

# FEMALE ATHLETE TRIAD RECOGNITION AND KNOWLEDGE OF COLLEGIATE CROSS-COUNTRY COACHES

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**BACKGROUND:** To examine Female Athlete Triad (Triad) recognition and knowledge of collegiate cross-country coaches, as well as team access to Triad-related resources.

**METHODS:** After identifying collegiate women's cross-country coaches from publicly available records, an internally validated, 44-item survey was emailed to assess Triad recognition and knowledge in order to perform a cross-sectional study. Respondents were grouped by National Collegiate Athletic Association (NCAA) division and geographically based on the location of conference headquarters. Survey responses were analyzed and reported using descriptive statistics where appropriate. Statistical comparisons and contrasts were made using chi-square and Fisher's exact tests. A significance level of  $p < .05$  was used.

**RESULTS:** A total of 143 NCAA cross-country coaches participated in the survey. Notably, 29% of coaches did not recognize the Triad and close to 40% of responding coaches could not identify any of the three Triad components. A greater number of Division I coaches demonstrated Triad recognition (85.4%) and component knowledge (68.3%) compared to Division II and Division III coaches. Geographic region was associated with respondent Triad recognition ( $p = .011$ ), but not identification of Triad components ( $X^2 = 7.015$ ,  $p = .135$ ). Access to Triad-related resources was low. Only 51% and 29% of responding teams had access to a registered dietitian or sports psychologist, respectively.

**CONCLUSION:** This study suggests that further Triad education amongst NCAA cross-country coaches is warranted. Future research is needed to illuminate specific strategies to improve Triad knowledge of collegiate cross-country coaches.

## INTRODUCTION

The Female Athlete Triad (Triad) is recognized as the occurrence of three interrelated spectrums – energy availability, menstrual function, and bone mineral density (BMD).<sup>1–3</sup> The common etiology of the Triad components is low energy availability (LEA), which leads to alterations in hormonal equilibrium, which causes secondary menstrual dysfunction and reduced bone density. Women in endurance sports, such as long-distance running, swimming, rowing, and those requiring aesthetic

focus (gymnastics, figure skating, cheerleading, etc.), are at increased Triad risk.<sup>4,5</sup> All three Triad clinical manifestations have potential short- and long-term negative ramifications on health and sports performance.<sup>6</sup> These include skeletal,<sup>7–11</sup> reproductive,<sup>7,12–14</sup> endocrine,<sup>15,16</sup> and cardiovascular complications.<sup>17–20</sup> Psychological problems associated with the Triad include anxiety disorders, depression, and low self-esteem.<sup>21,22</sup>

Triad prevention and treatment require a team approach.<sup>2</sup> While sports medicine personnel

(physician, athletic trainer, sports psychologist) are important members of this team, athletes don't necessarily interact with this medical team unless they are injured. Due to their frequent contact with athletes, coaches can play an important role in primary Triad prevention and early detection.<sup>3</sup> Coaches are poised in a particularly opportune position to educate and encourage athletes to adopt safe sports performance practices.<sup>23</sup> Nonetheless, previous research indicates that coaches may not possess adequate Triad awareness and knowledge.<sup>23–31</sup> Troy et al. explored the level of Triad knowledge possessed by coaches and health care professionals (physicians, medical students, athletic trainers, physical therapists). Of these individuals, coaches were found to possess the lowest Triad knowledge.<sup>26</sup>

Female athletes engaged in long-distance running sports, such as cross country, are known to have an increased risk of Triad development.<sup>4,5,32,33</sup> Currently, the level of Triad knowledge possessed by National Collegiate Athletic Association (NCAA) women's cross-country coaches remains unknown. Due to the important role that collegiate cross-country coaches can play in Triad prevention and identification, the primary objective of this study was to investigate Triad recognition and knowledge of NCAA cross-country coaches. Additionally, we sought to measure team access to Triad-related resources, such as registered dietitians and sports psychologists.

## METHODS

### *Participants*

A complete list of all NCAA Division I (DI), II (DII), and III (DIII) programs was obtained from the NCAA webpage.<sup>34</sup> Email contact information of NCAA women's cross country coaches was then obtained via open-access records on college/university webpages. A total of 957 emails were acquired. Ethical approval was provided by the Institutional Review Board (IRB) of Mercyhurst University (Erie, PA). Participant informed consent was obtained before survey completion. Assistant coaches and those who only coached male cross-country athletes were excluded from participation. Participation was optional and no compensation was provided for those coaches who chose to complete the survey.

### *Instrumentation*

A 44-item survey was developed based on current literature and ACSM Triad Position Stands.<sup>2–4,24</sup> The questionnaire had four sections (Table 1). The Momentive – SurveyMonkey (San Mateo, CA) platform was utilized to produce this survey. Survey content validity was assessed by a fellowship-trained, board-certified primary care sports medicine physician. After the completion of necessary revisions, the reliability of the instrument was then pilot tested amongst ten local NCAA Division II coaches of female athletes and iteratively revised based on feedback from this group.

### *Procedure*

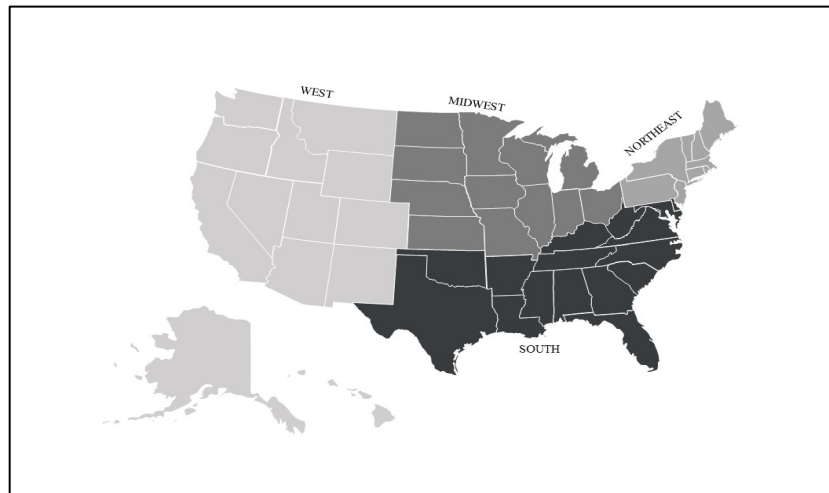
The web-based survey was sent to 957 NCAA collegiate cross-country coaches via email. The initial contact email included a brief synopsis of the study, an informed consent statement, and the IRB-approved survey tool. Reminder emails were sent approximately two months after the original participation request. All responses were collected and recorded within four months. Responses were collected anonymously. Results were grouped geographically based on conference headquarters location. Geographic regions were defined by the U.S. Census Bureau region distinctions (Northeast, Midwest, South, and West) as seen in Figure 1.<sup>35</sup> Each of these geographic regions included programs of NCAA DI, DII, and DIII standing. Free text questions were independently assessed by two authors and compared to increase reliability. Those who responded "yes" to the question "Have you heard of the Female Athlete Triad?" were deemed as having Triad recognition. The three Triad components (low energy availability, menstrual dysfunction, and poor bone health) were used to determine Triad component knowledge. Free text responses were ranked as being able to correctly identify three, two, one, or no Triad components.

### *Statistical Analysis*

Responses were analyzed and reported using descriptive statistics where appropriate. Two-tailed independent sample t-tests were used to compare sex, years of cross-country coaching experience, and knowledge of Triad components. Statistical comparisons were made using chi-square and Fisher's exact tests. A significance level of  $p < 0.05$  was used. All data were analyzed using the IBM Statistical Package for the Social Sciences 28 (IBM SPSS Statistics, Cary, NC, USA) and figures were compiled using GraphPad Prism (La Jolla, USA).

**Table 1.** Survey topics.

Question Type	Number of Questions
Demographics and Coaching Experience	51
Female Athlete Triad Recognition and Knowledge	36.4
Athlete Dietary Habits, Menstruation, and Bone Health	17
Access to triad-Related Resources	9
<b>Total</b>	<b>44</b>



**Figure 1:** Geographic Regions of the United States based upon the US Census Bureau classifications.<sup>35</sup> Respondents were assigned to geographic locations based on NCAA conference headquarters.

## RESULTS

### *Demographics and Coaching Experience*

A detailed description of demographic and coaching experience information is presented in Table 2. There was a total of 143 NCAA cross-country coach survey respondents, representing a response rate of approximately 15%. Of these, 104 (72.7%) were male, the mean age was  $40.7 \pm 11.9$  years, and the mean cross-country coaching experience was  $14.1 \pm 10.3$  years. Respondents represented participation from 44 (44.5% of all 99) NCAA conferences. NCAA divisions were represented evenly (DI = 28.7%, DII = 35.5%, DIII = 33.6%) (Table 2). Geographic region representation of respondents was 39.9% from the Northeast, 26.6% from the South, 14.7% from the Midwest, and 12.6% from the West. Most coaches reported that their female athletes run between 25-50 miles per week (76.2%), engage in strength training 1-2 hours

per week (67.8%), and are given one rest day per week (61.5%) (Table 3). Remarkably, 12.6% of responding coaches report that their female athletes are either never allowed a rest day or are given one rest day per month.

### *Triad Recognition and Knowledge*

Of participating coaches, 29% had not heard of the Triad and close to 40% of responding coaches could not identify any of the Triad components (Table 4). Only 52.4% of coaches could accurately list all three Triad components (low energy availability, menstrual dysfunction, and poor bone health), with 60.8% identifying at least two and 63.6% identifying at least one. Age of respondent ( $t = 0.032$ ,  $p = .974$ ) nor years of cross-country coaching experience ( $t = 0.118$ ,  $p = .906$ ) were associated with ability to name the three Triad components. There was no significant association between the gender of

respondent and Triad component knowledge ( $X^2 = 0.226$ ,  $p = .634$ ). Compared to other Divisions, a greater number of responding DI coaches had heard of the Triad and were able to identify the three Triad

components (Figure 2). Geographic region was associated with respondent recognition of the Triad ( $p = .011$ ), but not identification of Triad components ( $X^2 = 7.015$ ,  $p = .135$ ).

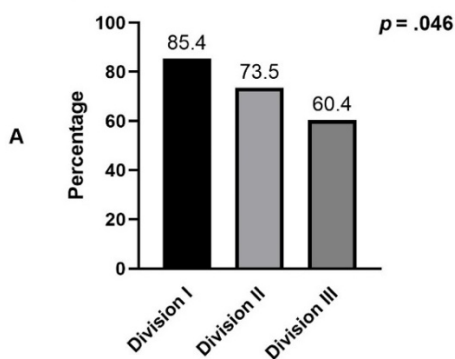
**Table 2.** Demographic and coaching experience information.

		Participants (N)	Percentage (%)
Gender	Male	104	72.7
	Female	36	25.2
	Prefer not to say	3	2.1
Age	< 25 years	3	2.1
	25-35 years	49	34.3
	36-45 years	41	28.7
	46-55 years	28	19.6
	$\geq 56$ years	19	13.3
	No response	3	2.1
Sports Coached	Cross-Country	143	100
	Indoor Track and Field	111	77.6
	Outdoor Track and Field	122	85.3
Years of Coaching Cross-Country	$\leq 2$ years	3	2.1
	3-5 years	22	15.4
	6-10 years	37	25.9
	11-15 years	27	18.9
	$\geq 16$ years	45	31.5
	No response	9	6.3
Years of Coaching Indoor Track and Field	$\leq 2$ years	11	8.2
	3-5 years	22	14.2
	6-10 years	37	24.6
	11-15 years	27	23.1
	$\geq 16$ years	45	29.9
	No response	9	6.3
Years of Coaching Outdoor Track and Field	$\leq 2$ years	17	13
	3-5 years	19	14.5
	6-10 years	30	22.9
	11-15 years	28	21.5
	$\geq 16$ years	37	28.2
	No response	9	6.3
Female Athletes Coached	0-25%	1	0.7
	26-50%	78	54.5
	51-75%	37	25.9
	76-100%	20	14
	No response	7	4.9
NCAA Division	Division I	41	28.7
	Division II	49	34.3
	Division III	48	33.6
	No response	5	3.5
Geographic Location	Northeast	57	39.9
	Midwest	21	14.7
	West	18	12.6
	South	38	26.6

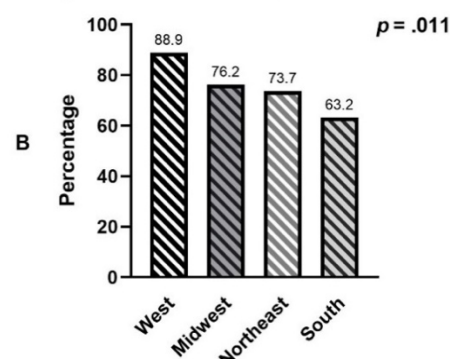
**Table 3.** In-season coaching practices.

		Participants (N)	Percentage (%)
Running per Week	0-25 miles	2	1.4
	26-50 miles	109	76.2
	≥ 51 miles	25	17.5
	No response	7	4.9
Strength Training per Week	0 hours	8	5.6
	1-2 hours	97	67.8
	3-4 hours	30	21
	> 4 hours	3	2.1
Rest-No Organized Exercise	No response	5	3.5
	Never	9	6.3
	Once per month	9	6.3
	Once every other week	31	21.7
	Once per week	88	61.5
	> Once per week	2	1.4
	No response	4	2.8

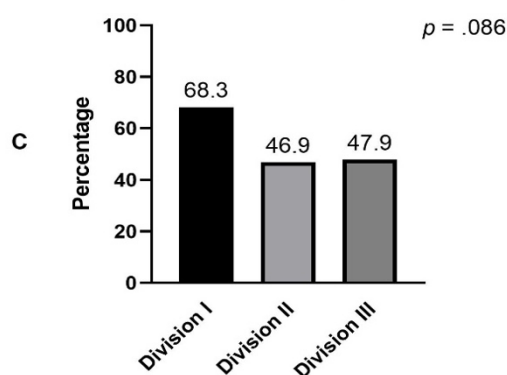
**Have you heard of the Female Athlete Triad?**



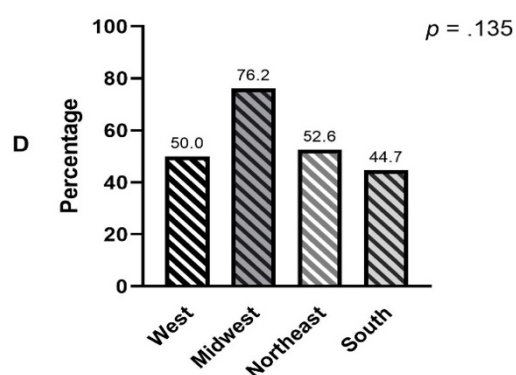
**Have you heard of the Female Athlete Triad?**



**Coaches who correctly identified the 3 Triad components**



**Coaches who correctly identified the 3 Triad components**



**Figure 2:** Recognition of Triad and knowledge of the three Triad components by NCAA division status and geographic region: A) percent of coaches who had heard of the Triad by NCAA division status, B) percent of coaches who had heard of the Triad by geographic region, C) percent of coaches who correctly identified the three Triad components by NCAA division status, and D) percent of coaches who correctly identified the three Triad components by geographic region.

**Table 4.** Coaches Triad Recognition and Knowledge of Components.

		Participants (N)	Percentage (%)
<i>"Have you heard of the Female Athlete Triad?"</i>	Yes	102	71.3
	No	41	28.7
<i>"Please name the three Female Athlete Triad components."</i>	3 components	75	52.4
	2 components	87	60.8
	1 component	91	63.6
	No components	52	36.4
<i>"How did you first become aware of the Female Athlete Triad?"</i>	Research	36	25.2
	Schooling	24	16.8
	Conference	2	1.4
	Other	42	29.4
	Not familiar with the Triad	39	27.3

#### *Athlete Dietary Habits, Menstruation, and Bone Health*

Of responding coaches, 84% reported that they were comfortable discussing dietary habits with female athletes. Similarly, 80.5% of coaches reported that they were likely to talk to female athletes about this topic. Only 59.5% of coaches reported that they were comfortable or very comfortable discussing menstrual issues. When asked if they were likely to talk about this topic with their female athletes, only 31.5% responded with being likely. About 64% of coaches identified "12 or more" menstrual cycles per calendar year as the most appropriate response. When asked to indicate their level of agreement with the following statement "absence of menses is a normal result of exercise in female athletes," 27.3% neither agreed nor disagreed, and 12.6% agreed.

There was a significant association between gender and menstrual cycle discussion comfort ( $X^2 = 29.272$ ,  $p < .001$ ). Fifty-three percent of female coaches were "very comfortable" discussing menstrual issues with female athletes compared to 16.3% of male respondents. There was also a significant association between gender and menstrual discussion likelihood ( $X^2 = 33.084$ ,  $p < .001$ ). Sixty-four percent of female coaches were "likely" or "very likely" to discuss menstrual issues with female athletes compared to 20.2% of male respondents. There was a significant association between gender and dietary discussion comfort ( $p = .002$ ). Sixty-one percent of female coaches were

"very comfortable" discussing dietary habits with female athletes compared to 26.9% of male respondents. There was also a significant association between gender and dietary discussion likelihood ( $p = .001$ ). Seventy-five percent of female coaches were "very likely" to discuss dietary habits with female athletes compared to 35.6% of male respondents. No association was found between comfort or likelihood of dietary or menstrual discussion and NCAA divisions.

There was a significant association between knowledge of the three Triad components and menstrual knowledge ( $X^2 = 33.587$ ,  $p < .001$ ). Seventy-two percent of coaches with Triad component knowledge disagreed with the following statement "absence of menses is a normal result of exercise in female athletes," compared to only 27.9% of coaches without knowledge of the three Triad components. There was also a significant association between knowledge of the three Triad components and comfort ( $X^2 = 11.897$ ,  $p = .018$ ) and likelihood ( $X^2 = 14.113$ ,  $p = .015$ ) of discussing menstrual issues with female athletes. No association was found between comfort and likelihood of dietary discussion and knowledge of the three Triad components.

#### *Access to Triad-Related Resources*

Only 51% of responding coaches reported that their female athletes had access to a registered dietitian. In a follow-up question regarding



**Table 5.** Coaches' perceptions and attitudes regarding Triad-related topics.

		Percentage (%)
<i>"Are you comfortable discussing diet and dietary habits with female athletes?"</i>	Very comfortable	35.7
	Comfortable	48.3
	Neutral	9.1
	Uncomfortable	2.8
	Very uncomfortable	0
	No response	4.2
<i>"How likely are you to discuss healthy eating habits with female athletes?"</i>	Very likely	45.5
	Likely	35
	Neither likely nor unlikely	14
	Unlikely	1.4
	Very Unlikely	0
	No response	4.2
<i>"What number of menstrual cycles is 'normal' for a female athlete to have in one calendar year?"</i>	≥ 12	64.3
	8-12	15.4
	6 or greater	4.9
	I do not know	15.4
<i>"Are you comfortable discussing menstrual issues with female athletes?"</i>	Very comfortable	25.2
	Comfortable	34.3
	Neutral	21
	Uncomfortable	10.5
	Very uncomfortable	0
	No response	9.1
<i>"How likely are you to ask a female athlete if they have regular menses?"</i>	Very likely	13.3
	Likely	18.2
	Neither likely nor unlikely	27.3
	Unlikely	16.1
	Very Unlikely	16.8
	No response	8.4
<i>"Please indicate your level of agreement with the following statement: Absence of menses is a normal result of exercise in female athletes."</i>	Strongly agree	0
	Agree	12.6
	Neither agree nor disagree	27.3
	Disagree	38.5
	Strongly disagree	12.6
	No response	9.1

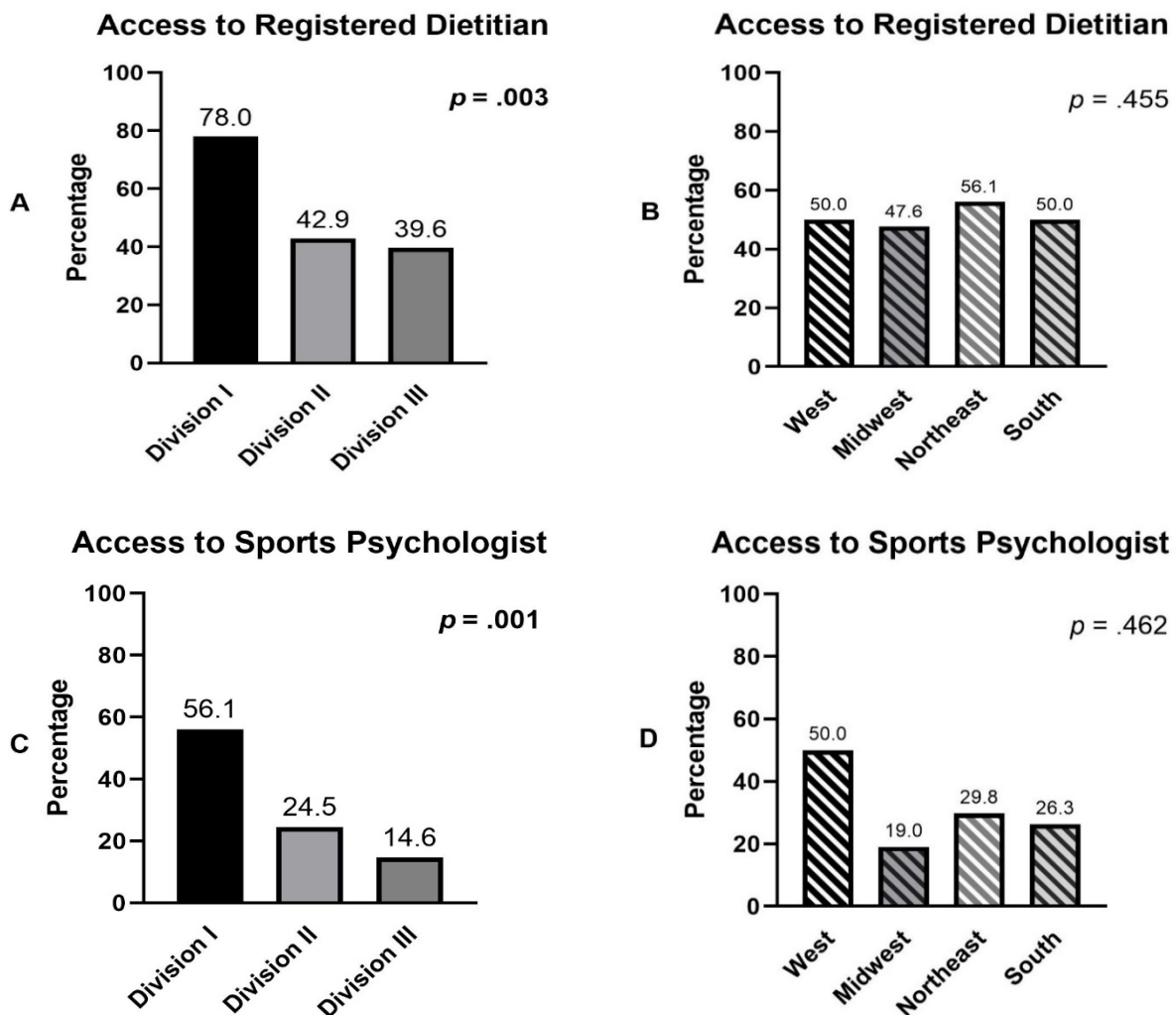
frequency of access, 24.5% reported that their female athletes had weekly access. When asked whether their female athletes have access to a sports psychologist, only 29.4% responded affirmatively. Of coaches that reported their athletes had access to a registered dietitian, 15.4% stated that their female athletes have weekly access.

There was a significant association between NCAA Division status and registered dietitian access ( $p = .003$ ). Seventy-eight percent of DI coaches had female athletes with access to a registered dietitian, compared to 42.9% of DII and 39.6% of DIII female athletes. Likewise, there was a significant association between NCAA Division

status and sports psychologist access ( $p = .001$ ). Fifty-six percent of DI coaches had female athletes with access to a sports psychologist, compared to 24.5% of DII and 14.6% of DIII female athletes. There was no association between geographic region and registered dietitian access ( $p = .455$ ). Likewise, there was no association between geographic region and sports psychologist access ( $p = .462$ ).

## DISCUSSION

To our knowledge, this is the first study to assess NCAA cross-country coaches' recognition and



**Figure 3:** Access to Triad-related resources by geographic region and NCAA division status: A) access to registered dietitian by NCAA division status, B) access to registered dietitian by geographic region, C) access to sports psychologist by NCAA division status, and D) access to sports psychologist by geographic region.



**Table 6.** Access to Triad-related resources.

		Percentage (%)
<i>Access to Registered Dietitian</i>	Yes	51
	No	36.4
	Unsure	8.4
	No response	4.2
<i>Frequency of access to Registered Dietitian</i>	Weekly	24.5
	Monthly	11.2
	Once per season	15.4
	Never	49
<i>Access to Sports Psychologist</i>	Yes	29.4
	No	58.0
	Unsure	8.4
	No response	4.2
<i>Frequency of access to Registered Dietitian</i>	Weekly	15.4
	Monthly	9.8
	Once per season	7.7
	Never	67.1

knowledge of Triad components. Coaches are an important component of the recommended team approach for Triad recognition and treatment described by the ACSM,<sup>2</sup> as they have potentially the greatest amount of face-to-face interaction with athletes. Thus, this study sought to provide novel insight regarding Triad knowledge held by collegiate cross-country coaches. The main findings of this study demonstrate that inadequate Triad recognition and component knowledge exists amongst NCAA cross-country coaches. A substantial proportion of responding coaches held incorrect perceptions related to healthy menstruation during sports participation and lacked program access to Triad-related resources.

About 29% of responding coaches had never heard of the Triad and close to 40% of responding coaches could not identify any of the three Triad components. Respondent age, sex, nor years of coaching experience was associated with Triad component knowledge. A greater proportion of DI coaches demonstrated Triad recognition (85.4%) and component knowledge (68.3%) compared to other NCAA divisions. The West geographic region represented the highest proportion of coaches who had heard of the Triad (88.9%), while the Midwest (76.2%) represented the highest proportion of coaches who could correctly identify all Triad components. The South geographic region

represented both the lowest percent of coaches with Triad recognition (63.2%) and the lowest percent of coaches who could identify the three Triad components (44.7%).

This is not the first study to suggest that there is a lack of Triad knowledge amongst coaches.<sup>23,24,26,31</sup> Since the ACSM introduced the Triad in 1992, much literature has been published on this topic. Organizations, such as the Female and Male Athlete Triad Coalition, have been developed to facilitate early recognition and therefore prevention of this syndrome. Yet, our work reveals that many collegiate cross-country coaches are not familiar with the Triad or its components. This is alarming, as coaches are in the opportune position to notice abnormal or concerning training or eating behaviors. But to do this, coaches must have a basic understanding of the Triad and its symptomology. As previously suggested by Pantano et al. and reinforced by the present study, further collegiate coach Triad education is necessary. Future research should explore the development of Triad education tools tailored to this population.

One of the more alarming findings of this study was that 12.6% of responding coaches believed that absent menstruation is a “normal” result of exercise in female athletes, and 36.4% of coaches did not report an opinion on this topic. Further, when asked how many menstrual cycles are considered

“normal” for a female athlete to have in one calendar year, 20.3% of responding coaches reported a number less than 8. These results demonstrate that some coaches may incorrectly believe that absent or irregular menstruation is a normal response to exercise, a myth that remains pervasive in female athletics.

The vast majority of responding coaches were male (72.7%) but gender was not associated with Triad recognition or components knowledge. Interestingly, gender was associated with comfort and likelihood of discussing dietary or menstrual cycle topics. A greater proportion of female coaches reported that they were “very comfortable” discussing dietary habits (61.1% female coaches vs. 26.9% male coaches) and menstrual issues (52.8% female coaches vs. 16.3% male coaches) with their female athletes. Similarly, a greater proportion of female coaches reported that they were “very likely” to discuss dietary habits (75.0% female coaches vs. 35.6% male coaches) and menstrual issues (33.3% female coaches vs. 6.7% male coaches) with their female athletes. These results suggest that male coaches may be less inclined to discuss these important topics with their female athletes, potentially resulting in overlooked Triad symptomology. Exploration of potential barriers encountered by male coaches regarding discussion of Triad-related topics may be a meaningful area of further investigation.

Previous literature suggests that female athletes may have limited sports nutrition knowledge.<sup>36,37</sup> Nutritional education in this population is important due to LEA risk.<sup>38–41</sup> Limited access to dietary resources may increase an athlete’s risk of poor energy balance.<sup>20</sup> Alarming, this study found that only 51% of responding coaches reported that their program has access to a registered dietitian. Of those with access, only 24.5% of coaches reported that their female athletes had access to a registered dietitian at least once a week.

As has been widely established, the Triad can result in serious psychological ramifications.<sup>2,3,42</sup> When disordered eating or clinically defined eating disorders (ED) are present, evaluation and management by a trained mental health professional may become necessary.<sup>42</sup> Even in the absence of an ED, the services of a sports psychologist may be beneficial for Triad prevention and treatment. Not only are these individuals specifically trained to foster counseling and clinical interventions, such as cognitive-behavioral therapy

(CBT), but they also specialize in helping athletes develop self-confidence, self-esteem, and competence in sports. Sports psychologists can play an instrumental role in disordered eating recovery and the development of healthy weight management strategies.<sup>43–45</sup> Without sufficient access to sports psychologists, athletes may be at increased risk of Triad development, as well as poorer response to Triad treatment. At present, access to sports psychologists across women’s collegiate cross-country is very limited. Of all responding coaches, only 29.4% reported that their program has access to a sports psychologist. Even fewer reported that this access is at least once per week (15.4%).

This study was not without limitations. The largest limitation of this study was a relatively low response rate. Though the sample size was sufficient to represent this homogenous population, a greater number of responses may have allowed for the identification of other notable findings. No comparisons between Triad knowledge and Triad prevalence could be determined, as team Triad prevalence of responding coaches was not assessed. This connection should be explored in future research. Conferences were categorized geographically based upon headquarters location; however, it is important to recognize that some conferences contain schools that are not within the same geographic region as their respective conference headquarters.

Coaches can be instrumental in the establishment of a healthy athletic culture and are in an opportune position to identify athletes who may be experiencing the Triad. Triad recognition and knowledge are particularly important for coaches of endurance sports, as these athletes are at increased risk. As illuminated by this study, gaps in Triad recognition and knowledge exist amongst coaches of women’s collegiate cross-country. Lack of access to Triad-related resources (registered dietitian and sports psychologist) across all NCAA divisions and geographic regions was also identified. Future work should explore ways to increase NCAA coaches’ Triad-related knowledge, as well as strategies to promote greater female athlete access to Triad-related resources.

## CONCLUSION

This study suggests that further Triad education amongst NCAA cross-country coaches is warranted. Future research is needed to illuminate

specific strategies to improve Triad knowledge of collegiate cross-country coaches.

### Conflict of Interest Statement

The authors report no conflict of interest with the contents of this manuscript.

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