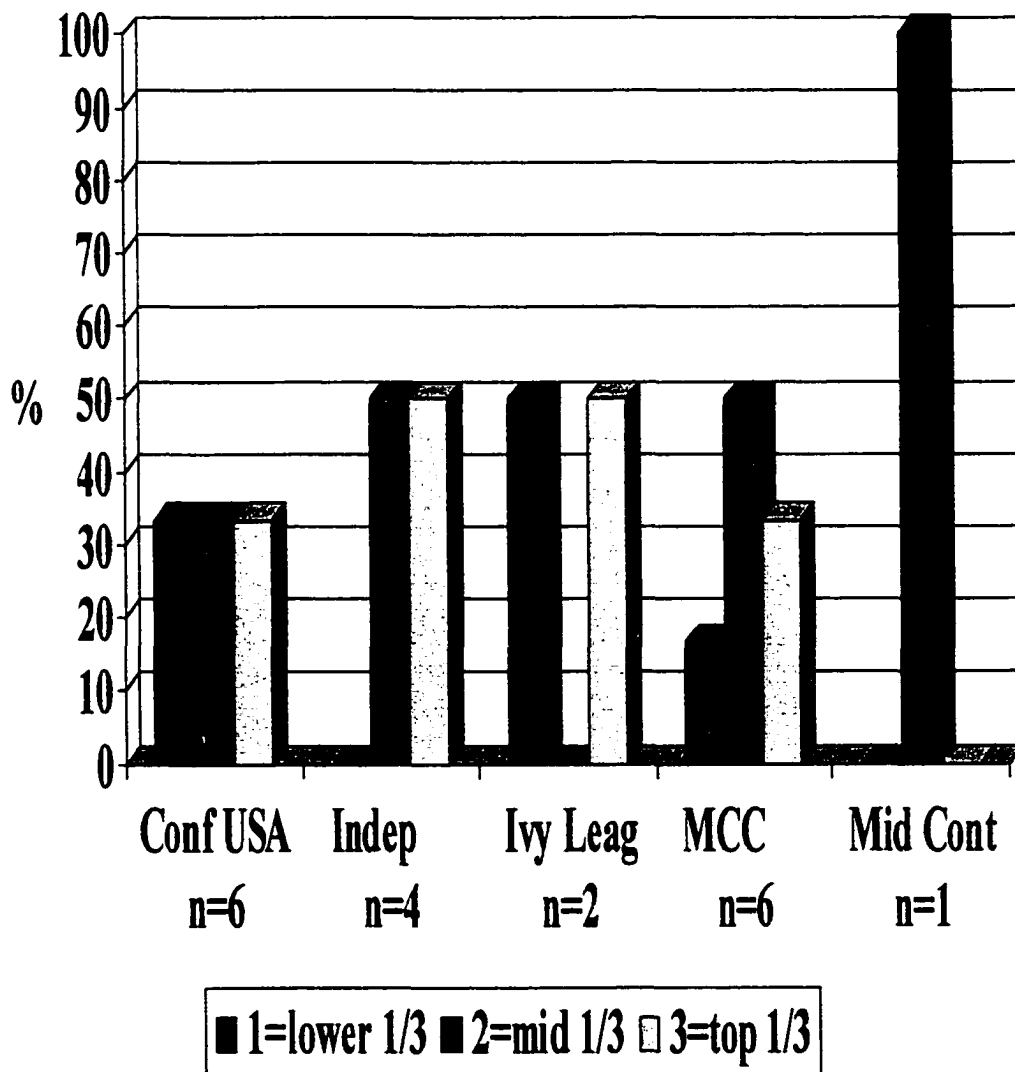


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference

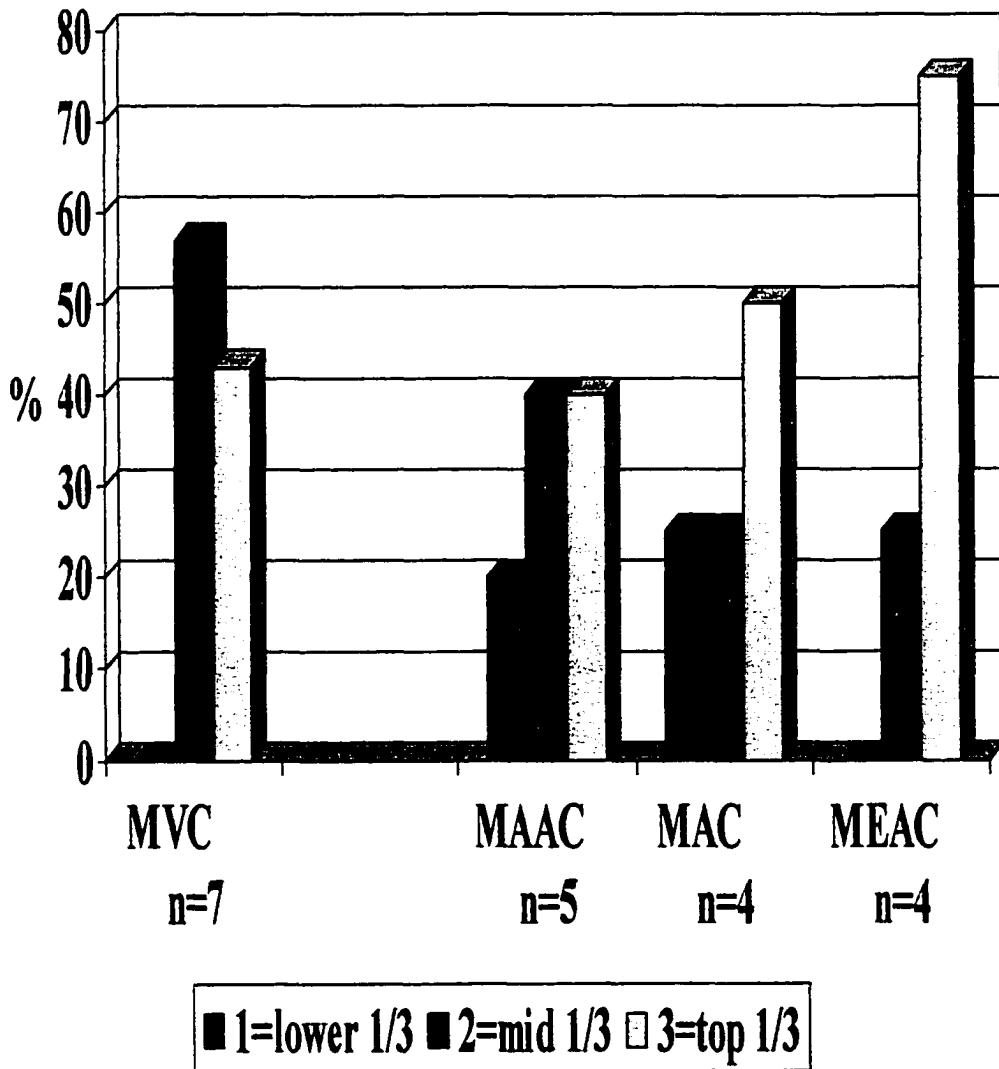


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference

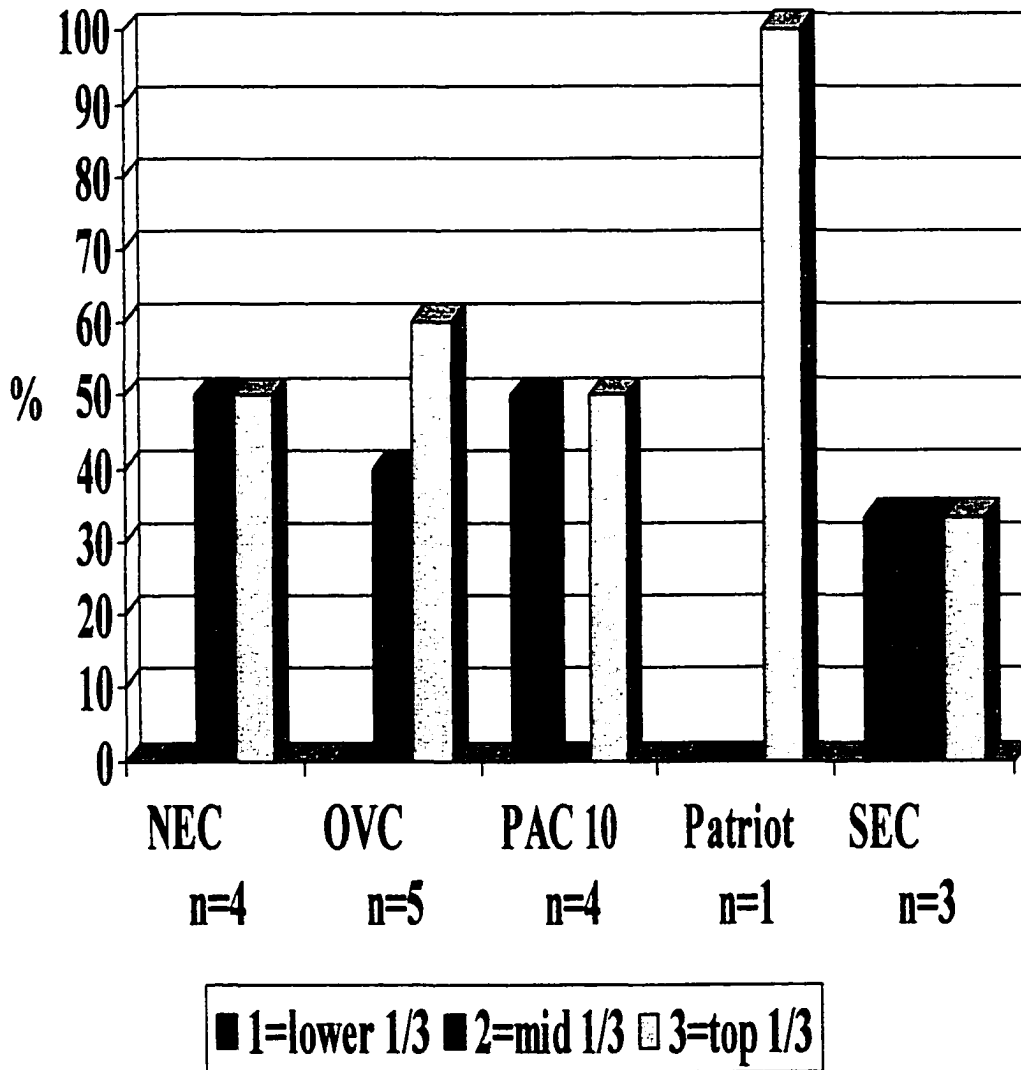


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference

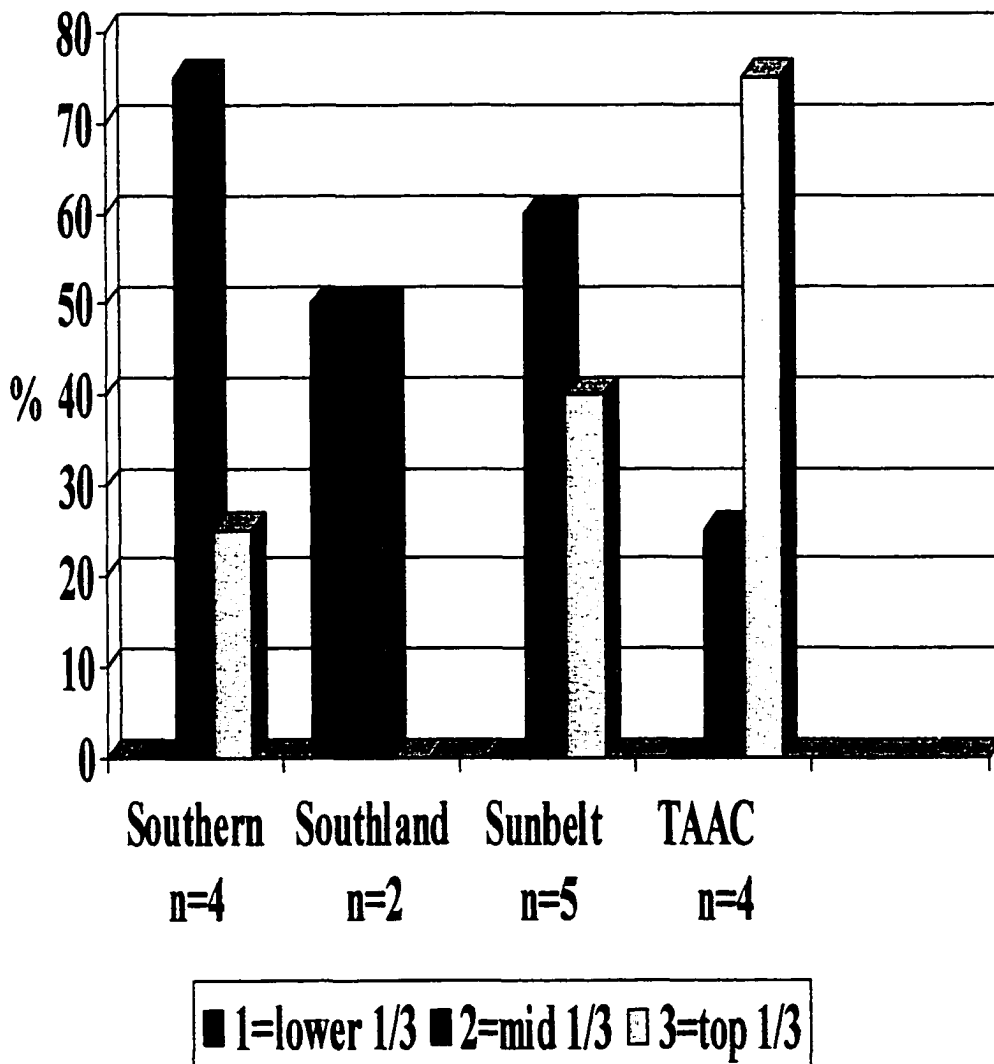
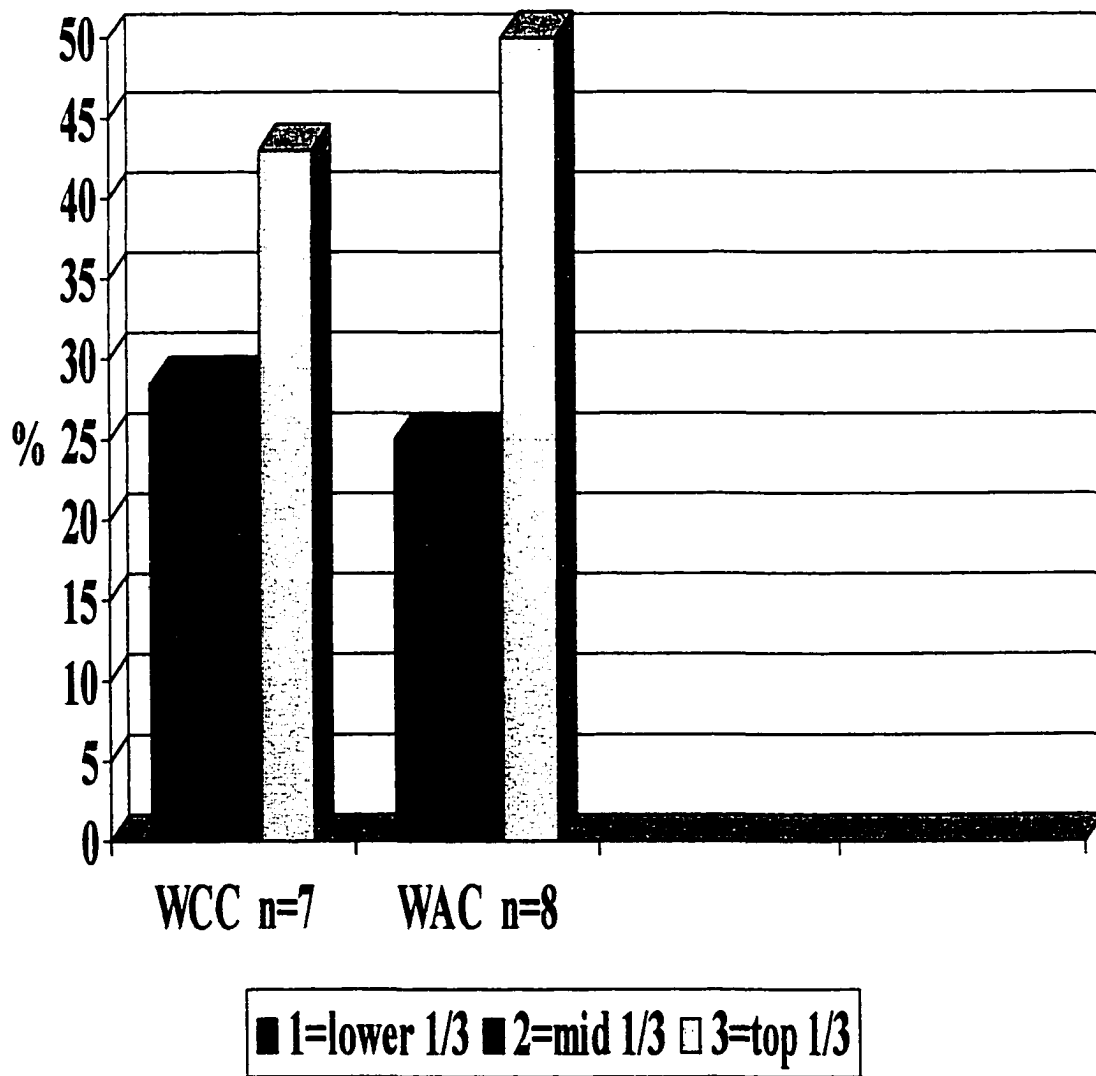


FIGURE 9 (Continued)

AHA Cardiovascular Preparticipation

History and Physical Recommendations

Forms Adequacy Per Conference



Adequacy of the history questions reflecting the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations were analyzed. The lower 33% category represented 8 to 25 items matching, the mid 33% category represented 26 to 34 items matching, and the top 33% category represented 35 to 50 items. Most of the conferences had a mixture of each category (see Figure 10). In the Mid-Continent Conference one university form scored in the lower 33%, and the Sun Belt Conference had only one university send a history form, which scored in the mid 33% category. Universities scoring more in the top category of adequate history forms were ACC (75%), Big 10 (75%), OVC (60%), PAC 10 (67%), and SEC (67%). The following universities scored more in the lower category of adequate history forms: Big East (57%), Big South (80%), MEAC (67%), and Southland Conference (80%).

The adequacy of the forms for the physical assessment components reflecting the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations were again a mixture of categories for most of the conferences (see Figure 11). The lower 33% represented 0 to 21 items in the forms, the mid 33% represented 22 to 26 items, and the top 33% represented 27 to 34 physical assessment items. Mid-Continent, Metro Atlantic Athletic (MAAC), and Sun Belt Conferences each had only one university to send physical assessment forms. The form from the Mid-Continent Conference and the MAAC scored in the lower 33%. The Sun Belt Conference form scored in top 33%. All of the forms from the Southland Conference and the West Coast Conference (WCC) scored in the top 33%. Other universities' forms that scored more in the top 33% were ACC (75%), Missouri Valley

FIGURE 10

Five National Medical Associations
Preparticipation Physical Evaluation History
Forms Adequacy Per Conference

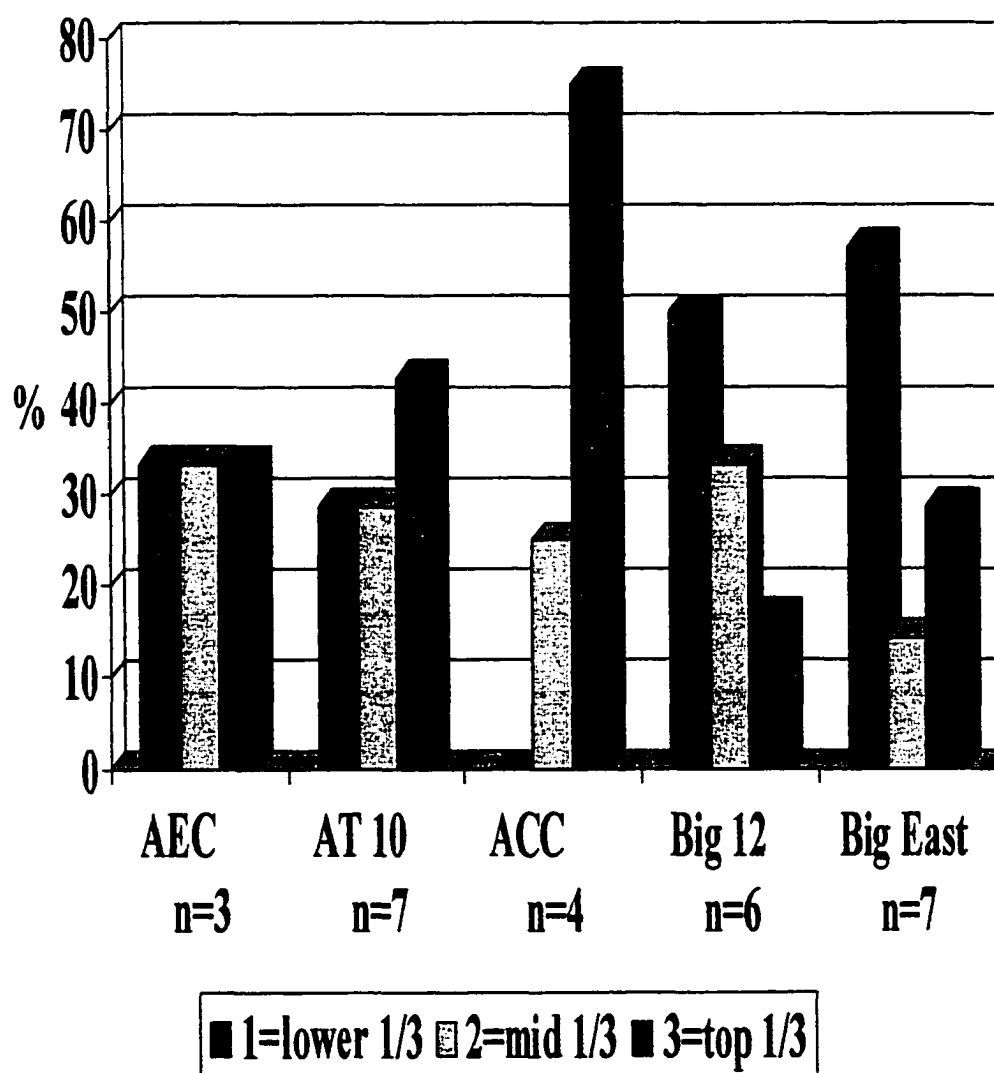


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

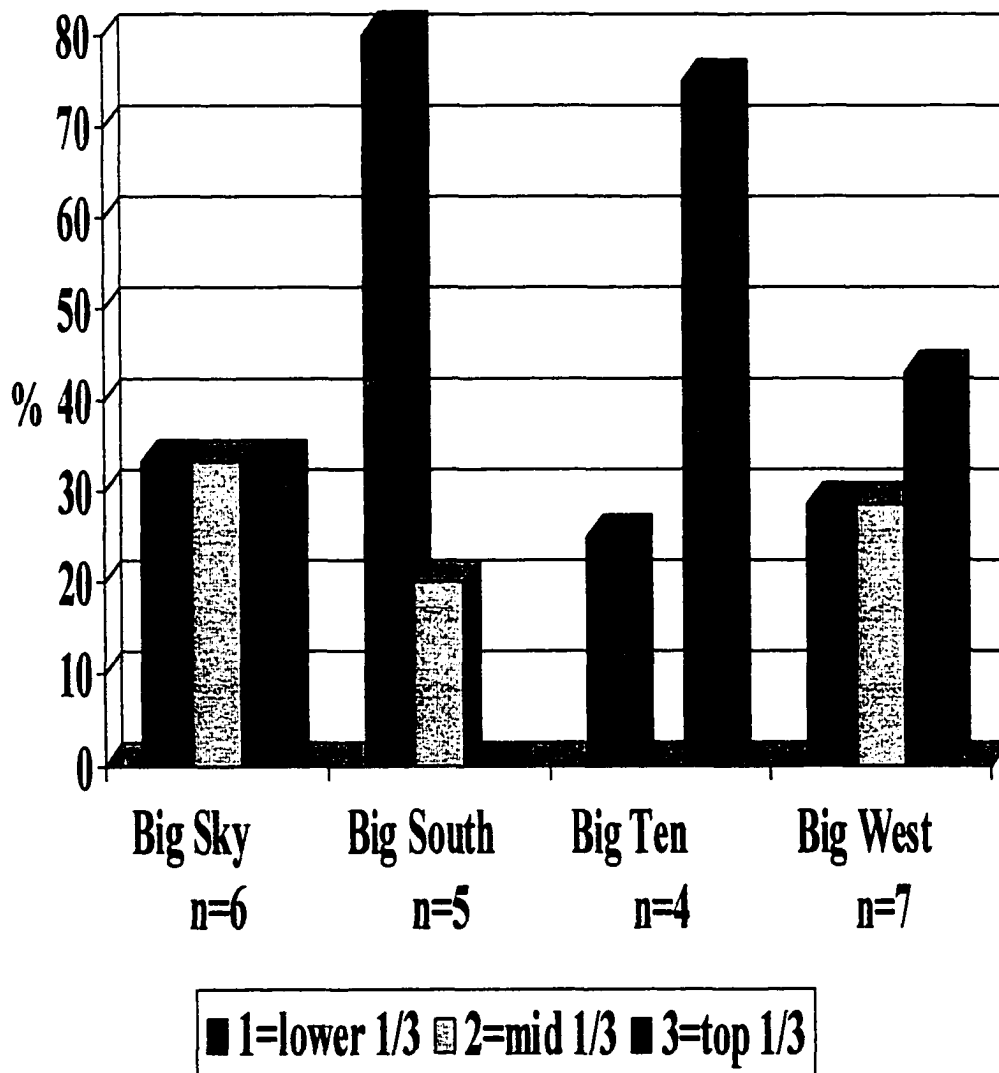


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

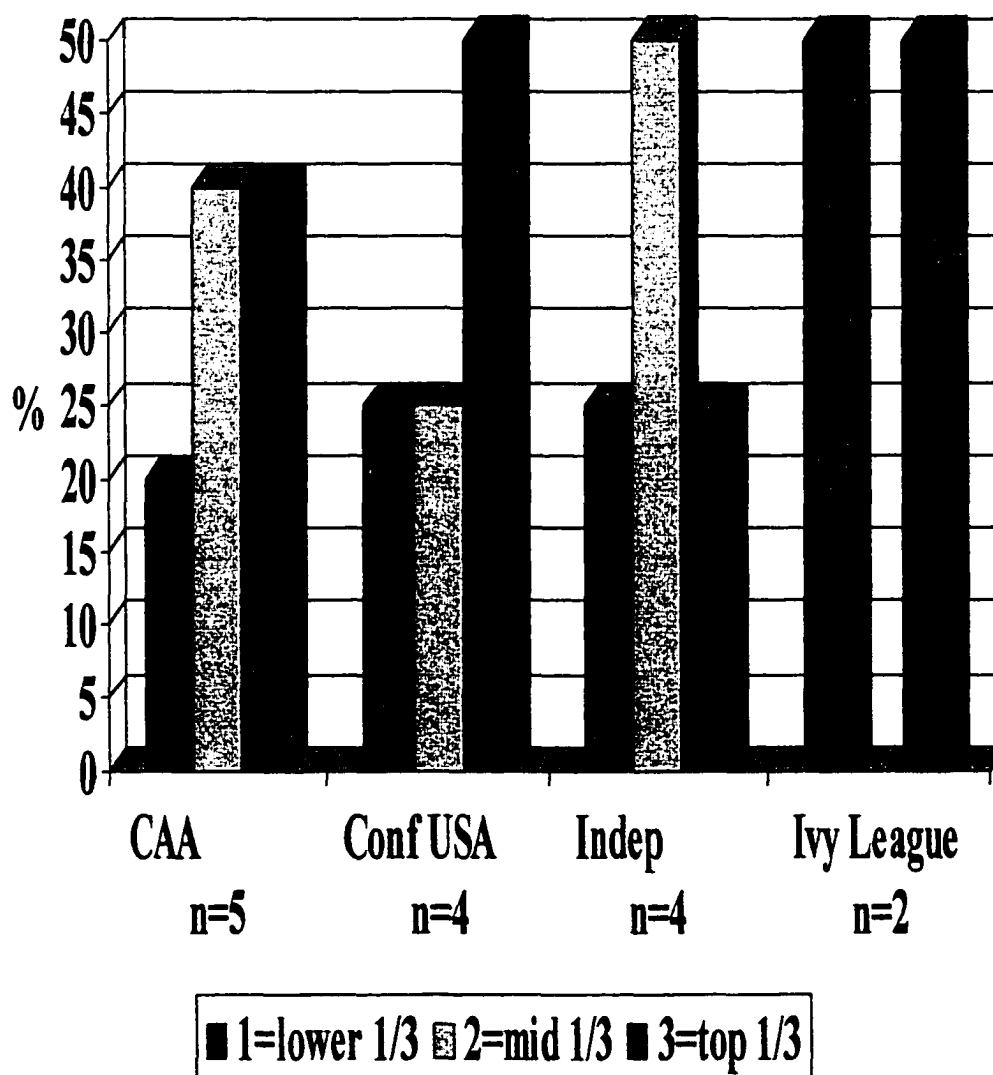


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

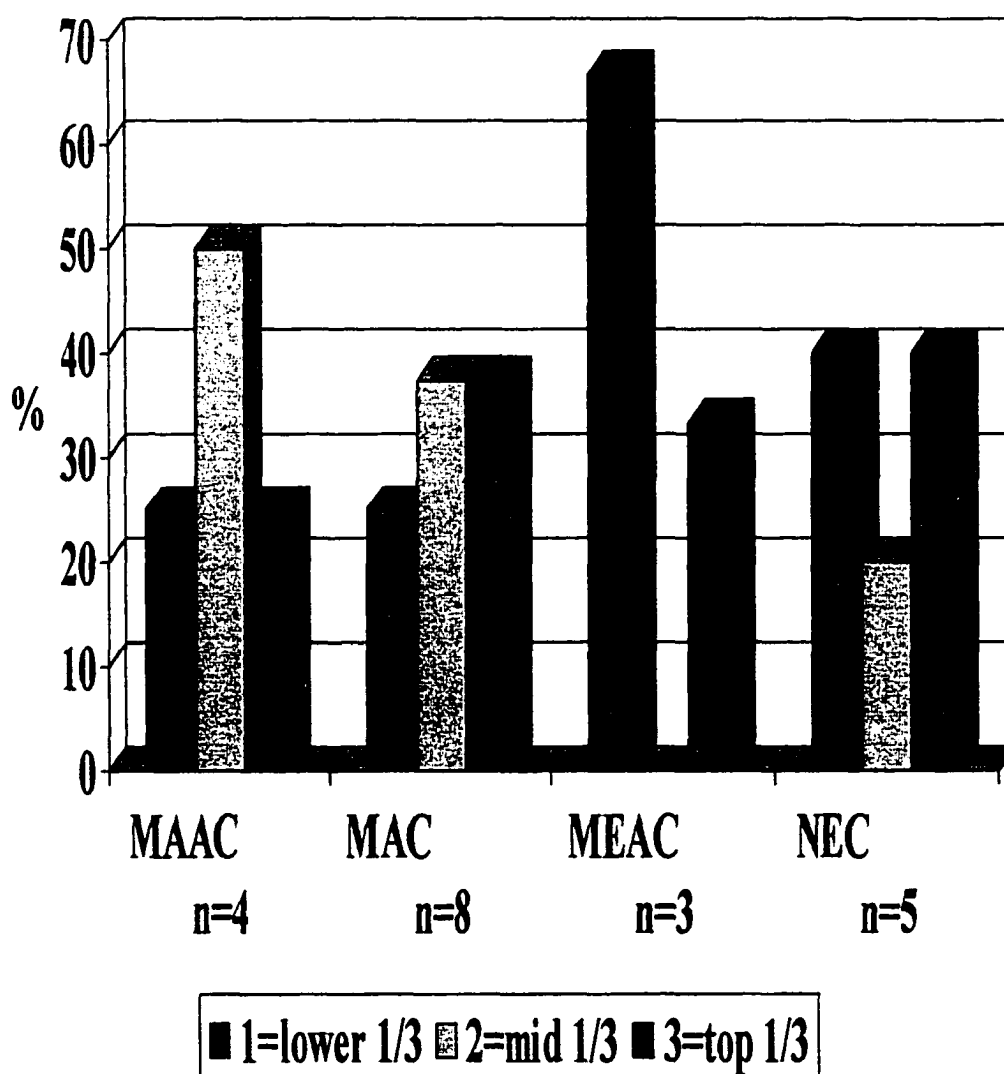


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conferences

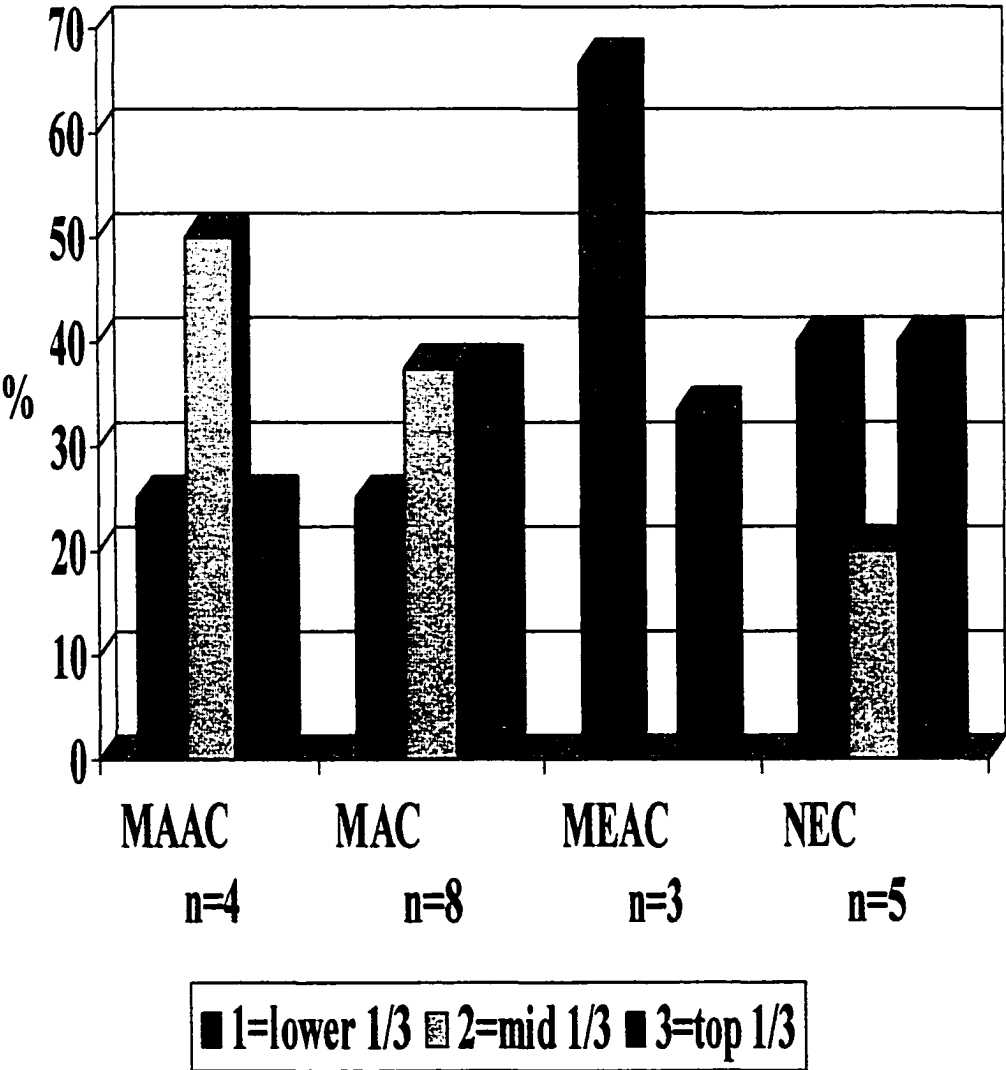


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

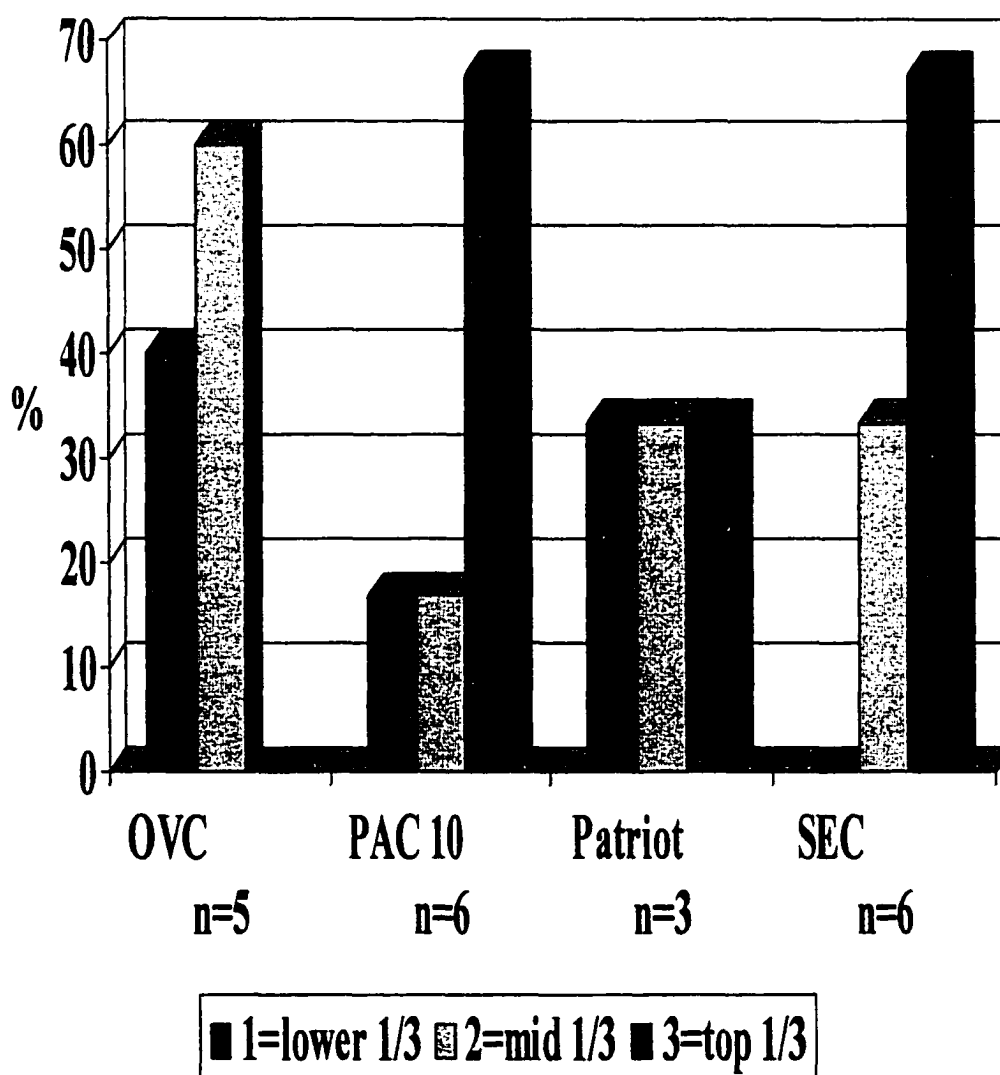


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

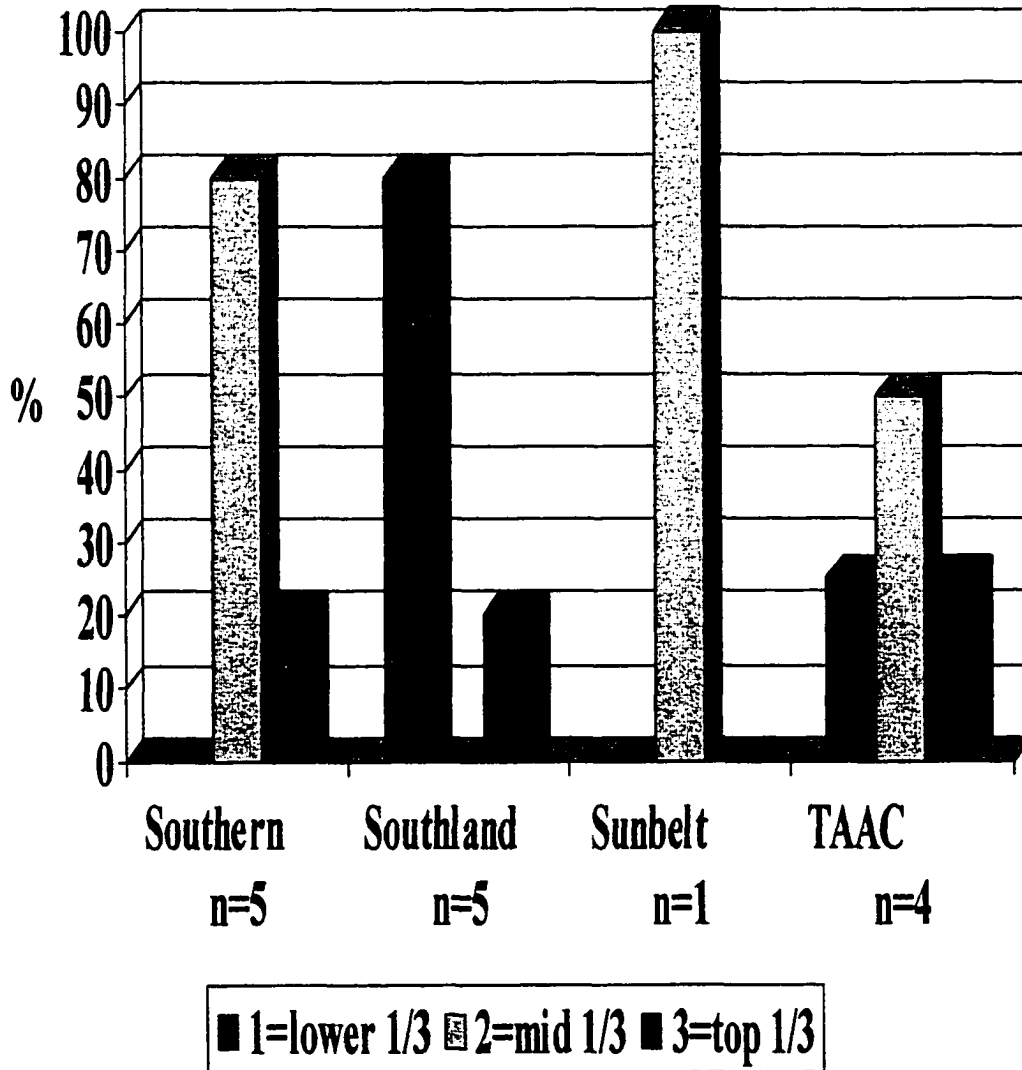


FIGURE 10 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History

Forms Adequacy Per Conference

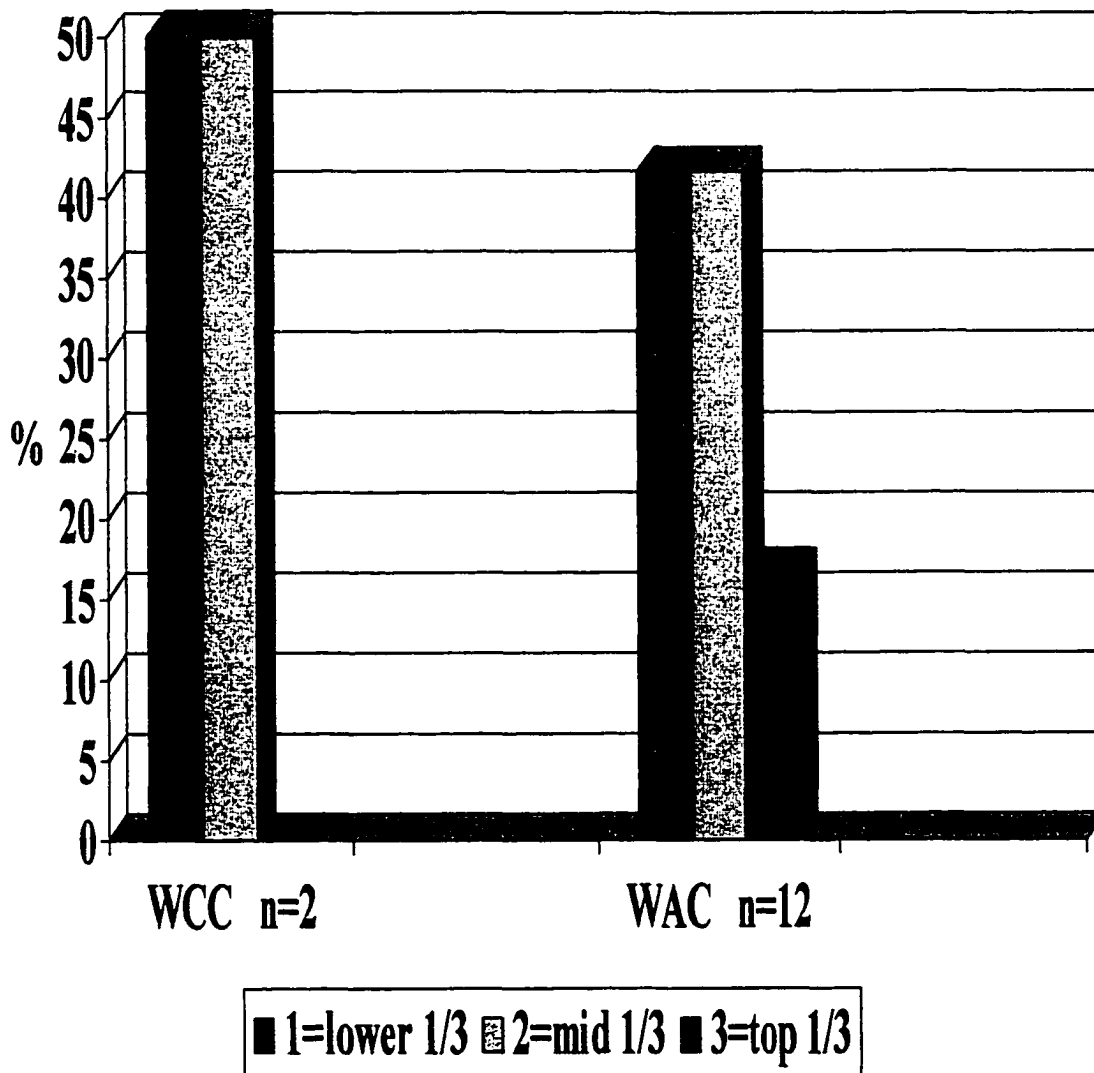


FIGURE 11

Five National Medical Associations *Preparticipation Physical Evaluation Physical* Forms Adequacy Per Conference

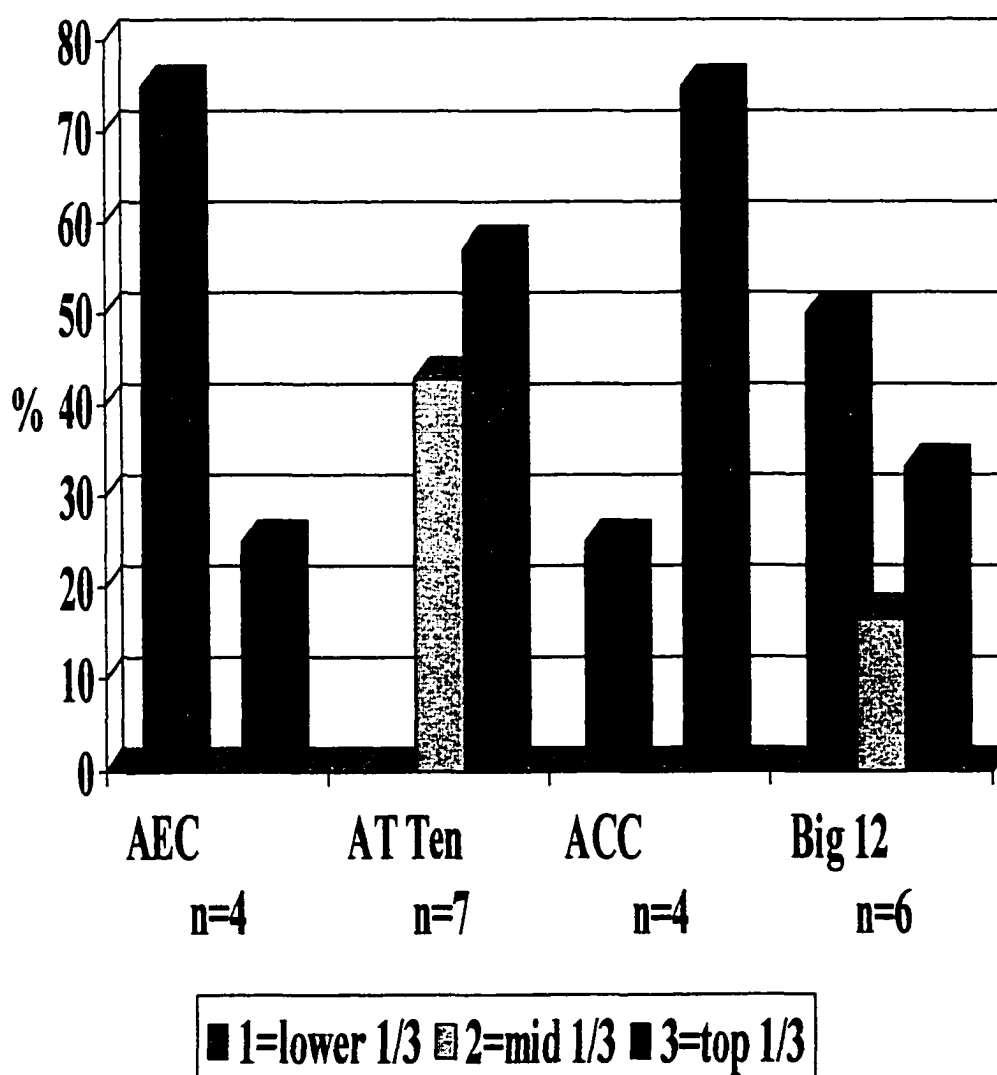


FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference

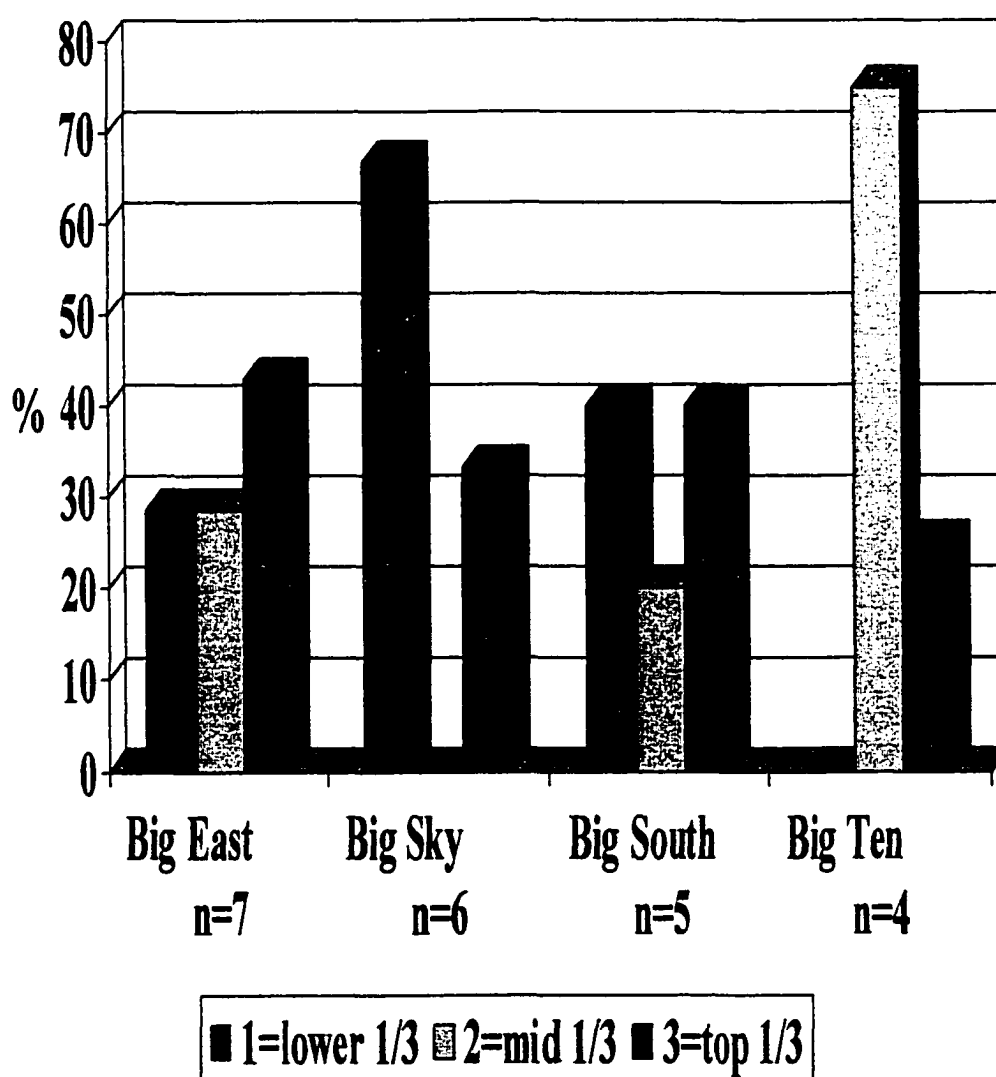


FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference

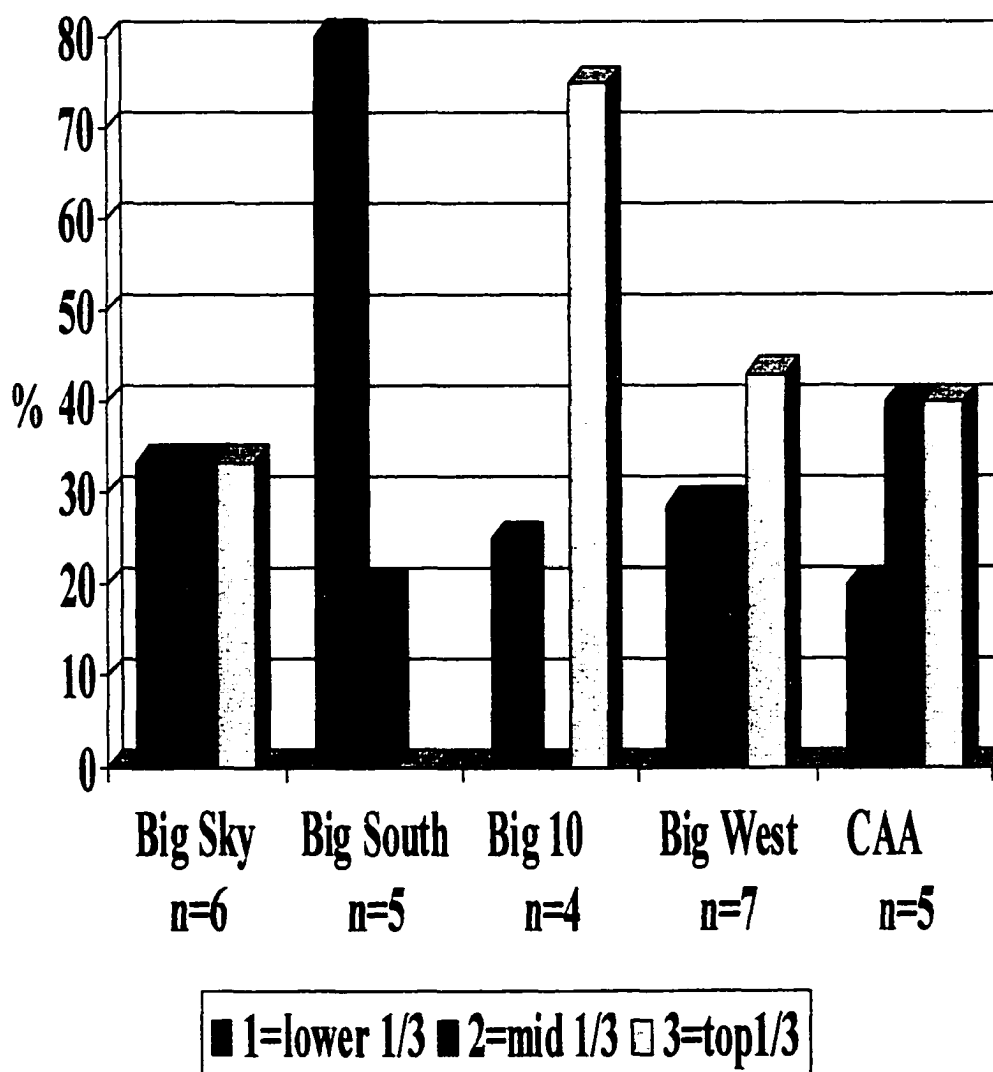


FIGURE 11 (Continued)

Five National Medical Associations *Preparticipation Physical Evaluation Physical* Forms Adequacy Per Conference

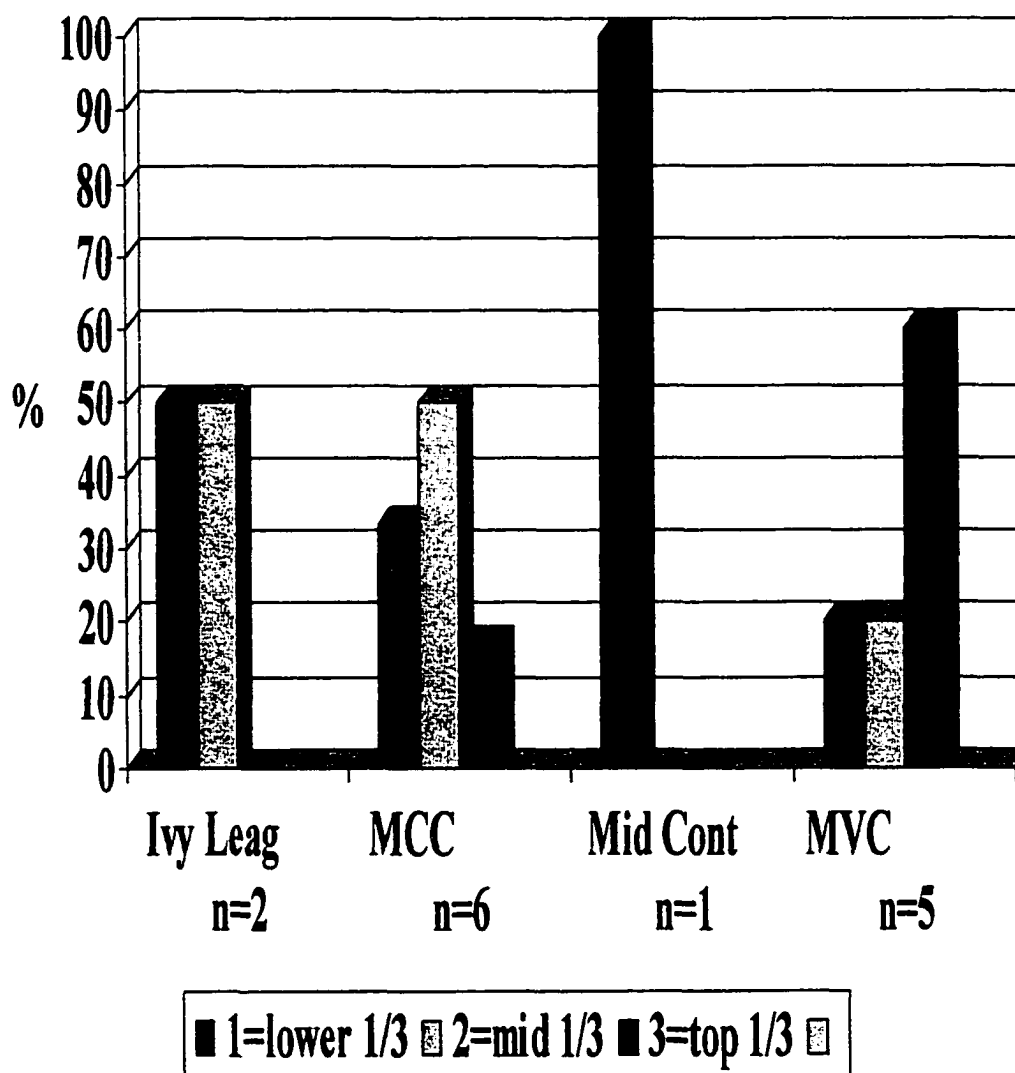


FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference

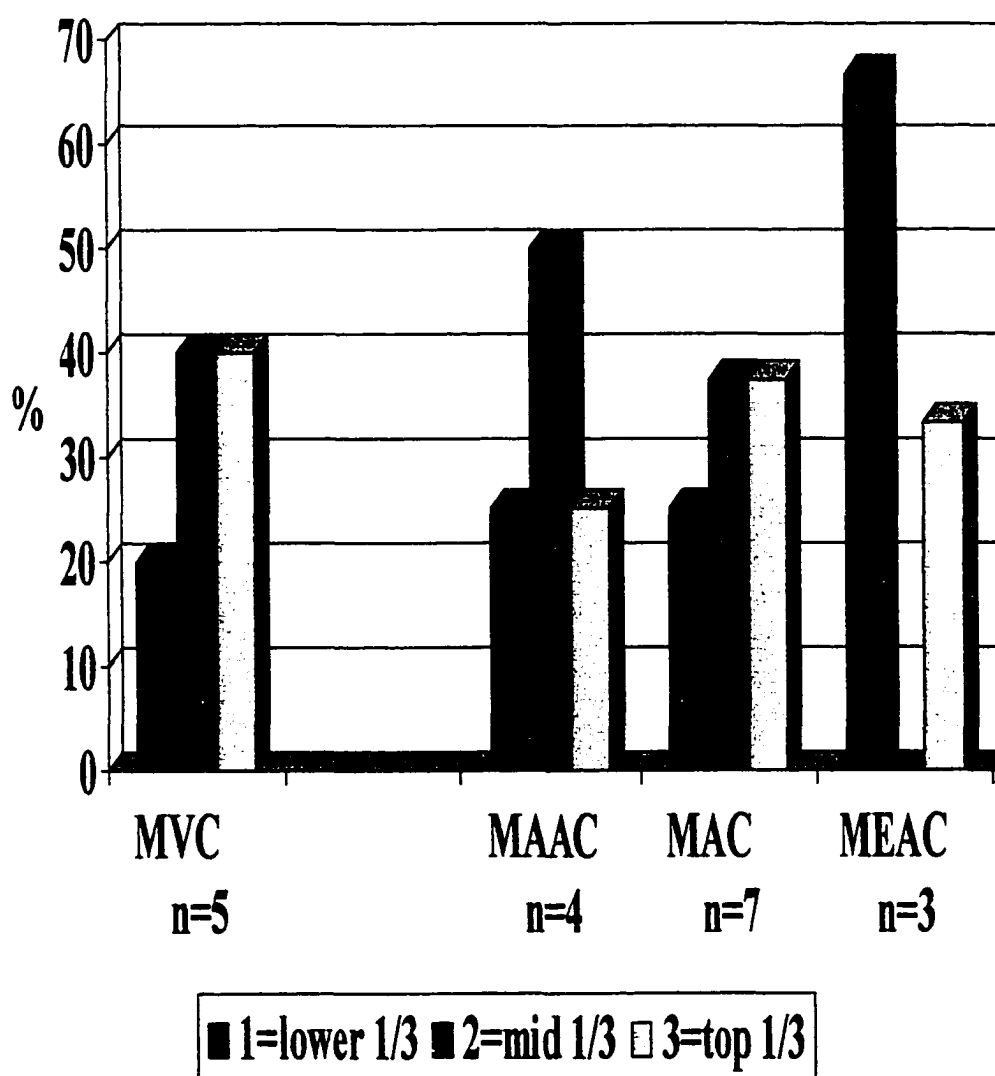
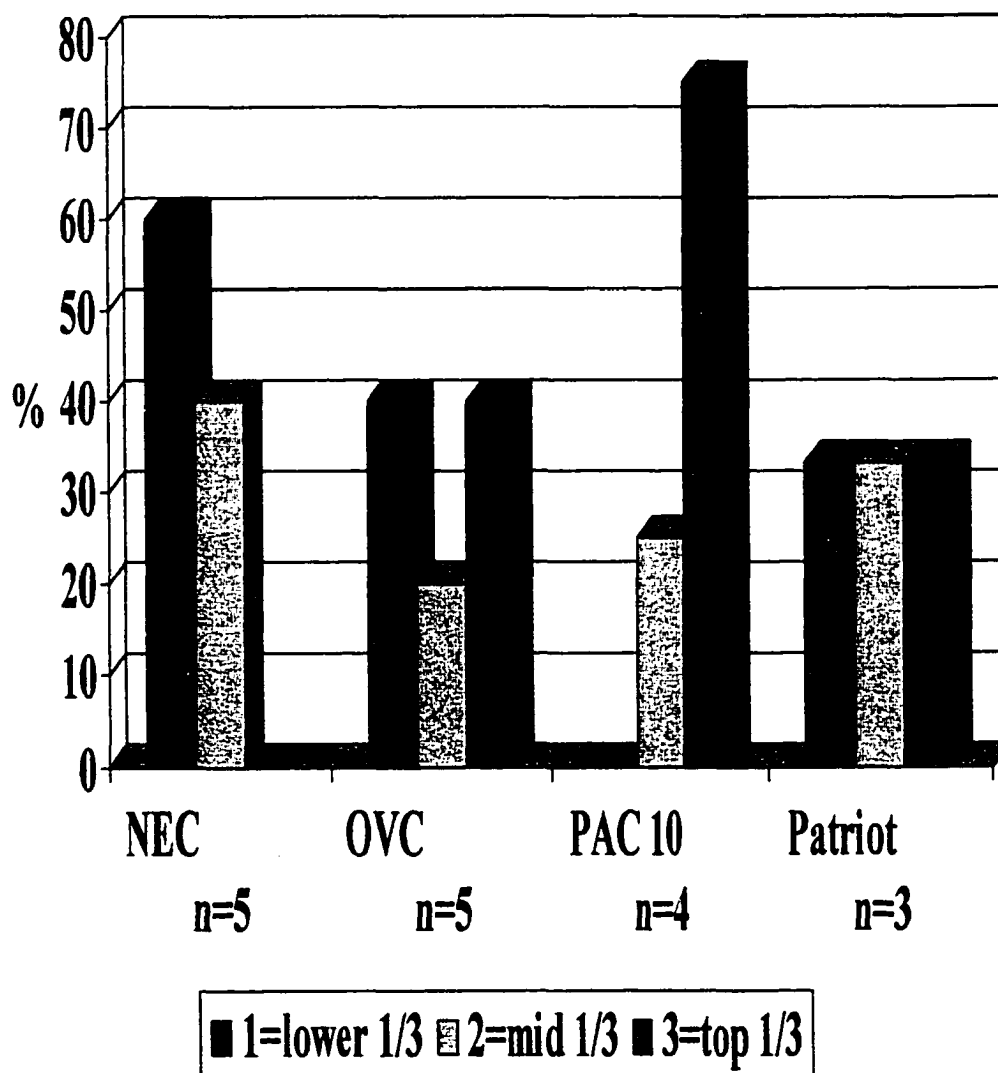


FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference



■ 1=lower 1/3 ■ 2=mid 1/3 ■ 3=top 1/3

FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference

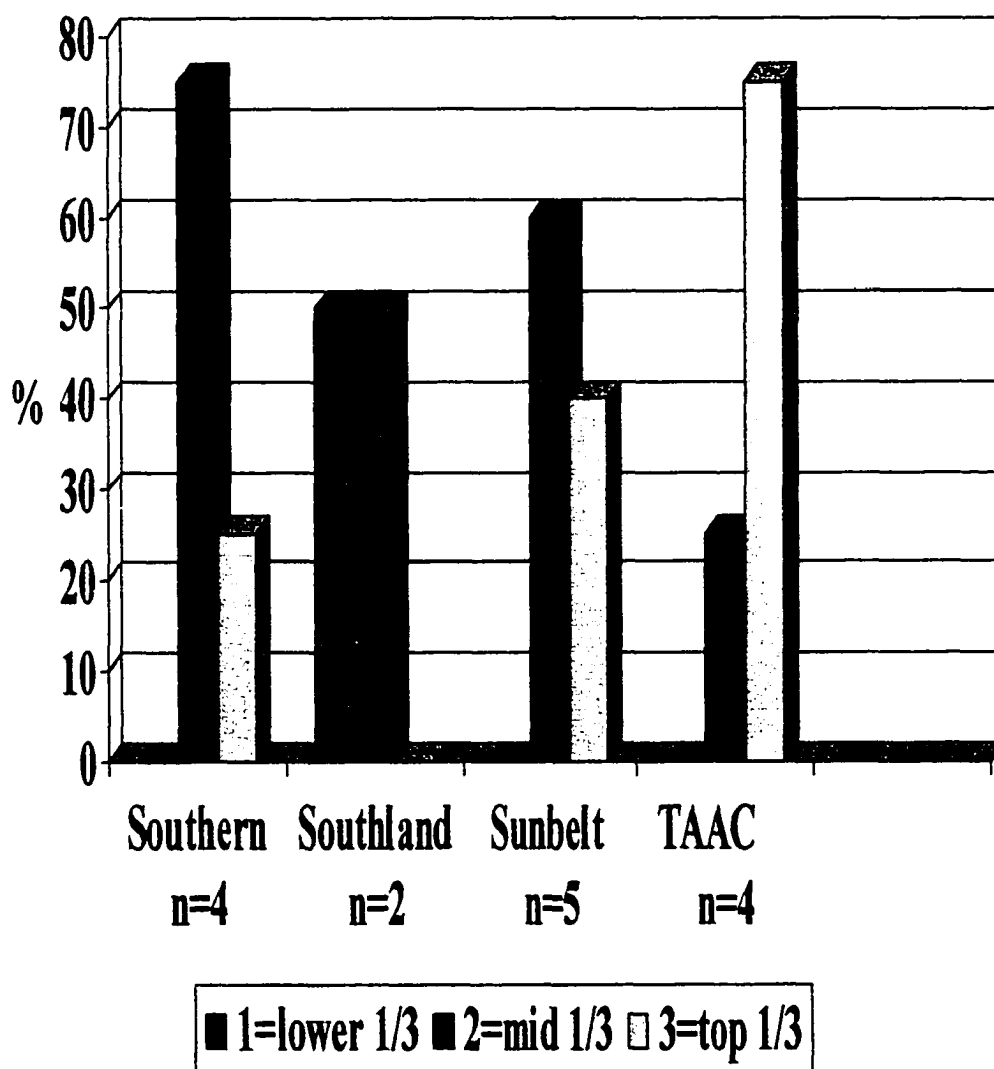
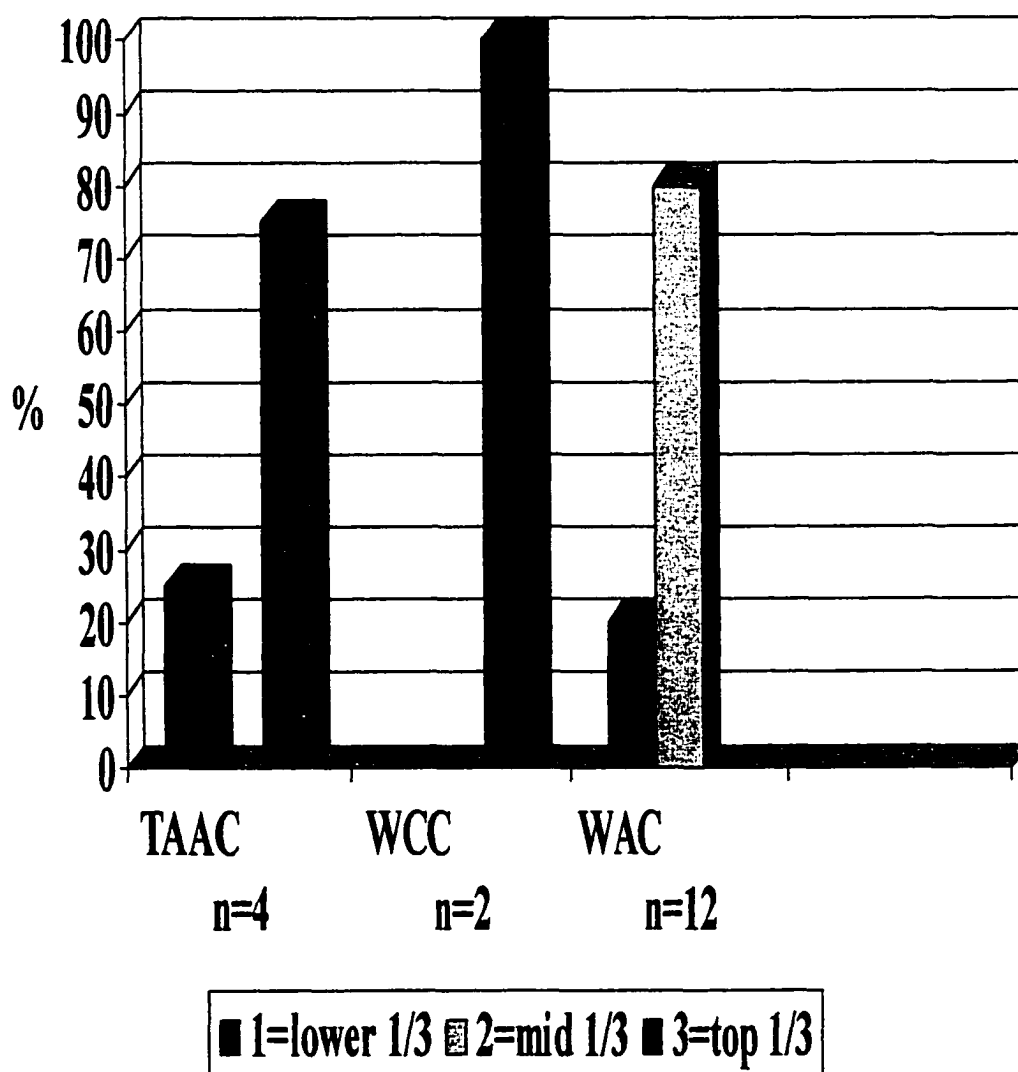


FIGURE 11 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation Physical

Forms Adequacy Per Conference



Conference (MVC) (60%), and the PAC 10 (75%). Forms from universities that scored more in the lower 33% were AEC (75%) and the Big Sky (67%).

The adequacy of forms for history questions and the physical assessment components reflecting the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations were a mixture of the three categories for most of the conferences. The lower 33% category represented 8 to 46 items, the mid 33% category represented 47 to 57 items, and the top 33% category represented 58 to 84 items found in the forms. The Mid-Continent Conference and the PAC 10 Conference each had one university send both history and physical assessment forms, with the Mid-Continent Conference scoring in the lower 33% and the PAC 10 in top 33% category. The Mid-American Conference forms all scored in the top 33%. Conferences with most of their forms in the top 33% category were ACC (75%), and the Big Ten (75%). Those conferences with most of their forms in the lower 33% category were Big East (57%), Big Sky (67%), and the Western Athletic Conference (63%) (see Figure 12).

Forms reflecting the adequacy of both history questions and the physical assessment components reflecting the AHA *Cardiovascular Preparticipation* (1996) and the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations were a mixture of the three categories for most conferences. The lower 33% represented 9 to 53 items, the mid 33% represented 54 to 66 items, and the top 33% represented 67 to 96 items found in the forms. The Mid-Continent Conference and the Sun Belt Conference had only one university send

FIGURE 12

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical Forms Adequacy Per Conference

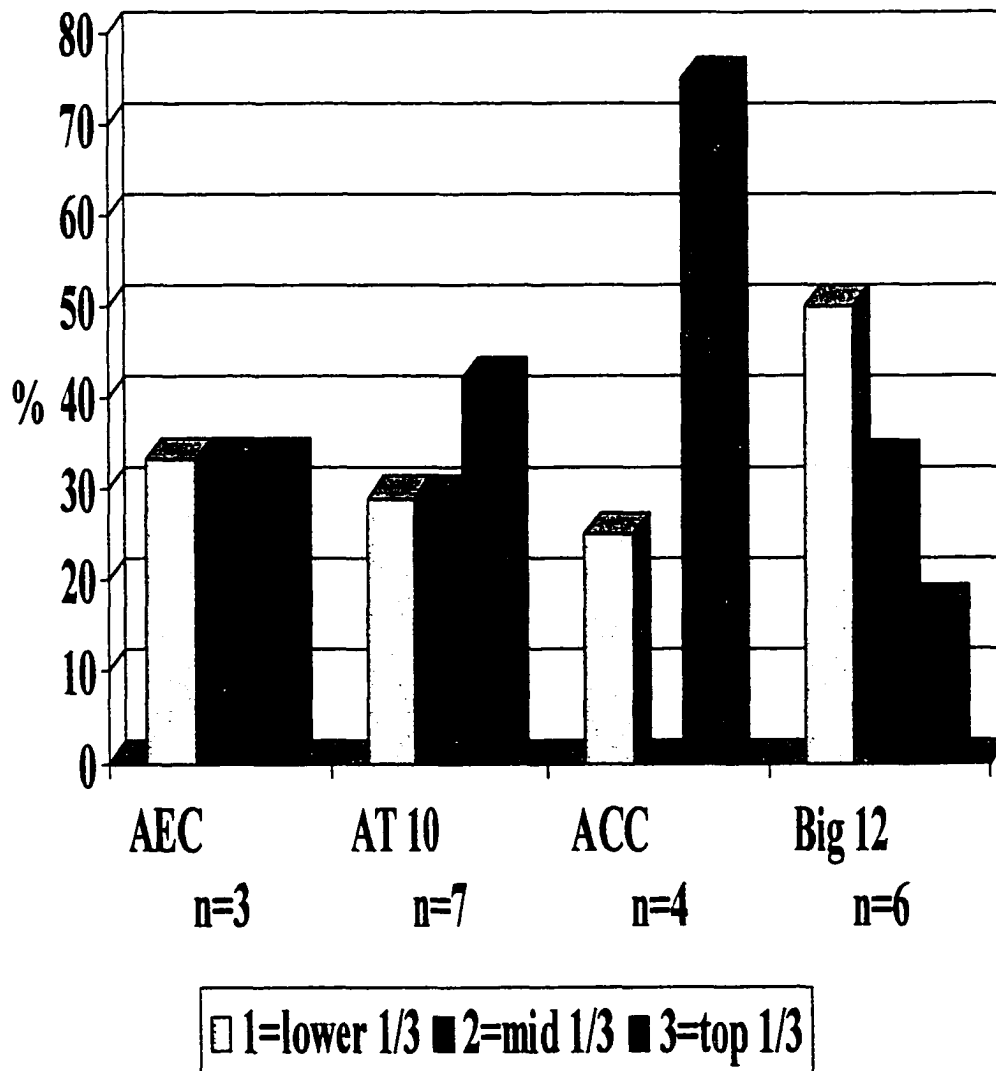


FIGURE 12 (Continued)

Five National Medical Association

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

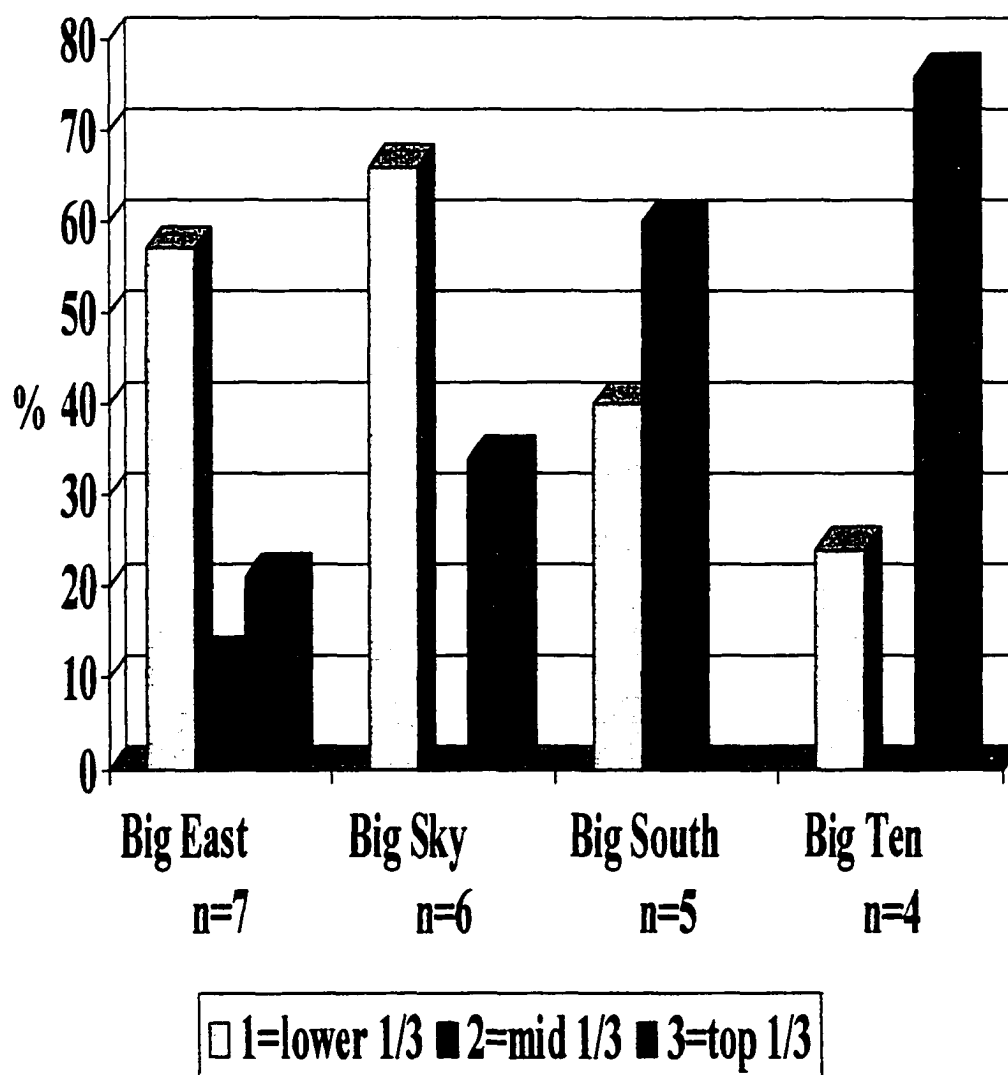


FIGURE 12 (Continued)

Five National Medical Association

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

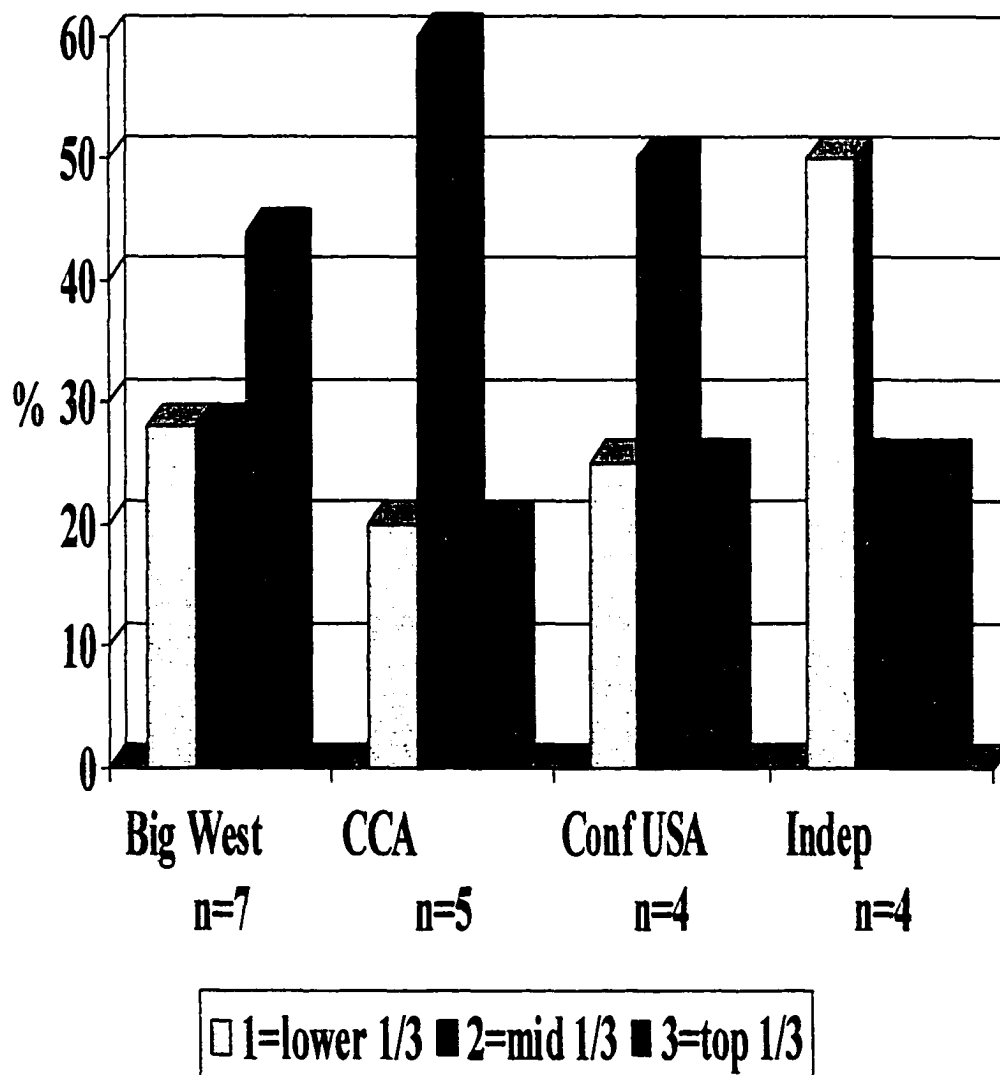


FIGURE 12 (Continued)

Five National Medical Association Preparticipation Physical Evaluation History and Physical Forms Adequacy Per Conference

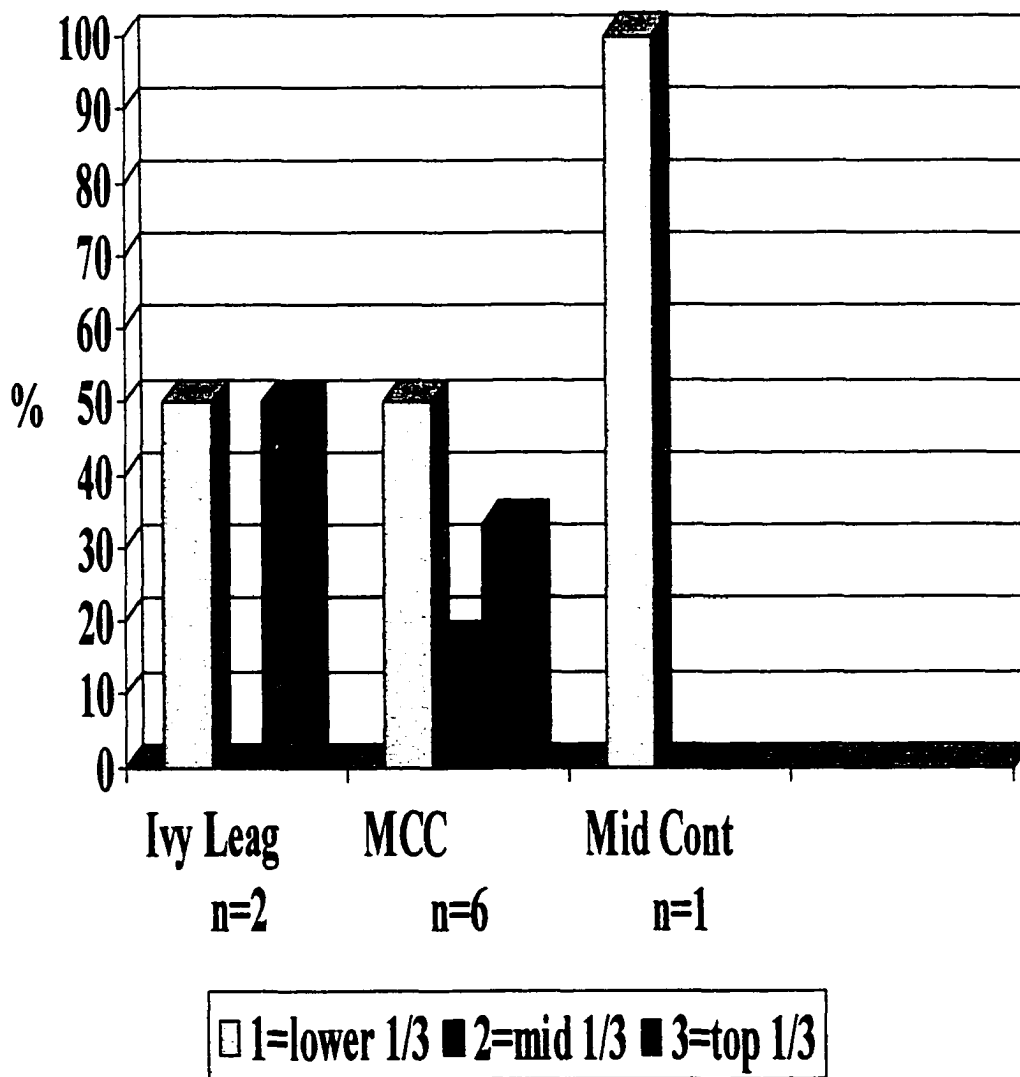


FIGURE 12 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical Forms Adequacy Per Conference

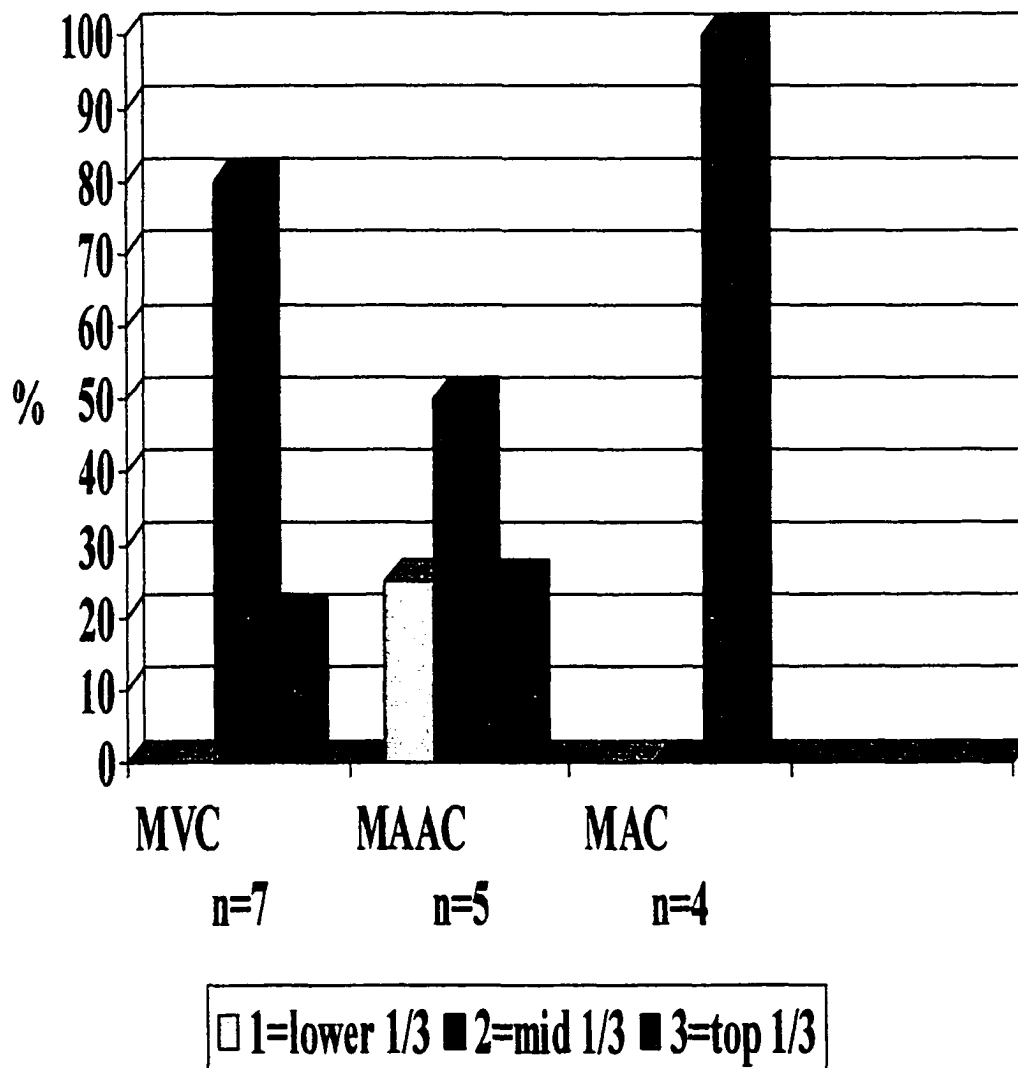


FIGURE 12 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

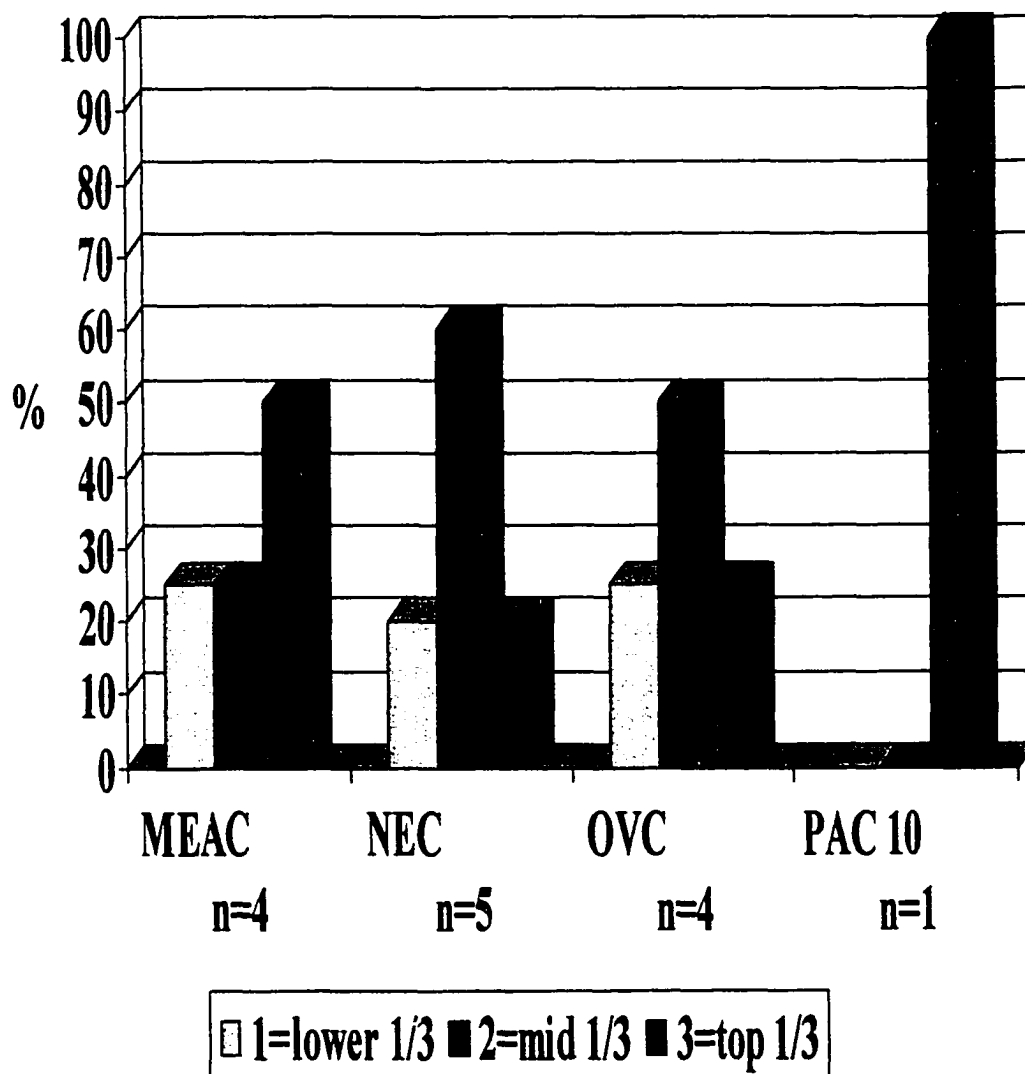


FIGURE 12 (Continued)

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

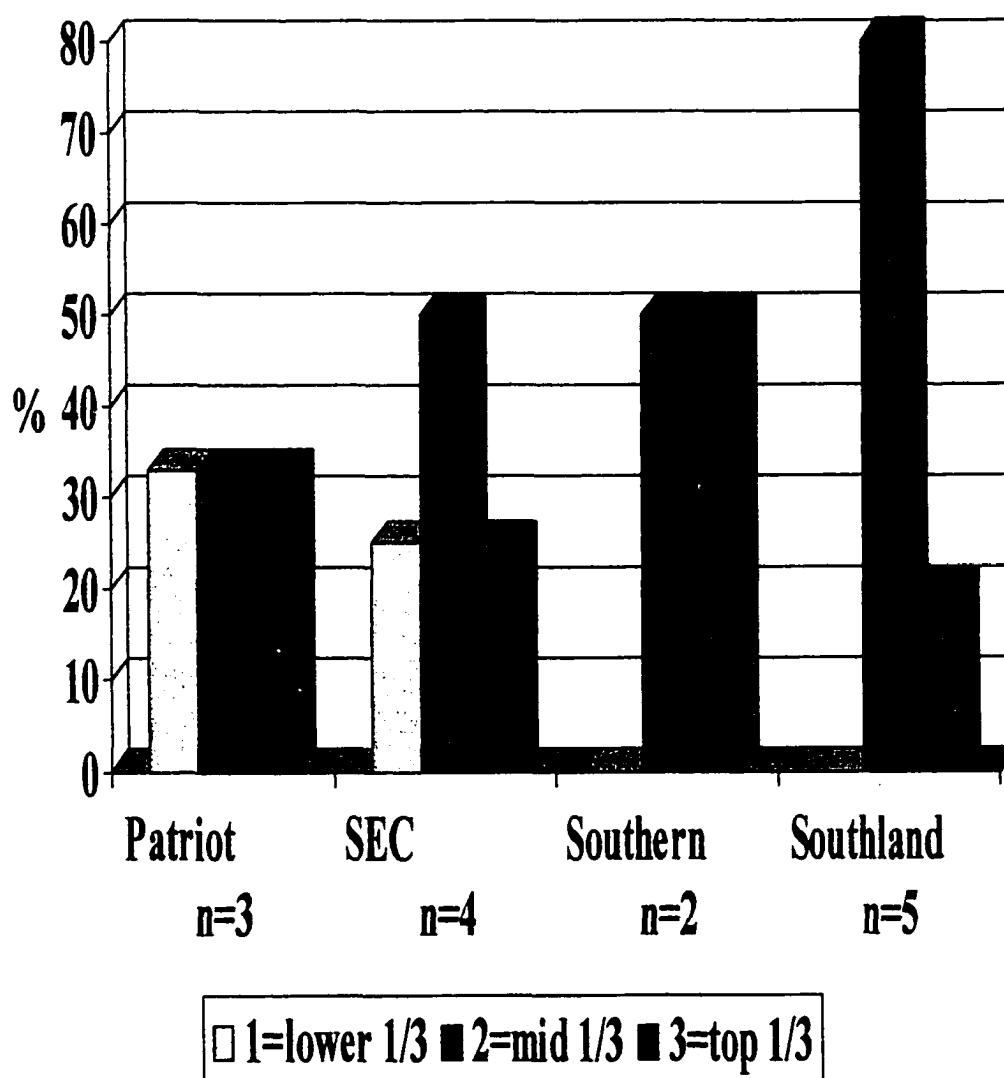
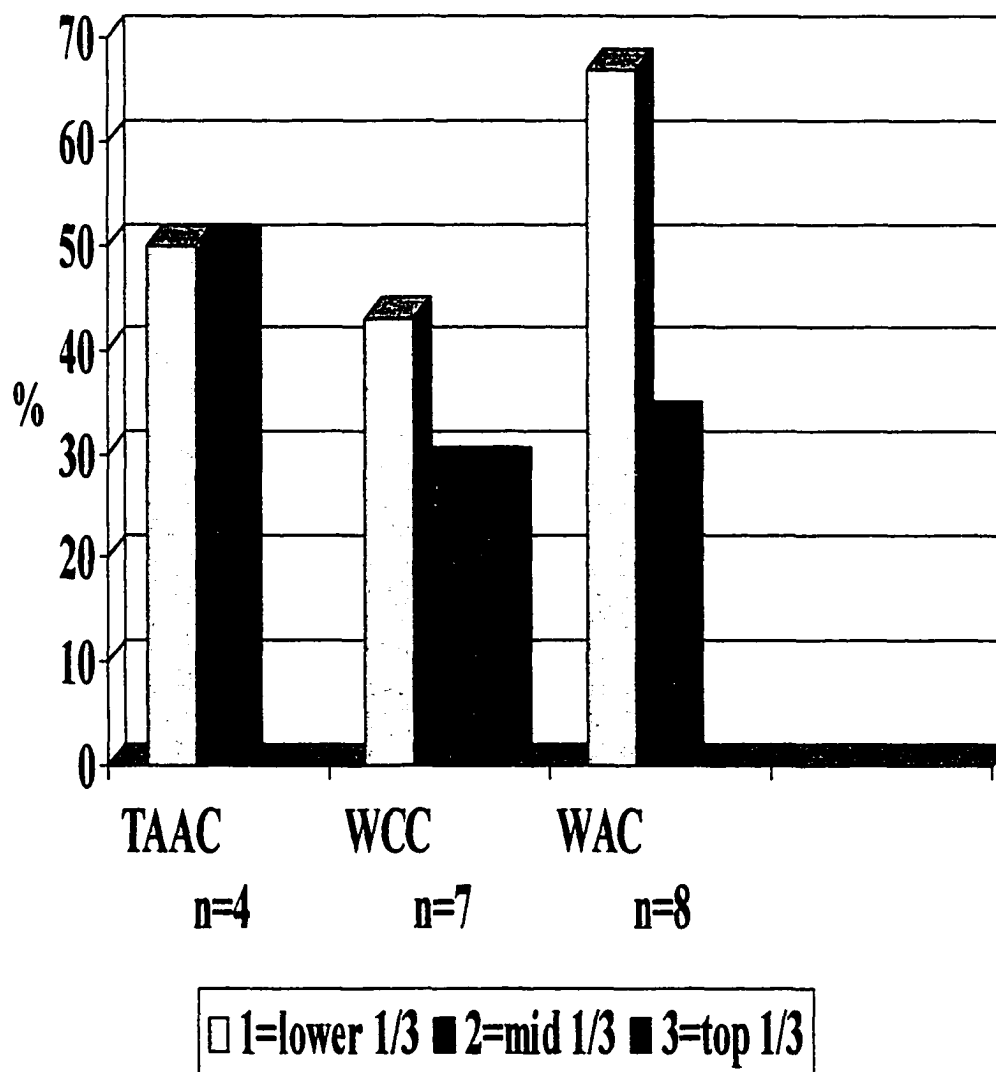


FIGURE 12 (Continued)**Five National Medical Associations*****Preparticipation Physical Evaluation History and Physical*****Forms Adequacy Per Conference**

history and physical forms and scored in the mid 33% category. The Big Ten (75%) and the MVC (60%) had more forms that were in the top 33% category. Conference forms scoring in the lower 33% category for adequacy were Big East (57%), Big South (60%) and the MEAC (67%) (see Figure 13).

COMPARISONS OF GROUPS AND ASSOCIATED FACTORS

Comparisons of the proportion of adequate forms between groups were performed using the chi-square or the one-way ANOVA. Chi-square was performed on comparisons between adequate forms and individual groups. The one-way ANOVA was used for the comparisons between adequate forms and school-based versus (vs.) community-based, and adequate forms and physician office-based versus station-based mass screening. Differences were considered significant for p values equal to or less than 5%.

There were no significant differences in the proportion of adequate forms between universities with services of team physicians, gynecologists, sports psychologists, massage therapists, nurse practitioners, physician assistants, nutritionists, nurses, physical therapists, chiropractors, and dentists vs. universities without these professional personnel. There were significant differences of adequacy of forms between universities that utilized dentists $X^2(2, n = 138) = 8.69, p < .01$ and ATCs $X^2(2, n = 138) = 8.993, p < .01$ to perform the preparticipation examination (PPE) vs. universities that did not utilize dentists and ATCs to perform the PPE.

The variety of the number of ATCs (1 to 12 or more) who provided medical follow-up for female athletes did not make a significant difference in the proportion of

FIGURE 13

***AHA Cardiovascular Preparticipation and
Five National Medical Associations
Preparticipation Physical Evaluation History and Physical
Forms Adequacy Per Conference***

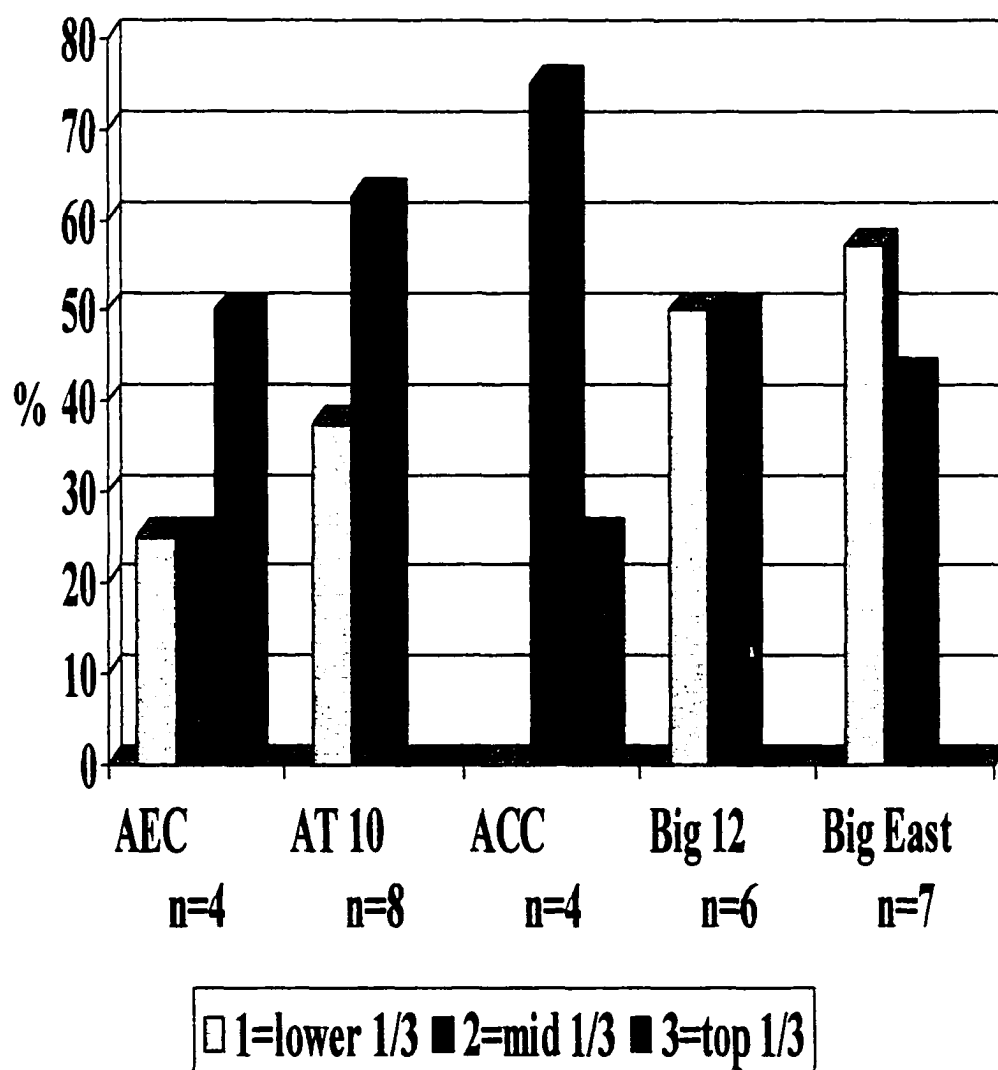


FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

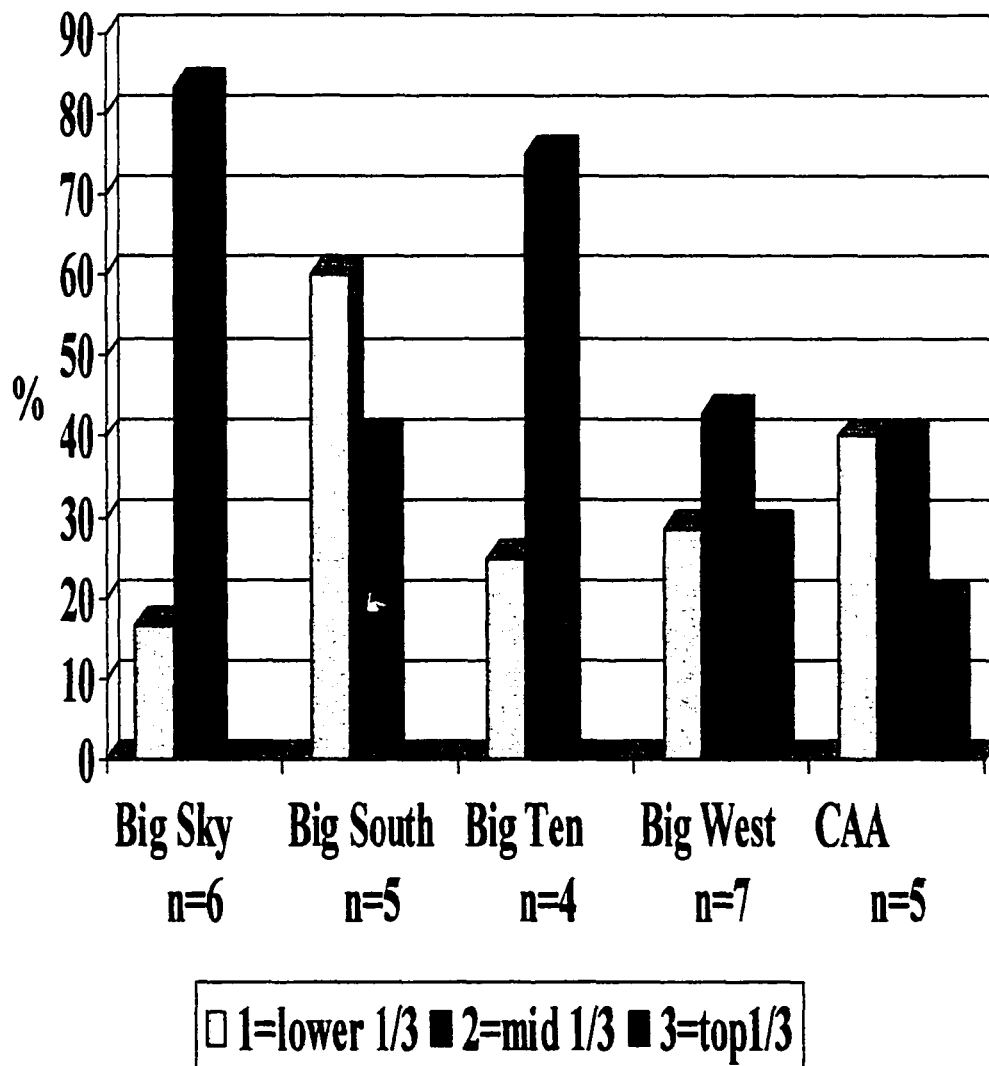


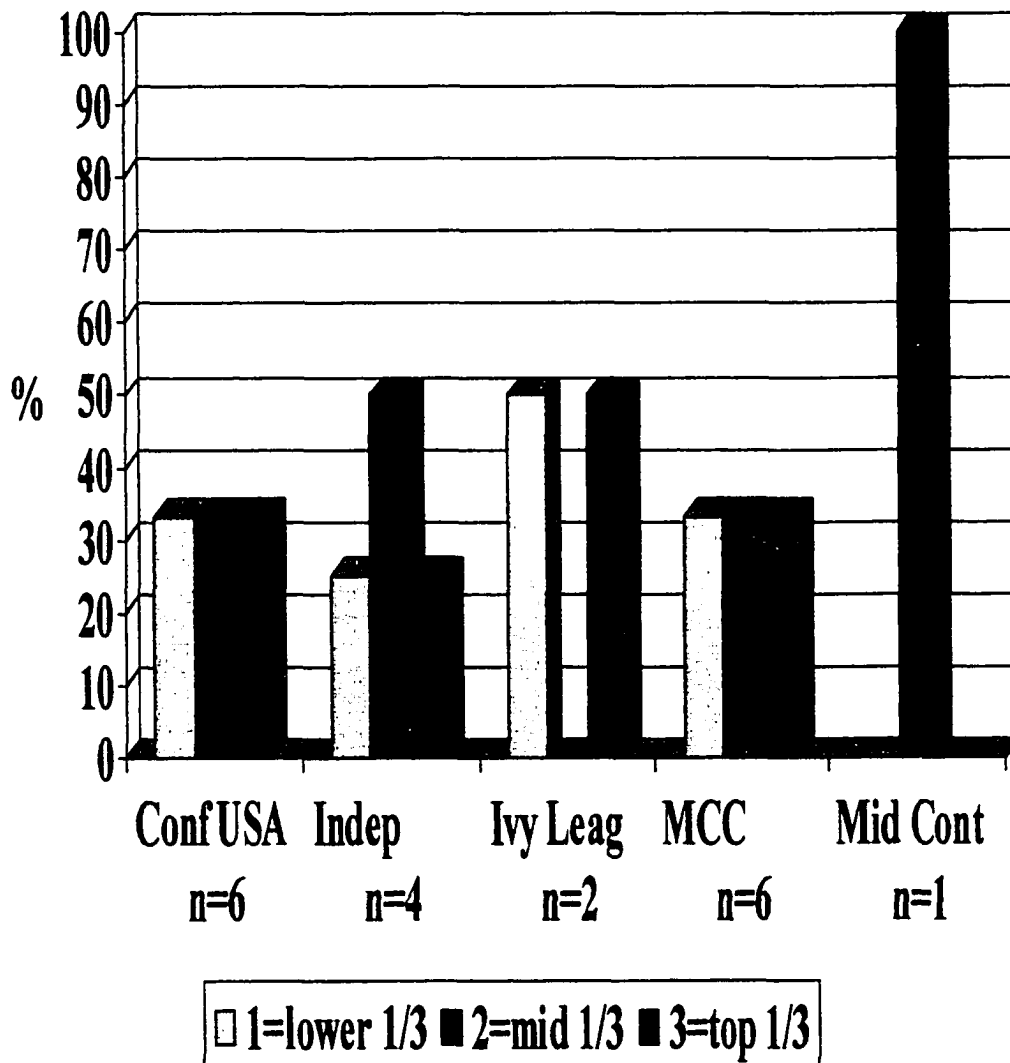
FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference



□ 1=lower 1/3 ■ 2=mid 1/3 ■ 3=top 1/3

FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

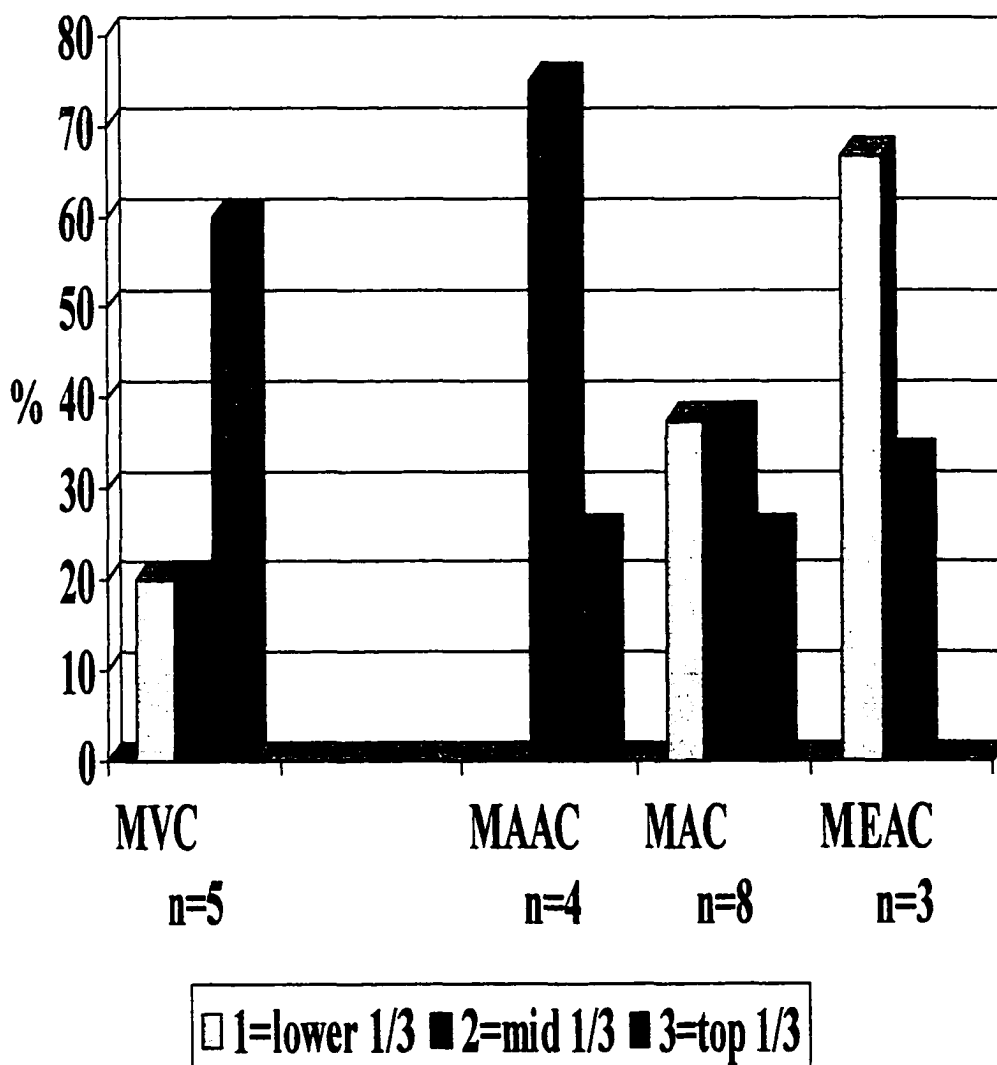


FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Organizations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

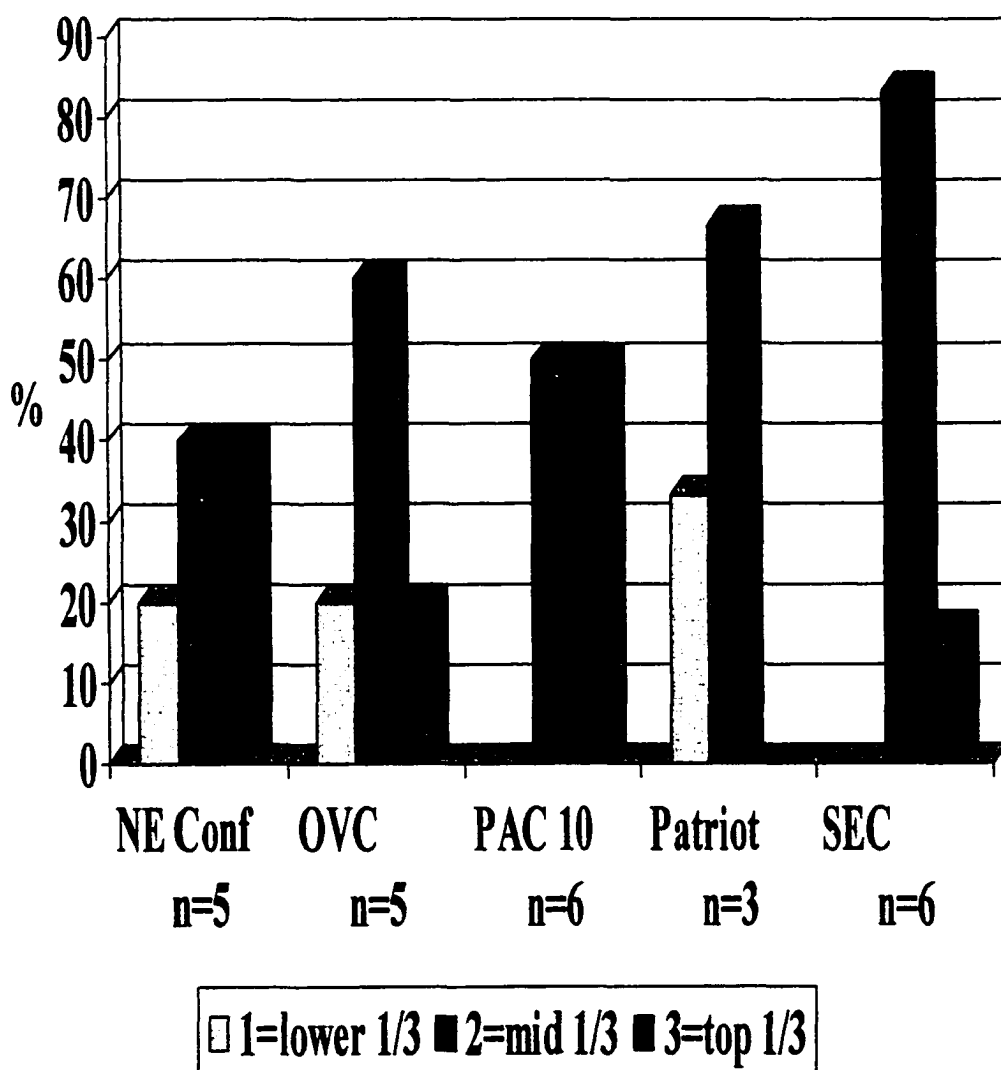


FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference

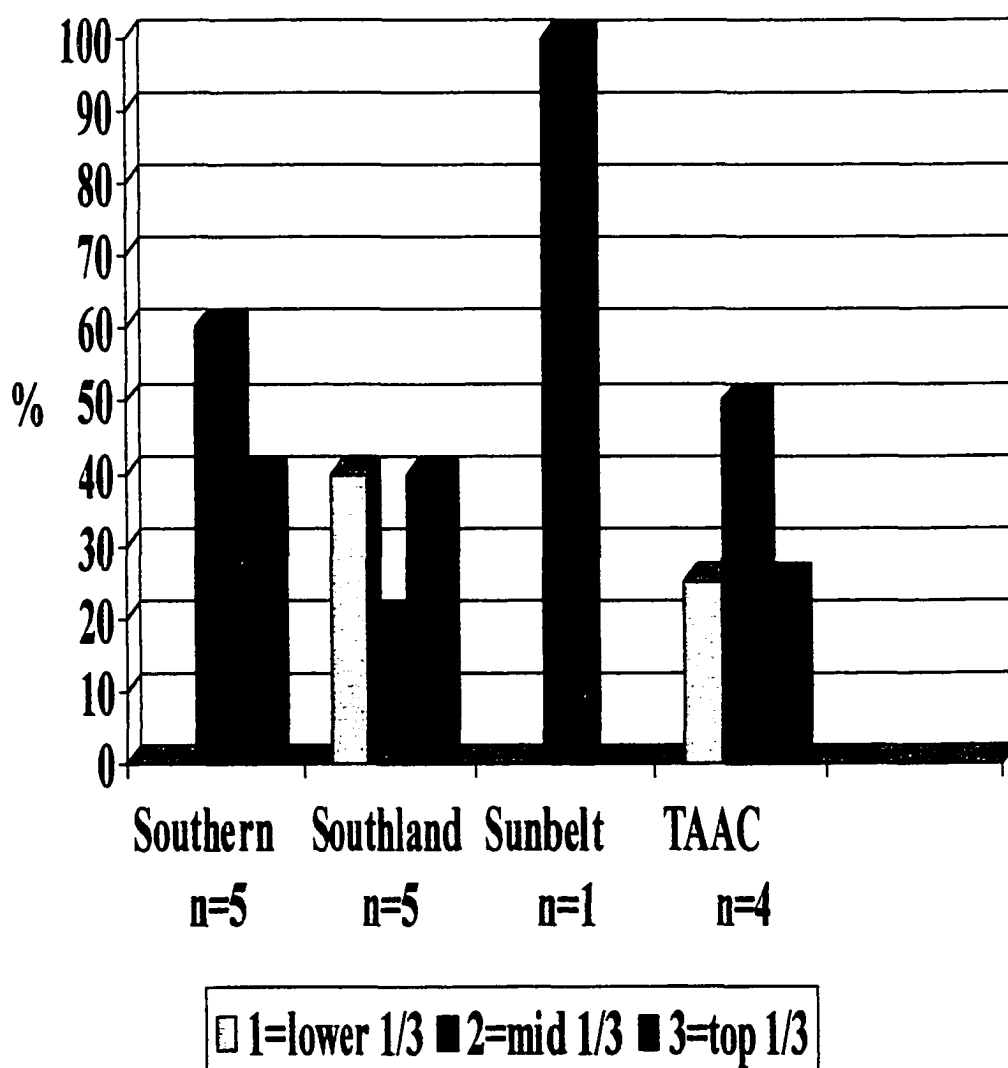


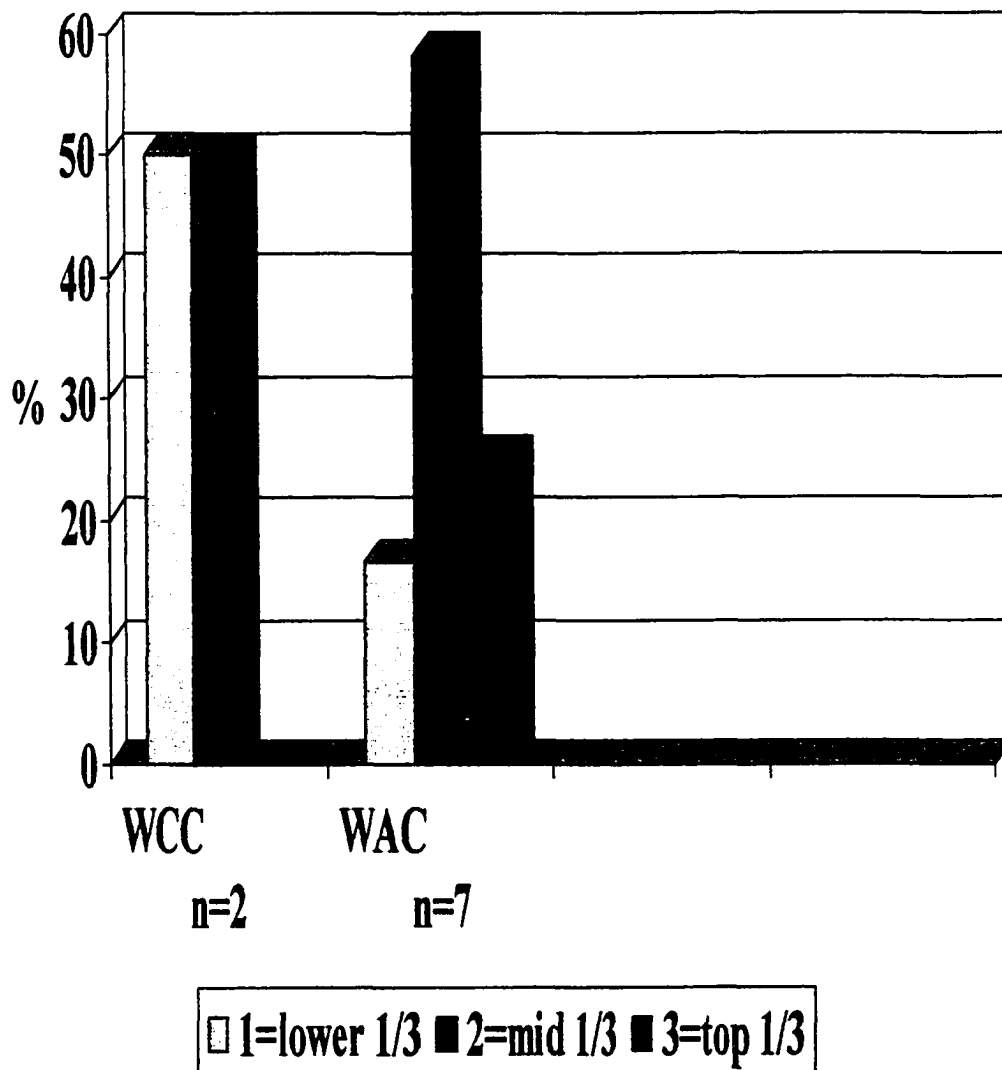
FIGURE 13 (Continued)

AHA Cardiovascular Preparticipation and

Five National Medical Associations

Preparticipation Physical Evaluation History and Physical

Forms Adequacy Per Conference



adequate PPE forms from the universities. The proportion of adequate PPE forms was not significantly different between universities that utilized physicians, dietitians, nurse practitioners, ophthalmologists, physician assistants, physical therapists, registered nurses, chiropractors or exercise physiologists to perform the PPE vs. universities that did not utilize these health care personnel to perform the PPE.

Significant differences were found in the proportion of adequate PPE forms from universities that had questions regarding the Female Athlete Triad, $X^2 (2, n = 138) = 9.07, p < .01$), vs. universities that did not have forms with these questions. There were no significant differences found in the proportion of adequate PPE forms from universities between other form items on the history questions or the physical assessment components.

There were no significant differences of adequacy of forms between universities that utilized physician office-based for the PPE vs. universities that utilized station-based mass screening for the PPE. Nor were there significant differences in the proportion of adequate PPE forms from universities that had school-based health screening/follow-up programs vs. community-based health screening programs.

There were no significant differences between adequacy of forms for universities that utilized as a resource *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1966) vs. universities that did not utilize that resource. Nor were there significant differences between adequacy of forms for universities that utilized as a resource *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) vs. universities that did not utilize that resource. There

were also no significant differences between adequacy of forms from universities that utilized AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1966) vs. universities that utilized as a resource *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997). Significant differences were not found between the proportion of adequate PPE forms from universities that utilized NCAA guidelines vs. universities that did not utilize that resource.

Significant differences were not found between the proportion of adequate PPE forms from universities that provided post-season evaluations vs. universities that did not provide post-season evaluations. There were no significant differences between the proportion of adequate forms from universities that provided flexibility, muscular strength, muscular endurance, cardiovascular, composition, and exercise challenge tests vs. universities that did not provide each type of testing.

DISCUSSION

This study assessed the screening practices for preparticipation examinations (PPE) and the PPE process at NCAA Division I universities that have female athletes. Two hundred nine (66%) universities participated in this study.

Since these universities offer sports for athletes that have been reported to be high risk for injuries (especially for females), such as basketball, cross-country, tennis, volleyball, track and field (outdoors and indoors), soccer, softball, and gymnastics, assessment of PPE screening practices are of paramount importance.

SOURCES OF THE PPE

The sports medicine committee and the governing body are often cited in the literature as the primary sources for determining the PPE requirements. This study found that the primary source was the sports medicine committee, but other sources such as team physicians, athletic trainers (ATCs), and the NCAA, which are not usually included in the literature, were also seen as sources for determining the PPE requirements.

Identifying primary sources is helpful when attempting to make changes in the PPE process. Information needs to be made readily available to these sources to affect decisions concerning the PPE and the PPE process. These sources should become focal points for the distributions of PPE materials such as new forms, new studies on risks or injuries, and new prevention or screening strategies.

The sources for the content of the forms are not the American Heart Association (AHA) cardiovascular screening recommendations published in *Cardiovascular*

Preparticipation Screening of Competitive Athletes (Maron, Thompson, et al., 1996), nor the monograph *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations. The AHA cardiovascular recommendations were reported as being utilized as sources for the content of the forms only by one-fifth of the universities. Even so, none of these universities utilized all of the AHA recommendations on their forms, although they were aware of the recommendations.

Only five universities used all the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations on their forms. Although many items from the *Preparticipation Physical Evaluation* (1997) recommendations were included on most forms, this does not necessarily mean the use is due to the influence of the published monograph. The fact that most of the recommended items are common items found on any non-athletic history and physical assessment screening form may account for the inclusion.

Common recommended items included in history questions concern allergies, recent and/or chronic injuries, surgery, prescriptions, and physical assessment items of height, weight, pulse, eyes, ears, nose, throat, heart, lungs, and abdomen that were utilized at a high frequency on the forms. Yet, items that are specific to preparticipation to sports were not utilized at a high frequency. Some examples of these items are questions on being denied participation in sports, feeling stressed out, and tiring more quickly.

Items concerning the individual musculoskeletal areas were low frequency responses in the preparticipation screening. The assessment forms included the knee, shoulder, back, and ankle approximately 70% of the time, the foot, elbow, hand, hip, and

wrist approximately 60% of the time, and the thigh, arm, leg, and forearm were included only approximately 30% of the time. These are important musculoskeletal assessments for the PPE for student-athletes, yet many universities are not assessing them.

Universities reported utilizing the NCAA guidelines as a source for the content of the PPE more than any other source. Therefore, the NCAA seems to be the logical place to distribute and identify standards for the PPE. The NCAA has not accepted this responsibility, and stressed its only function was to provide guidelines. Standardization, at least minimally, of items specific to participation in sports is recommended. Content of the PPE needs to reflect items of the AHA cardiovascular recommendations as requirements, and guidelines should be provided on items, such as utilization of the EKG and echocardiogram screening. Components of the *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommendations specific to participation in sports, such as the musculoskeletal examination with the individual screening components should be a required component of the PPE.

More specific musculoskeletal individual component parameters on the physical assessment form are warranted. Presently, the monograph form lists only parts of the body, i.e., shoulder, to guide the assessment of musculoskeletal individual components during the examination. Specific assessment parameters to help guide the practitioner are included in the discussion portion for the musculoskeletal individual components in the monograph, *Preparticipation Physical Evaluation*, i.e., shoulder symmetry, resisted shoulder shrug, resisted shoulder abduction, internal and external rotation of shoulder, and should be included on the form.

The NCAA should include as part of its screening requirements, question items concerning the Female Athletic Triad syndrome. The menstrual history questions designed by the American Academy of Family Physicians, et al. (1997) to screen for amenorrhea should be utilized, these include: first menstrual period, most recent menstrual period, time from start of one period to start of another, number of periods in the last year, and longest time between periods.

Other Triad screening questions that should be included are items concerning disordered eating behaviors. History questions designed by the American Academy of Family Physicians, et al. (1997) to screen for disordered eating behaviors should be utilized, such as questioning the athlete's desire to weigh more or less, and whether the athlete loses weight regularly to meet weight requirements. Other history items such as dietary habits, questioning highest weight and lowest weight in the last year, excessive exercise in addition to training, or questioning techniques to lose weight such as use of diet pills, herbs, diuretics, laxatives, or vomiting should be included. In addition to screening for disordered eating behaviors, the physical assessment portion should add screening items that potentially reflect the disorder, such as oral ulcerations, decreased tooth enamel, bradycardia, skin texture or hair growth skin changes, hypothermia, hypotension, and edema.

More questions should be added to screen for the Triad. These should include questions concerning the history of stress fractures, and family history of osteoporosis. With the participation rate of females increasing with more sports offered for them, questions pertinent to the Triad syndrome need to be expanded, improved, and required

by the NCAA. There is obviously a need for better screening since female athletes have higher stress fracture and knee injury rates than males in many sports, and the potential for irreversible bone loss and osteoporosis, and even death.

Further study of form content needs to focus only on items pertinent to the PPE, especially items that can potentially make a difference in outcomes of sport participation. Perhaps with this emphasis, the need for required, pertinent, standardized items would be even more evident.

PPE PROCESS

A critical aspect of the PPE screening process is who provides the health care. Practically all the universities in this study utilized a team physician to perform the PPE as a part of their health care program with a wide variety of professional health care providers involved in the PPE. None of professional health care providers performed the PPE alone, except the team physician. The specialty of the team physician, which could be a factor for PPE screening efficacy, was not addressed in this study. Pfister, Puffer, and Maron (2000) addressed this issue and found that most of the team physicians specialized in orthopedic surgery, while the others were most commonly in family practice, internal medicine, or pediatrics.

Universities that utilized ATCs and dentists as part of the PPE evaluation had statistically significant more items from the AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) and the five national organizations' monograph history and physical examination, *Preparticipation Physical Evaluation* (1997) recommendations on their forms. Since the forms reflect the actual screening

examination, this finding may reflect that universities that can afford more professionals have potentially more thorough examinations, especially those that utilized the services of ATCs and dentists.

In assessing the different settings, such as office-based vs. station-based mass screening or school based vs. community-based, for the PPE, there were no significant differences found in the forms utilized for any of the different settings. Most of the universities performed the PPE in a university health care facility utilizing station-based mass screening.

The settings for the PPE and style, physician office-based or station-based mass screening, of the PPE do not seem important aspects for the outcome of the PPE. The content of the form seems to be the major factor affecting the PPE process.

SCREENING PRACTICES

Most universities require PPE screening annually. The *Preparticipation Physical Evaluation* (American Academy of Family Physicians, et al., 1997) recommends PPE screening at least every two years with an interim history and limited physical examination annually. The survey did not question if the screening annually was the same or limited, which would be a question for future research. A small percentage (15%) of universities requires the PPE only on college entry. Pfister, Puffer, and Maron (2000) studying NCAA Division I – III universities found 51% required annual PPE screening, and 49% required a PPE only on college entry. The differences in these results may be due to the inclusion of NCAA Division II and III universities as part of the sample.

Future research should look at the impact that finances have on the quality of the PPE. Comparisons of screening practices including frequency and utilization of professional health care workers due to finances should be examined for each NCAA Division.

Other screening practices that were investigated were additional testing that may be utilized as part of the examination, but were not recommended by AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) or the *Preparticipation Physical Evaluation* (1997). Flexibility testing and muscular strength testing were performed as part of the PPE at approximately half of the universities. Many ATCs commented that the coaches performed flexibility testing and other muscular testing after the PPE was completed at a later date. The test least utilized during the PPE was the exercise challenge test, which is the most reliable method for diagnosing exercise induced asthma (EIA).

Cost is a factor in utilizing the exercise challenge test. Some history questions, such as coughing and difficulty breathing after exercise, screen for EIA. The NCAA needs to identify and require specific history questions that broadly screen for EIA and then provide guidelines for use of the exercise challenge test. The other tests assessed are cheaper to perform and are utilized more frequently, yet they are not presently required as part of the PPE. Future research on the benefits and timeliness of providing additional tests that further screen for readiness of participation need to be evaluated.

SCREENING RECOMMENDATIONS

Although 66% of the NCAA Division I universities responded to the questionnaire survey, only 70% of those who participated sent their PPE screening forms. This is a similar return rate to Pfister, Puffer, and Maron (2000) return rate of 71% of PPE screening forms in their study. One major difference in the findings of this study and Pfister, et al., were results of screening for heart murmurs. They reported 71% of the universities screened for heart murmurs. The results of this study found only 3% of the universities utilized the recommended method of screening for heart murmurs by precordial auscultation in standing and lying positions, and 19% utilized the broader item “heart murmurs” on their forms.

Future research on the frequency of screening for heart murmurs on PPE forms needs to be conducted, since this is an important aspect of the heart exam for screening for cardiovascular sudden death. Perhaps, Pfister, et al., included for scoring a positive response, precordial auscultation in standing and lying positions, heart murmurs, and “heart exam”, which would explain the high percentage. In this study, if heart exam on the form were included as a positive response for screening for heart murmurs, then 90% of the universities would have screened for heart murmurs.

ADEQUACY OF FORMS

The term “adequacy” when describing forms is a term used by Gomez, et al., (1999) and Pfister, Puffer, and Maron (2000) in their studies comparing items on forms to percent of items that matched AHA *Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) recommendations. This study continued with the use of the

“adequacy” term, but more descriptive terminology would be compliance to or inclusion of items that matched the *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) which were grouped by percentages of actual item use.

The importance of defining adequacy of the forms is to have measurable outcomes from the utilization of the forms. Some desired outcomes would be fewer athletic injuries, fewer sudden deaths associated with athletic participation, normal menses for female athletes, lower percentage of eating disorders, and/or lower morbidity. More research is definitely needed in this area.

Conference forms that scored in the top 33% category for matched *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) and the *Preparticipation Physical Evaluation* (1997) items reflect steps taken by the universities to meet the only guidelines that have been published by major medical organizations. One outcome of scores in the top category is that the forms contain more recommended items, which might lead to more thorough screening. Universities that included questions on the Triad syndrome had significantly more history questions and physical assessment components that matched *AHA Cardiovascular Preparticipation Screening of Competitive Athletes* (1996) and the *Preparticipation Physical Evaluation* (1997) . Therefore, those universities that included items on the Triad had more thorough examinations, since the form guides the examination. Perhaps this result reflects a conscientious attitude of the universities to include items of the Female Athletic Triad, which is reflected in inclusion of other items as well.

LIMITATIONS

One limitation of this study is the lack of specific items concerning the Female Athlete Triad. More potential form items should have been identified and utilized to determine if and what areas are being screened on forms reflecting the issues of the Triad. The only items studied were menstrual and weight change. Other factors that could have been included are disordered eating patterns, cardiac arrhythmias, bradycardia, depression, stress fractures, body composition, psychological factors, and other physical warning signs. More research is needed in areas related to the Triad.

Another limitation is the lack of comparison of the components found in the university forms for the PPE to non-athletic physical examination components. The study would have been more comprehensive and items that are specific to the PPE could have been more clearly identified. Future research needs to address this comparison.

FUTURE DIRECTIONS

When the five national medical organizations update their monograph, their recommendations should be screened for pertinence to actual sports participation versus general health screening. The NCAA should identify specific items for the forms, and require all NCAA members to include these items on their forms with a sample form to facilitate usage. These should include screening items from the AHA recommendations as well. This study, as well as the numerous previous studies, provide strong support for identification and development of national PPE standards of care that are specific to screening for participation in sports for both males and females. The NCAA should disseminate these standards of care, since it is already seen as the major source of the

content and process of the PPE. Research needs to continue to assess the quality of the screening parameters for the preparticipation physical examination for athletes and begin to utilize outcome measurements to determine the effectiveness.

APPENDIX A

Hello,

My name is Sharon Whiteside and I am in the process of gathering data for my dissertation. I have worked as a Nurse Practitioner since 1978 and am presently working on my doctorate in Physical Education at Middle Tennessee State University. Dr. Malissa Martin, Director of Athletic Trainer Education, is on my doctoral committee and suggested I solicit your participation.

My dissertation topic is "Preparticipation Physical Examination Practices for NCAA Division I Female Athletes". Please send a copy of the preparticipation physical examination forms that are presently in use for your athletes. This might include your medical history forms, physical examination forms, laboratory tests forms, referral form(s), and any other request forms that the university utilizes for screening purposes. In addition, please complete the enclosed questionnaire.

The form(s) will be compared to other NCAA Division I university forms. Schools will be coded to ensure anonymity and confidentiality. Data will be organized or grouped by athletic conferences.

Enclosed is a self-addressed, pre-paid postage envelope to facilitate returning the requested information. You may also fax or e-mail the information to me. My fax number is 1-615-890-5007 and my e-mail address is sharon.whiteside@prodigy.net. I thank you for your time and cooperation. Please return this information by May 1, 2000.

Please indicate if you would like a copy of the results.

Sincerely,

Sharon Whiteside

APPENDIX B

Preparticipation Physical Examination (PPE) Questionnaire

1. How many female student-athletes participate in your athletic program?

1 to 25 _____ 26 to 50 _____ 51 to 75 _____ 76 to 100 _____

101 to 150 _____ 151 to 200 _____ 201 to 300 _____ More than 300 _____

2. How many ATCs/Licensed Athletic Trainers are responsible for any necessary medical follow-up for female athletes?

1 to 3 _____ 4 to 6 _____ 7 to 9 _____ 10 to 12 _____ more _____

3. Who determines the components of the PPE requirements? (Check All That Apply)

Governing Body _____ Conference Officials _____ Medical Association _____

State Health Department _____ State Legislation _____ State Education Dept. _____

Sports Medicine Committee _____ Other _____

4. Does your program use any of the following resources for the PPE?

Cardiovascular Preparticipation Screening of Competitive Athletes (Amer. Heart Assoc., 1996) _____

Preparticipation Physical Evaluation (Amer. Academy of Family Physicians et al., 1997) _____

NCAA Guidelines _____

APPENDIX B (CONTINUED)

5. What personnel does your program(s) utilize for health care: (Please check all that apply)

Personnel	Yes	University –Employee Based	Outside Consultant
Team Physician			
Massage Therapist			
Nurse			
Gynecologist			
Nurse Practitioner			
Physician Assistant			
Nutritionist			
Sports Psychologist			
Physical Therapist			
Chiropractor			
Dentist			

6. Who performs the PPE examination? (Please check all that apply)

Physician _____ Nurse Practitioner _____ Physician Assistant _____

Chiropractor _____ Dietitian _____ Athletic Trainer _____

Physical Therapist _____ Exercise Physiologist _____

Dentist _____ Ophthalmologist _____ Registered Nurse _____

APPENDIX B (CONTINUED)

7. After the initial PPE, how often is screening repeated?

Annually _____ Every other year _____ Every two years _____ Not repeated _____

8. At the end of the season, do you provide a post-season evaluation? Yes ___ No ___

9. Does the PPE include:

TEST	YES	NO
Flexibility		
Muscular strength		
Muscular endurance		
Cardiovascular		
Body composition		
Exercise challenge test		

10. Is the PPE

Physician Office-Based (Physician providing most of the exam except vital signs) _____

Station-Based Mass Screening (More than one professional providing parts of exam) ___

11. Is your health screening/follow-up program:

School-based _____

Community-based _____

APPENDIX B (CONTINUED)

12. What sports do female student-athletes participate in your athletic program? (Please check all that apply)

- | | | |
|---|--|--|
| <input type="checkbox"/> Basketball | <input type="checkbox"/> Cross Country | <input type="checkbox"/> Fencing |
| <input type="checkbox"/> Field Hockey | <input type="checkbox"/> Golf | <input type="checkbox"/> Gymnastics |
| <input type="checkbox"/> Lacrosse | <input type="checkbox"/> Soccer | <input type="checkbox"/> Softball |
| <input type="checkbox"/> Swimming & Diving | <input type="checkbox"/> Tennis | <input type="checkbox"/> Track & Field
(outdoors) |
| <input type="checkbox"/> Track & Field (indoor) | <input type="checkbox"/> Volleyball | <input type="checkbox"/> Baseball |
| <input type="checkbox"/> Wrestling | <input type="checkbox"/> Cheerleading | <input type="checkbox"/> Riding |
| Other Sport(s) _____ | | |

13. Yes, please send me the results.

No, I'll read your results in the literature if published.

APPENDIX C

Summary of the American Heart Association History Recommendations

Cardiovascular Preparticipation Screening of Competitive Athletes

Cardiovascular history should include:

1. Prior occurrence of exertional chest pain/discomfort
2. Syncope/near syncope
3. Excessive, unexpected, and unexplained shortness of breath (exertional dyspnea)
4. Fatigue associated with exercise (excessive fatigability)
5. Past detection of a heart murmur
6. Past detection of systemic blood pressure (systemic hypertension)
7. Family history of premature death (sudden or otherwise)
8. Family history of significant disability from cardiovascular disease in close relative(s) younger than 50 years old or specific knowledge of the occurrence of certain conditions (e.g. Hypertrophic cardiomyopathy, dilated cardiomyopathy, long QT syndrome, Marfan syndrome, or clinically important arrhythmia's).
9. Parental verification of the history

APPENDIX D

Summary of the American Heart Association Physical Recommendations
Cardiovascular Preparticipation Screening of Competitive Athletes

Cardiovascular physical examination should include:

1. Precordial auscultation in both the supine and standing positions to identify heart murmurs.
2. Assessment of the femoral artery pulses
3. Recognition of the Marfan syndrome (Marfan stigma)
(Abnormal length of extremities, especially of the fingers and toes, with subluxation of the lens, congenital anomalies of the heart and other musculoskeletal deformities)
4. Brachial blood pressure measurement in the sitting position (120/80 to 100/60 is normal for this age group)

APPENDIX E

Descriptive Summary of the Physical Examination Screening Recommendations from
The Preparticipation Physical Evaluation

History:

- Identifies approximately 75% of problems affecting athletes
- Emphasizes greatest concern for participation and general health
- Parental input is important

Questions regarding...

- #1. Recent and/or chronic injury or illness

New placement of this question at beginning of history to stimulate memory
and to serve as a “red flag” to the physician

- #2. Hospitalization and surgery – to detect any illness or injury that might affect participation and to determine if any chronic problems are not well controlled
- #3. Medication use – Prescription and non-prescription medications

Important questions regarding supplements and vitamins for performance enhancement are included to help the physician establish a pattern for possible use of ergogenic aids

- #4. Allergic and anaphylactic reactions to medications, insects and exercise
- #5. Cardiac function – designed to investigate any symptoms of structural cardiac problems

APPENDIX E (CONTINUED)**Descriptive Summary of the Physical Examination Screening Recommendations from***The Preparticipation Physical Evaluation***History (Continued)**

- #6. Skin – Now includes warts, fungus and blisters
- #7. Neurological disorders – including recurrent headaches, burners, concussions, and seizures, numbness or tingling in extremities
- #8. Heat illness
- #9. Asthma and seasonal allergies
- #10. Protective devices –present use of special equipment and to help identify problems in the past
- #11. Eyes and vision – to assist physician in finding the “functionally one-eyed” athlete
- #12. Musculoskeletal system –Sprains, strains, fractures, and dislocations – including inquiry regarding operative and non-operative treatment as well as rehabilitation
- #13. Weight and eating disorders –or possible anabolic steroid usage. This was not previously addressed in the first monograph.
- #14. Stress/Psychosocial concerns – this is a place in the history to discuss psychosocial issues
- #15. Immunizations –including tetanus, measles, hepatitis B, and varicella are checked to insure up-to-date status

APPENDIX E (CONTINUED)

Descriptive Summary of the Physical Examination Screening Recommendations from

The Preparticipation Physical Evaluation

Physical (Continued)

- #16. Menstrual history –to identify amenorrhea and associated problems including eating disorders, inadequate bone mineralization, and stress fractures. Physician should also inquire about pap testing. New question to monograph

Height and Weight

- Extremely thin athletes warrant questioning about recent weight loss, eating habits, and body image.

Visual acuity and equality of pupils

Eyes, Ears, Nose, and Throat examination

- Mouth/Throat –oral ulcers, gingival atrophy, and decreased enamel seen with disordered eating behaviors, especially bulimia;
- leukoplakia seen with smokeless tobacco use;
- high arched palate with other characteristics of Marfan syndrome;
- corrective braces on the teeth may need protective mouth guard

Ears

- scarring of tympanic membrane or auditory canals may need hearing screen;
- perforated tympanic membranes in athletes competing in water sport would need protective earplugs;
- adenopathy may suggest infection or malignancy

APPENDIX E (CONTINUED)

Descriptive Summary of the Physical Examination Screening Recommendations from

The Preparticipation Physical Evaluation

Physical (Continued)

Nose

- nasal polyps or deviated septum can be referred for correction

Cardiovascular System

Blood pressure –if elevated recheck after 15 minutes

Pulses (radial, femoral) –palpate right radial and femoral pulses simultaneously for coarctation of the aorta screen

Heart (rate, rhythm, murmurs with athlete in supine and standing positions)

Lungs (pulmonary examination)

Abdomen

Masses (further evaluation)

Tenderness (further evaluation)

Organomegaly (enlargement of liver, kidney or spleen requires further evaluation)

Genitalia (males only)

Single or undescended testicle (counseling)

Testicular mass (further evaluation)

Hernia (further evaluation)

APPENDIX E (CONTINUED)

Descriptive Summary of the Physical Examination Screening Recommendations from
The Preparticipation Physical Evaluation

Physical (Continued)

Skin

Rashes (further evaluation)

Lesions (further evaluation)

Musculoskeletal System –general musculoskeletal screening exam follows 14 steps to
assess range of motion, strength, and symmetry

Contour (inspection of symmetry of trunk, upper extremities front and
back)

Range of motion (plus gross muscle strength and symmetry)

Stability

Musculoskeletal System Continued:

Symmetry of neck (Forward flexion, extension, rotation, lateral flexion of
neck, and range of motion of cervical spine)

Back extension –with knees straight to detect spondylolysis
and spondylolisthesis

Back flexion –with knees straight, facing toward and away for range
of motion, thoracic and lumbosacral spine to check spine curvature
and hamstring flexibility

APPENDIX E (CONTINUED)

Descriptive Summary of the Physical Examination Screening Recommendations from

The Preparticipation Physical Evaluation

Physical (Continued)

Shoulder/arm –resisted shoulder shrug for strength of trapezius and resisted shoulder abduction for strength of deltoid plus internal and external rotation of shoulder to check range of motion of glenohumeral joint

Elbow/forearm –extension and flexion of elbow to check range of motion of elbow

Wrist/hand –pronation and supination of elbow to check range of motion of elbow and wrist and clench fist, spread fingers to check range of motion of hand and fingers

Hip/thigh –inspection of lower extremities, contraction of quadriceps muscles to check for alignment and symmetry

Knee –duck walk four steps to check motion of hip, knee, and ankle; strength and balance

Leg/ankle –standing on toes, then on heels to check for symmetry of calf and strength and balance

Foot –check for cavus or rigid flatfoot deformities and toe deformities

APPENDIX F

PREPARTICIPATION PHYSICAL EVALUATION HISTORY FORM

Name _____ Sex _____ Age _____ Date of birth _____
 Grade _____ School _____ Sport(s) _____
 Address _____ Phone _____
 Personal physician _____
In case of emergency, contact
 Name _____ Relationship _____ Phone (H) _____ (W) _____

Explain "Yes" answers below.
 Circle questions you don't know the answers to.

	Yes	No		Yes	No
1. Have you had a medical illness or injury since your last check up or sports physical? Do you have an ongoing or chronic illness?	<input type="checkbox"/>	<input type="checkbox"/>			
2. Have you ever been hospitalized overnight? Have you ever had surgery?	<input type="checkbox"/>	<input type="checkbox"/>			
3. Are you currently taking any prescription or nonprescription (over-the-counter) medications or pills or using an inhaler? Have you ever taken any supplements or vitamins to help you gain or lose weight or improve your performance?	<input type="checkbox"/>	<input type="checkbox"/>			
4. Do you have any allergies (for example, to pollen, medicine, food, or stinging insects)? Have you ever had a rash or hives develop during or after exercise?	<input type="checkbox"/>	<input type="checkbox"/>			
5. Have you ever passed out during or after exercise? Have you ever been dizzy during or after exercise? Have you ever had chest pain during or after exercise? Do you get tired more quickly than your friends do during exercise? Have you ever had racing of your heart or skipped heartbeats? Have you had high blood pressure or high cholesterol? Have you ever been told you have a heart murmur? Has any family member or relative died of heart problems or of sudden death before age 50? Have you had a severe viral infection (for example, myocarditis or mononucleosis) within the last month? Has a physician ever denied or restricted your participation in sports for any heart problems?	<input type="checkbox"/>	<input type="checkbox"/>			
6. Do you have any current skin problems (for example, itching, rashes, acne, warts, fungus, or blisters)?	<input type="checkbox"/>	<input type="checkbox"/>			
7. Have you ever had a head injury or concussion? Have you ever been knocked out, become unconscious, or lost your memory? Have you ever had a seizure? Do you have frequent or severe headaches? Have you ever had numbness or tingling in your arms, hands, legs, or feet? Have you ever had a stinger, burner, or pinched nerve?	<input type="checkbox"/>	<input type="checkbox"/>			
8. Have you ever become ill from exercising in the heat?	<input type="checkbox"/>	<input type="checkbox"/>			
9. Do you cough, wheeze, or have trouble breathing during or after activity? Do you have asthma? Do you have seasonal allergies that require medical treatment?	<input type="checkbox"/>	<input type="checkbox"/>			
			10. Do you use any special protective or corrective equipment or devices that aren't usually used for your sport or position (for example, knee brace, special neck roll, foot orthotics, retainer on your teeth, hearing aid)?	<input type="checkbox"/>	<input type="checkbox"/>
			11. Have you had any problems with your eyes or vision? Do you wear glasses, contacts, or protective eyewear?	<input type="checkbox"/>	<input type="checkbox"/>
			12. Have you ever had a sprain, strain, or swelling after injury? Have you broken or fractured any bones or dislocated any joints? Have you had any other problems with pain or swelling in muscles, tendons, bones, or joints? If yes, check appropriate box and explain below	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/> Head <input type="checkbox"/> Elbow <input type="checkbox"/> Hip		
			<input type="checkbox"/> Neck <input type="checkbox"/> Forearm <input type="checkbox"/> Thigh		
			<input type="checkbox"/> Back <input type="checkbox"/> Wrist <input type="checkbox"/> Knee		
			<input type="checkbox"/> Chest <input type="checkbox"/> Hand <input type="checkbox"/> Shin/calf		
			<input type="checkbox"/> Shoulder <input type="checkbox"/> Finger <input type="checkbox"/> Ankle		
			<input type="checkbox"/> Upper arm <input type="checkbox"/> Foot		
			13. Do you want to weigh more or less than you do now? Do you lose weight regularly to meet weight requirements for your sport?	<input type="checkbox"/>	<input type="checkbox"/>
			14. Do you feel stressed out?	<input type="checkbox"/>	<input type="checkbox"/>
			15. Record the dates of your most recent immunizations (shots) for:		
			Tetanus _____ Measles _____		
			Hepatitis B _____ Chickenpox _____		
			FEMALES ONLY		
			16. When was your first menstrual period? _____ When was your most recent menstrual period? _____ How much time do you usually have from the start of one period to the start of another? _____ How many periods have you had in the last year? _____ What was the longest time between periods in the last year? _____		
			Explain "Yes" answers here: _____ _____ _____ _____ _____ _____ _____		

I hereby state that, to the best of my knowledge, my answers to the above questions are complete and correct.
 Signature of athlete _____ Signature of parent/guardian _____ Date _____

APPENDIX G

PREPARTICIPATION PHYSICAL EVALUATION PHYSICAL FORM

PHYSICAL EXAMINATION

Name _____ Date of birth _____
 Height _____ Weight _____ % Body fat (optional) _____ Pulse _____ BP _____/_____/_____
 Vision R 20/ _____ L 20/ _____ Corrected: Y N Pupils: Equal _____ Unequal _____

	NORMAL	ABNORMAL FINDINGS	INITIALS*
MEDICAL			
Appearance			
Eyes/Ears/Nose/Throat			
Lymph Nodes			
Heart			
Pulses			
Lungs			
Abdomen			
Genitalia (males only)			
Skin			
MUSCULOSKELETAL			
Neck			
Back			
Shoulder/arm			
Elbow/forearm			
Wrist/hand			
Hip/thigh			
Knee			
Leg/ankle			
Foot			

*Station-based examination only

CLEARANCE

Cleared

Cleared after completing evaluation/rehabilitation for: _____

Not cleared for: _____ Reason: _____

Recommendations: _____

Name of physician (print/type) _____ Date _____

Address _____ Phone _____

Signature of physician _____, MD or DO

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GLOSSARY

Adequacy of forms – determined by using percentages and dividing the percent of actual matching responses into three groups: 1 = lower 1/3 (33%), 2 = mid 1/3 (33%), and 3 = top 1/3 (33%).

Adipose tissue – body fat.

AEC – America East Conference

Amenorrhea – the cessation of the menstrual cycle with ovulation occurring infrequently or not at all.

Anorexia nervosa – characterized by severe caloric restriction (self-induced starvation) refusal to maintain minimal normal weight of at least 85% of that expected for age and height, intense fear of fatness or gaining weight (even when underweight), distorted perception of body image, amenorrhea, and lack of medical illness to cause any of the prior characteristics.

ANOVA – analysis of variance (univariate)

ACC – Atlantic Coast Conference

AT 10 – Atlantic 10 Conference

Bradycardia – abnormal slowing of the heart rate and pulse, usually less than 60 beats per minute.

Bulimia nervosa – characterized by recurrent bingeing (over eating) followed by purging (vomiting, laxative or diuretic use, and/or excessive exercising while fasting) at least two times a week for a minimum of three months.

CAA – Colonial Athletic Association

Demineralization – reduced bone mineralization.

Dilated Cardiomyopathy – a syndrome characterized heart enlargement which eventually leads to congestive heart failure.

Disordered eating behaviors – include anorexia nervosa, bulimia nervosa, binge eating disorder, restrained eating and insufficient caloric intake.

Echocardiography – recording of the position and motion of the heart borders and valves by reflected echoes of ultrasonic waves transmitted through the chest wall.

Electrocardiography – graphic recording from the body surface of variation in electric potential produced by the heart. The pattern of heart electrical activity that is traced on the paper indicates the heart's rhythm.

Energy availability – consuming calories equal to high-energy expenditure.

Eumenorrheic – female with normal menses.

Exercise Induced Asthma – characterized by diffuse airway obstruction following vigorous exercise. Symptoms include difficulty breathing, coughing, chest tightness, and wheezing.

Female Athlete Triad – three distinct interrelated components, which include disordered eating, amenorrhea, and osteoporosis.

Hypertrophic cardiomyopathy – disproportionate thickening of the heart muscle which leads to rigidity of the heart wall.

Hypoestrogenism – abnormally decreased plasma estrogen.

Intercondylar notch – deep depression between the knee's condyles (rounded end part of the bone) on the anterior surface between the femur and tibia bones.

Joint laxity – looseness in a joint

Kyphosis - abnormally increased convexity in the curvature of the thoracic spine.

Long QT Syndrome – hereditary abnormal ventricular repolarization.

Ventricular (heart) muscle depolarization is represented by the QRS complex.

The T wave represents ventricular muscle repolarization. An approximation of the refractory period of the ventricles is obtained by measuring the Q-T interval.

Marfan syndrome – abnormal length of the extremities, especially of the fingers and toes, with incomplete or partial dislocation of the lens, congenital anomalies of the heart and other deformities.

Menarche – establishment or beginning of the menstrual function.

MAAC – Metro Atlantic Athletic Conference

MAC – Middle Atlantic Conference

MCC – Midwestern Collegiate Conference

MEAC – Mid-Eastern Athletic Conference

MVC – Missouri Valley Conference

Myocarditis – dysfunction of the myocardium usually the result of an infectious processes such as viruses or rheumatic fever.

n – number in a subsample

NEC – Northeast Conference

Osteoporosis - a disease characterized by low bone mass and microarchitectural deterioration of bone tissue, leading to enhanced bone fragility.

OVC – Ohio Valley Conference

P - probability

Parental Verification – parents sign history form to verify accuracy.

Purging – vomiting, laxative or diuretic use, and/or excessive exercising while fasting.

Scoliosis – lateral curvature of the spine.

SEC – Southeastern Conference

Stress fractures - partial or complete fracture of bone.

Sudden death - death within 24 hours of the onset of symptoms.

Syncope – fainting, sudden loss of strength.

TAAC – Trans American Athletic Conference

WCC – West Coast Conference

WAC – Western Athletic Conference

X^2 – computed value of a chi-square test