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ORIGINAL RESEARCH

Athletic Trainers' Knowledge and Practice Application of Public Health Topics

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Context: Athletic training is at the forefront of the prevention of injury and illness. As the push for population-level approaches continues, including the expansion of standards related to professional preparation, there is a need to examine the knowledge and practice application of public health topics of athletic trainers (ATs), as they may serve as role models or preceptors.

Objective: To assess ATs' knowledge and practice application of public health topics.

Design and Setting: Online survey with knowledge assessment.

Participants: Four hundred eighty-seven ATs (age = 35.8 ± 11.1 years, years credentialed = 12.8 ± 10.6) voluntarily participated.

Intervention(s): The instrument included a demographic section, a pre and post perceived-knowledge assessment, a practice-behavior frequency matrix, and the Public Health Assessment Tool (PHAT) developed by the authors and Delphi panelists.

Main Outcome Measure(s): Measures of central tendency were calculated for the practice-behavior frequency matrix. Perceived knowledge was compared pre- and post-PHAT. We calculated a total PHAT score to measure actual knowledge, and compared perceived and actual knowledge to determine if a knowledge gap existed.

Results: A significant difference ($P > .001$) was identified for perceived knowledge before and after the PHAT. On the PHAT, participants scored 12.14 ± 2.21 out of 19. The 3 most commonly missed questions directly related to the 3 least practiced topics: social determinants of health, assessing environmental health factors, and assessing health-related quality of life. When exploring the relationship between perceived and actual knowledge, we identified a weak, significant relationship between post-PHAT perceived-knowledge mean and actual-knowledge assessment scores ($r = 0.105$, $P = .022$).

Conclusions: A knowledge gap exists concerning public health topics in ATs. A lack of knowledge related to public health topics identifies the need for ATs to be mindful of the intersection of daily clinical practice and population health with a future emphasis on deploying community-based health promotion.

Key Words: Population health, prevention, clinical care

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KEY POINTS

- Athletic trainers report using the social determinants of health, assessing environmental health factors, and assessing health-related quality of life the least in their clinical practice.
- The participants scored poorly on the public health assessment tool and lacked the ability to self-recognize their deficiencies.
- A lack of knowledge related to public health topics may influence one's daily clinical practice and future efforts related to community-based health promotion.

INTRODUCTION

Athletic training is at the forefront of injury and illness prevention among health care professions.[1–3] Athletic trainers (ATs) engage with patients on a daily basis to reduce the risk of injury, protect individual wellness, and reduce the burden of injury and illness.[4] However, much of the work around injury prevention and wellness protection in which ATs engage is focused at the individual patient level.[2] This approach is effective in addressing the individual needs of specific patients, but diminishes the opportunity to design and implement population-level injury-prevention and wellness-protection systems.[3] The integration of population-level systems and interventions is a major component of public health.[5] The Centers of Disease Control and Prevention Foundation define public health as "the science of protecting and improving the health of families and communities through promotion of healthy lifestyles."[6] Using this definition, the practice of ATs, specifically the injury- and illness-prevention and wellness-promotion domain of athletic training, clearly aligns athletic training with the realm of public health.[6,7]

Many of the emerging challenges to and profession-wide efforts to promote public health, such as sport-related concussion,[8] osteoarthritis,[9] and sudden cardiac arrest,[10,11] require the implementation and design of policies, procedures, and systems that move beyond individual patient–level care, which practicing ATs may be unready to fulfill.[2] In an effort to address these potential concerns, the Commission on Accreditation of Athletic Training Education (CAATE) has made additions to the educational standards in professional-level athletic training programs.[12] The new educational standards for professional-level athletic training programs state that students must have foundational knowledge in a range of topics, including epidemiology and public health, that is either required as prerequisite coursework or delivered during the curriculum of the program.[12] Although these changes to the educational standards address the challenges for future ATs, it is unknown if the practicing AT has the requisite knowledge in public health to effectively protect patients from the negative health consequences of the emerging challenges of sport-related concussion, osteoarthritis, and sudden cardiac arrest. It is also vital to explore the role of the practicing AT, not only in regards to patient care, but additionally as the AT serves as a role model or preceptor through clinical education to athletic training students through social learning theory, as imitation of behavior leads to future optimal results.[13]

Previous research has established that ATs often have a knowledge gap, or a disconnected relationship between their perceived confidence in athletic training related knowledge, skills, and abilities and their actual knowledge measured through knowledge assessments.[14–17] However, to the authors' knowledge no work has examined ATs' perceived and actual knowledge of public health topics necessary to integrate individual-level public health practices before implementing population-level health initiatives. Therefore, the purpose of this study was to assess ATs' knowledge of and practice application of public health topics.

METHODS

Study Design

To assess ATs' knowledge and practice behaviors related to public health topics, we designed a cross-sectional study using a Web-based survey (Qualtrics, Inc, Provo, UT). Indiana State University Institutional Review Board deemed this study exempt.

Public Health Assessment Tool Development

No current measurements of knowledge or practice behaviors related to public health are available in the literature, and as such, the authors, with assistance from a Delphi panel, designed the Public Health Assessment Tool (PHAT) to match the purposes of the study. The Delphi panel comprised a group of experts with background in epidemiology, public health, sports medicine, and athletic training. The Delphi technique is a method of structuring the collective judgments of a group of experts, conducted through a series of sequential questionnaires, each containing summarized information from earlier responses.[18,19] Ten experts (7 ATs, 1 sports medicine physician, and 2 public health educators/researchers) with an average of 17 years of experience (range = 7–31 years of experience) in their respective professions served on the panel.

The panel of experts completed a multiphase process, called rounds, of online review and questionnaires to gather their thoughts and opinions on the content for the instrument. After being posed with the research question and specific aims for the study, the initial round asked the Delphi panel to rank a list of 30 public health topics in order of importance that they believed an AT would need to have the knowledge in related to public health. The initial list of 30 public health topics was developed from the Healthy People 2020 topic areas and relevant athletic training literature.[20–22] The Delphi panel provided panelists a rationale to explain why they believed the ones they ranked were the most important. Additionally, Delphi panelists had the option to provide any additional topics that were omitted from the list. From the

responses, the authors were able to identify consensus related to 15 topics, which were transformed into 23 knowledge assessment questions and 18 practice-behavior items. In the second round, the Delphi panelists were e-mailed a copy of the proposed tool, including demographic items. The members were asked to indicate whether each item was adequate as written, should be included in the instrument but must be edited, or should be removed from the instrument.

The primary investigator compiled responses and revised the instrument with 3 knowledge assessment questions removed based on feedback. The PHAT was then transferred into the Web-based platform that would be used for the final study deployment. The Delphi panelists were provided a link containing the PHAT in its entirety to preview the informed consent, participant directions, and instrument flow. Next, the members were provided a questionnaire via a Web-based survey to evaluate the instrument in 3 areas: how the question was worded, how the answer choices were worded, and the appropriateness of the question in the final instrument. Each of the 3 measures were scored on a 5-point Likert scale (*inappropriate* = 1, *appropriate* = 5) with the goal to achieve consensus in each of the 3 measures by scoring an average of 70% (3.5 out of 5 on the Likert scale) or higher from the compiled Delphi panelists' responses. Each of the 20 knowledge assessment questions included an open-ended response box for the Delphi panelist to provide suggestions for revisions. The data from round 3 of the Delphi technique identified consensus at or higher than 70% for 16 of the 20 questions in all 3 variables of interest. One question was omitted from the PHAT based on the feedback, and 3 questions required another round of analysis related to the wording of questions or answers. For items that did not meet consensus during round 3, the authors modified the item and created a new questionnaire with the specific knowledge assessment questions and analysis item. Content consensus was reached after the fourth round of the Delphi technique signifying content validity.

After content consensus from the Delphi panel, the authors used a pilot study to evaluate instrument flow, navigation, and internal consistency for the PHAT. For the pilot study, 200 currently credentialed ATs in good standing from the National Athletic Trainers' Association (NATA) membership database were recruited with a 1-time e-mail with no reminders; the study remained open for 1 week. Six participants completed the pilot study in its entirety. The data were not used for the final statistical analysis and all participants recruited for the pilot study were removed from the potential recruitment list for the final study data collection. The outcomes of the pilot study determined that the 19-question knowledge assessment resulted in strong internal consistency (Cronbach $\alpha = 0.630$). An "item-if" analysis was used to determine if a change in internal consistency occurred if any of the 19 items were removed. This assessment did not change the internal consistency of the PHAT. Overall, 7 of the 19 questions had a 100% correct response rate from the pilot participants, 1 question had a 0% correct response rate from pilot participants, and no major changes were made to the PHAT before final study distribution.

Instrument

The final instrument for this study included a demographic section (5 items), a pre-PHAT perceived-knowledge assessment (5 items), a practice-behavior matrix (Table 1, 18 items), the PHAT developed by the authors and Delphi panelists (19 items), and a post-PHAT perceived-knowledge assessment adapted from the literature (5 items).

The demographic section included items related to the age, years of credentialed athletic training experience, clinical practice setting using the NATA membership database categories, highest level of education, and gender of the participant. The pre- and post-PHAT perceived-knowledge assessment was adapted from the literature.[23] The PHAT contained a 19-item, multiple-choice actual-knowledge assessment that included both knowledge-retrieval (returning information) and knowledge-use (making care decisions) items. Finally, the practice-behavior matrix asked participants to identify how frequently, if at all, they implemented each of the public health topics into their clinical practice. The anchors for the matrix included *never*, *daily*, *weekly*, *monthly*, *every 6 months*, *annually*, *unsure how to do the task*, and *task was unnecessary for their job*.

Procedures

After approval from the Institutional Review Board and the pilot study, recruitment e-mails were sent at variable times of day to 6466 ATs who were members of the NATA on February 5, 2019, with 5 reminder e-mails sent weekly; the final reminder was sent on March 4, 2019, and the study closed on March 11, 2019. After electronically indicating informed consent, the participant began the instrument.

Participants

Of the initial 6466 recruitment e-mails sent, 750 ATs opened the survey link (access rate = 11.6%). Of the 750 who opened the link, 666 ATs responded to a portion of the instrument (response rate = 10.3% of total recruited population, 88.8% of accessed population) with 500 completed responses collected, meaning that participants completed the final question but could skip questions as they wished according to best practices in survey research (completion rate = 75.1%). During the data extraction process of the 500 completed responses, 12 responses were removed as ineligible (6 did not agree to participate or did not identify as a currently credentialed AT) and 1 response was removed as the participant had finished the instrument but did not answer any of the perceived-knowledge assessment or the PHAT items. A total of 487 participants (35.8 $\pm$ 11.1 years old, 12.8 $\pm$ 10.6 years of credentialed experience) were included in the analysis. Table 2 shows the background of the participants, which also supports the representativeness of the study itself as well as the profession of athletic training.

Statistical Analysis

Data were collected and transferred from the Web-based survey platform into custom spreadsheet software (Microsoft Excel 2016; Microsoft Corp, Redmond, WA) for data cleaning. Next, all data were transferred and analyzed using commercially available statistical analysis software (SPSS version 25.0; IBM Inc, Armonk, NY). Measures of central tendency (mean, mode, interquartile ranges, and standard deviations) were calculated for all variables of interest. For the perceived-knowledge assessment, the 5 items included both positive (n = 2) and negative (n = 3) question stems that

Table 1. Self-Reported Frequency of Public Health Topic Practice Behavior, No. (%)[a]

Public Health Task	Never	Daily	Weekly	Monthly	Every 6 Months	Annually	Unsure How to Do the Task	Unnecessary for Job	Missing
Assess environmental health factors	18 (3.7)	**196 (40.2)**	93 (19.1)	57 (11.7)	22 (4.5)	24 (4.9)	25 (5.1)	52 (10.7)	0 (0)
Assess health-related quality of life	27 (5.5)	**154 (31.6)**	121 (24.8)	66 (13.6)	13 (2.7)	24 (4.9)	**26 (5.3)**	53 (10.9)	3 (0.6)
Assess drug and/or medical product safety	52 (0.7)	76 (15.6)	75 (15.4)	95 (19.5)	38 (7.8)	45 (9.2)	18 (3.7)	86 (17.7)	2 (0.4)
Collect and/or analyze injury surveillance data	65 (3.3)	**107 (22.0)**	54 (11.1)	56 (11.5)	48 (9.9)	71 (14.6)	10 (2.1)	76 (15.6)	0 (0)
Create, implement, and/or review policies	14 (2.9)	18 (3.7)	32 (6.6)	**104 (21.4)**	**84 (17.2)**	**183 (37.6)**	1 (0.2)	50 (10.3)	1 (0.2)
Discussions related to vaccines and immunizations	92 (18.9)	9 (1.8)	17 (3.5)	65 (13.3)	62 (12.7)	94 (19.3)	9 (1.8)	**139 (28.5)**	0 (0)
Encourage physical activity and exercise	2 (0.4)	**393 (80.7)**	56 (11.5)	11 (2.3)	1 (0.2)	6 (1.2)	0 (0)	18 (3.7)	0 (0)
Handwashing	8 (1.6)	**412 (84.6)**	36 (7.4)	7 (1.4)	4 (0.8)	5 (1.0)	1 (0.2)	13 (2.7)	1 (0.2)
Manage mental health illnesses	34 (7.0)	**129 (26.5)**	121 (24.8)	97 (19.9)	32 (6.6)	20 (4.1)	13 (2.7)	40 (8.2)	1 (0.2)
Manage nutrition and/or weight status for patients	40 (8.2)	76 (15.6)	**127 (26.1)**	96 (19.7)	36 (7.4)	20 (4.1)	6 (1.2)	86 (17.7)	0 (0)
Mitigate substance abuse and misuse	95 (19.5)	33 (6.8)	56 (11.5)	91 (18.7)	40 (8.2)	46 (9.4)	18 (3.7)	**107 (22.0)**	1 (0.2)
Perform primary, secondary or tertiary prevention for sport-related injuries	4 (0.8)	**311 (63.9)**	86 (17.7)	37 (7.6)	5 (1.0)	5 (1.0)	1 (0.2)	37 (7.6)	1 (0.2)
Practice proper blood safety considerations	1 (0.2)	**392 (80.5)**	49 (10.1)	14 (2.9)	1 (0.2)	5 (1.0)	1 (0.2)	24 (4.9)	0 (0)
Evaluate the determinants of wellness reflective to the patient	23 (4.7)	**200 (41.1)**	115 (23.6)	37 (7.6)	8 (1.6)	9 (1.8)	49 (10.1)	44 (9.0)	2 (0.4)
Prevent and/or manage infectious disease outbreaks	29 (6.0)	**187 (38.4)**	63 (12.9)	62 (12.7)	39 (8.0)	25 (5.1)	4 (0.8)	78 (16.0)	0 (0)
Promote community health efforts in your surrounding neighborhoods	**140 (28.7)**	26 (5.3)	21 (4.3)	68 (14.0)	51 (10.5)	57 (11.17)	9 (1.8)	113 (23.2)	2 (0.4)
Provide patient education materials	25 (5.1)	**165 (33.9)**	116 (23.8)	85 (17.5)	29 (6.0)	30 (6.2)	2 (0.4)	33 (6.8)	2 (0.4)
Sexual health and family planning discussions	158 (32.4)	8 (1.6)	16 (3.3)	40 (8.2)	40 (8.2)	31 (6.4)	8 (1.6)	**185 (38.0)**	1 (0.2)

[a] Bold text represents the mode for each public health topic behavior.

Table 2. Demographics of Participants

Parameter	No. (%)
Gender	
Male	192 (39.4)
Female	295 (60.6)
Highest level of education	
Bachelor's	128 (26.3)
Master's	294 (60.4)
Doctorate	65 (13.3)
Clinical practice setting	
Secondary school	157 (32.2)
College/university	152 (31.2)
Clinic/hospital	70 (14.4)
Education/academia/research	47 (9.7)
Occupational health/industrial	14 (2.9)
Professional Sports	11 (2.3)
Amateur/recreational/youth sports	8 (1.6)
Independent contractor	7 (1.4)
Health/fitness/sports performance clinic/clubs	7 (1.4)
Business/sales/marketing	4 (0.8)
Military/law enforcement/government	4 (0.8)
Performing arts	2 (0.4)
Unemployed	2 (0.4)
Missing	2 (0.4)

were reverse score corrected to avoid response bias. The perceived-knowledge questionnaire was calculated as a mean per participant before and after the PHAT. Data were coded for the PHAT with each correct answer counting as 1 and each incorrect or omitted answer as 0. A pairwise comparison was used to evaluate the change in perceived knowledge after the PHAT. A Pearson correlation was used to identify a knowledge gap. The α level was set at $P = .05$ a priori.

RESULTS

Practice Behaviors

A majority of participants stated they practiced several skills daily, including handwashing (n = 412, 84.6%) and encouraging physical activity/exercise (n = 393, 80.7%). The public health topic that was most frequently practiced either monthly (n = 104, 21.4%), every 6 months (n = 84, 17.2%), or annually (n = 193, 37.6%) was related to creating, implementing, and reviewing policies. The topic that had the highest frequency for never being practiced was promoting community health efforts in surrounding neighborhoods (n = 140, 28.7%). On the same note, the 3 topics the participants were most frequently unsure how to implement included evaluating the determinants of wellness reflective to a patient (n = 49, 10.1%), assessing health-related quality of life (n = 26, 5.3%), and assessing environmental health factors (n = 25, 5.1%). Table 1 provides the full breakdown of public health topics with frequency of reported behaviors from the participants.

Knowledge Assessment: Perceived, Actual, Correlation

On the perceived-knowledge assessment, participants ranked themselves at a mean of 4.13 ± 1.00 before the PHAT and at a mean of 3.95 ± 1.00 after the PHAT. A significant difference was identified when comparing the means of the perceived-knowledge assessment before (mean = 4.13 ± 1.00) and after (mean = 3.95 ± 1.00) the PHAT, yet it was not clinically meaningful (95% confidence interval = 0.12, 0.24; $P > .001$). From the sample, the interquartile ranges for the items "I know pretty much everything about public health" (25th percentile = 2) and "I do not feel very knowledgeable about public health" (25th percentile = 3) decreased meaning that the participants struggled to identify their perceived knowledge. Upon further evaluation, the participants in the 75th percentile had a reduction in their percentile mean value by 1 data point in those 2 areas meaning that they expressed a heightened self-awareness after completing the PHAT. Table 3 provides a statistical analysis of the 5 perceived-knowledge assessment items at both time points in the study.

On the PHAT (Table 4), the participants scored a 12.14 ± 2.21 out of 19 (63.89%) with a range of scores between 3 (15.79%) and 18 (94.74%). At face value, the 3 most commonly missed questions on the PHAT directly related to the 3 topics in which the participants were most frequently unsure of how to implement on the practice-behavior matrix. This included evaluating the determinants of wellness reflective to a patient (PHAT question 6, 29.6% correct), assessing environmental health factors (PHAT question 18, 25.7% correct), and assessing health-related quality of life (PHAT question 14, 3.5% correct). When exploring the relationship between perceived and actual knowledge, we identified a knowledge gap based upon a poor relationship (*r*

Table 3. Perceived-Knowledge Assessment

	Pre					Post				
			Percentile					Percentile		
Item	Mean	Mode	25th	50th	75th	Mean	Mode	25th	50th	75th
I know pretty much everything about public health	3.43	2	2	3	5	3.05	2	2	3	4
I do not feel very knowledgeable about public health	4.52	5	3	5	6	4.38	5	3	5	5
Among my colleagues, I am one of the "experts" on public health.	3.34	4	2	3.5	4	3.26	4	2	3	4
Compared to most other athletic trainers, I know less about public health	4.76	4	4	5	6	4.61	4	4	5	6
When it comes to public health, I really do not know a lot.	4.57	5	3	5	6	4.43	5	3	5	6

Abbreviation: IQR, interquartile range.

Table 4. Public Health Assessment Tool

Question	Correct Answer	No. Correct (%)
1. What are best practices to prevent widespread outbreak of an infectious disease in your athletic training facility?	Cover all wounds, ensure availability of adequate soap and hot water, and clean shared spaces (household, athletic equipment, and athletic training facility)[24]	425 (87.3)
2. A 15-year-old female patient asks about the human papillomavirus (HPV) vaccine during treatment for an unrelated condition. How do you respond related to sexual health and vaccine discussions?	The vaccination should be given to both boys and girls around the age of 13 or prior to sexual activity if earlier[25–27]	408 (83.8)
3. According to the literature, which of the following statements consists of potential long-term consequences following a lateral ankle sprain?	Decreased quality of life, decreased physical activity, and accelerated onset of ankle joint osteoarthritis[28]	417 (85.6)
4. How can athletic trainers promote healthy eating in a secondary school?	Collaborate with decision makers who create policy related to monitoring and limiting the food sold in vending machines, snack bars, and sporting events[29]	439 (90.1)
5. Compared to non-Hispanic white adults, a greater proportion of black/African American adults have a higher prevalence of asthma. Which of the following is a contributing factor for the health disparity of asthma in black/African American adults?	A greater proportion of black adults versus white adults living in an urban housing complex with frequent pest exposure[30,31]	269 (55.2)
6. Which statement identifies a health care disparity as it relates to socioeconomic status?	Men and women with less than a high school education could expect to live 8–9 years less than individuals with a bachelor's degree or higher[32–34]	144 (29.6)
7. What is the athletic trainer's most common role in injury surveillance?	To serve as an educated and experienced data collector who identifies, diagnoses, and reports conditions as they occur in a systematic manner[35]	298 (61.2)
8. A NCAA student-athlete on the track team reports to preparticipation physical exams at the beginning of the school year. The patient reports using cannabidiol (CBD oil), a product of the cannabis plant, to manage his seizure disorder. The student-athlete is also on the United States track team, which has told him that he may continue using the CBD oil. What are the appropriate "next steps" for the athletic trainer?	Instruct the patient to see their neurologist about other medications as the NCAA has a strict ban on cannabis products despite CBD oil being excluded from the 2018 World Anti-Doping Agency List[36]	277 (56.9)
9. What is the socioecological framework of public health?	A model that considers the complex interplay between individual, relationship, community, and societal factors. The interacting factors in the model illustrate how factors at one level influence factors at another level[37]	324 (66.5)
10. What is the MOST important consideration when providing patients written home care instructions regarding their injury?	Providing instructions in the written home language of the patient and caregivers[38]	387 (79.5)
11. Which of the following sport safety guidelines is recommended to prevent pitching-related injuries in pediatric (age 0–18) baseball players?	Pitchers between 15 and 18 years of age should throw no more than 90 pitches per game and pitch no more than 2 games per week[39]	323 (66.3)
12. Which of the following is considered a self-preparation act related to suicidal ideation that an athletic trainer should discuss with an at-risk patient?	Patient gives their valuables away[40]	411 (84.4)
13. When advising about exercise and physical activity, what are the national recommendations for children and adolescents (ages 6–17)?	60 minutes daily[41,42]	337 (69.2)

Table 4. Continued

Question	Correct Answer	No. Correct (%)
14. A soccer player suffers a first-degree ankle sprain. The evaluation determines range of motion and strength deficits at the ankle that have limited their ability to ambulate immediately after the injury. What valid and reliable tool should the athletic trainer consider incorporating as a comprehensive evaluation measure of the patient?	General, multidimensional outcome measure such as the Short Form/Veteran RAND Health Survey (SF-36 or VR-36)[43,44]	17 (3.5)
15. Concussion is a significant issue at all levels of play. Which of the following may be an acceptable primary prevention strategy for decreasing concussion risk?	Implementing a preseason neck strengthening program[45–47]	243 (49.9)
16. A secondary school student-athlete states they are feeling "powerless," "on edge," and "tired." Upon examination, you identify tachycardia and tachypnea with reported gastrointestinal problems and muscle stiffness. What condition do these signs and symptoms lead you to believe the patient is suffering from?	Anxiety disorder[48]	373 (76.6)
17. What is a secondary prevention measure for anterior cruciate ligament (ACL) injuries that could be implemented for a female soccer team?	Integration of a comprehensive neuromuscular training program[49]	324 (66.5)
18. What is the NCAA protocol regarding heat acclimatization to prevent environmental heat illnesses?	A 5-day acclimatization period required for all athletes regardless of arrival to preseason practice[50,51]	125 (25.7)
19. Proper assessment of suspected concussions is an important secondary prevention strategy. According to the 2017 Berlin statement, which of the following best describes critical elements of the sideline assessment?	Observation of signs, symptom reporting and interview, verbal cognitive evaluation, balance evaluation, clinical examination[52]	370 (76.0)

Abbreviation: NCAA, National Collegiate Athletic Association.

= 0.38, $P = .402$). Finally, we did not identify significant differences between groups of participants with 1 to 5, 6 to 10, 11 to 15, 16 to 20, 21 to 25, and more than 25 years of credentialed experience with regard to actual-knowledge score ($F_{5,485} = 2.199$, $P = .05$), whereby the differences between groups was nominal (range = 11.78–12.82 points).

DISCUSSION

Previous literature has called for the need for ATs to expand their professional focus beyond the individual level,[2,3] yet our data represent that the practicing AT is not able to recognize the individual-level integration of public health concepts and athletic training skills. In our sample, we identified a knowledge gap related to perceived and actual knowledge of public health topics, specifically with knowledge-use questions related to health-related quality of life, environmental factors, and social determinants of health. We believe that much of the problem in the "lack of knowledge" is due to an absence of continued education by currently practicing clinicians directed at public health topics. Previous research has identified that ATs typically seek continuing education respective to daily clinical problems related to their practice.[53] This characteristic of self-directed learners is also demonstrated in the fact that personal and professional experiences, rather than knowledge gaps, direct ATs' choices for continuing education.[14,54] It can be inferred that ATs do not regularly practice or recognize their knowledge gaps related to public health topics, and therefore may not seek out continuing education related to this area.

The delivery of prevention and wellness is at an interesting time in athletic training in which the domains of athletic training clinical practice align with the public health framework. However, the implementation of public health topics on a broader scale outside of the daily clinical problems in the athletic training facility may be failing to address community-wide health behaviors and outcomes. The impact of these data has magnifying effects when these individuals serve as preceptors and fail to model public health knowledge, skills, and abilities to the athletic training students they clinically mentor. As such, our data support that there are foundational knowledge deficits with individual-level public health topics that must be addressed before expanding into population-level or community-based health. Yet, if ATs are not engaging with continuing education efforts in individual-level public health topics, they will not be able to understand or implement population-level initiatives in their clinical practice. This important gap must first be bridged through continuing education for those already practicing in order for the profession to truly engage in prevention and wellness at a population level. When continuing education does not occur, there is a hindrance to the delivery of high-quality patient care.[55]

One might think that our recommendations to resolve knowledge gaps through continuing education, particularly in areas of knowledge deficits, may be in conflict with the new CAATE standards relative to contemporary expertise for program directors, clinical education coordinators, core faculty, and preceptors (standards 37, 39, 42, and 45, respectively).[12] However, there is a place for both maintaining competence in all domains of practice and developing contemporary clinical expertise with personal and professional development. Specifically, the Board of Certification and many state practice acts indicate that continuing education to promote continued competence, the development of current knowledge and skills, and the enhancement of professional skills and judgment related to the practice of athletic training are required to maintain competence. To maintain competence in athletic training, one would need to demonstrate competence in all domains of clinical practice, while still developing areas of contemporary expertise that complement instructional assignments and clinical practice specialties.

Public Health: Current Realities and Future Direction

The Institute for Health Improvement developed the Triple Aim framework, which describes 3 overall goals for health systems to strive for in order to optimize the systems performance.[56] The Triple Aim for population health includes a 3-pronged approach: improvement of the individual patient experience, improved health of populations, and lowering the costs associated with health care.[56] These 3 individual goals of the Triple Aim are interconnected, meaning that attempts to achieve one goal could impact the others. For instance, if providers want to improve individual patient health or experience, this potentially could increase health care costs. Therefore, it is imperative that ATs have a better understanding of not only individual-level and population-level public health concepts, but also how these initiatives impact the cost of care and influence one another. From the population health dimension, measures of health/functional status,[57,58] assessing risk,[59,60] understanding the incidence and prevalence of diseases,[61,62] and appreciating the years of potential life lost[63,64] are all relevant standards for ATs to be competent in as they deliver patient care.

The public health realm has 3 domains and 10 essential services related to public health.[65] The 3 domains are health services, health protection, and health improvement.[65] In health services, the essential services include assuring a competent health services workforce, evaluating health services, linking people to needed health services, and developing policies and plans.[65] The health protection domain includes the essential services of enforcing laws and regulations, protecting the environment and workplace, and diagnosing and investigating health problems.[65] Finally, the health improvement domain includes informing, educating, and empowering the public; monitoring health status of the population; and mobilizing community action.[65] The data gathered in this study indicate that ATs may need continuing education directed at these 3 domains, specifically health protection and health improvement.

As the intersection of athletic training and public health occurs, ATs who are working in both the clinical and education sectors must be cognizant of the Triple Aim and the public health essential services.[56] The current realities include a movement for population health with activities designed and directed to improving the health of the patient.[56] In athletic training, we have continually focused on implementing the measures of the population health dimension through a singular lens, without respect to our colleagues' experiences throughout the country. Particularly in the area of sport-related concussion, we have placed an emphasis on sharing injury prevention methods such as the Heads Up Football program with stakeholders at the interpersonal and community levels of the socioecological model of intervention.[66,67] As we continue to progress, interprofessional educational opportunities centered on public health may be an advantageous technique that brings learners from several disciplines together for a common goal to achieve the Triple Aim and maximize potential team-based care.[68,69] Moreover, ATs should consider that teamwork does not always mean working alongside other members of the health care community. The socioecological model of public health stresses the importance of how interactions with different levels of influence can determine the health of the individual.[67] The framework emphasizes the role of intraprofessional practice, or the collaboration of ATs to gather, analyze, and communicate patient outcomes.[70] Although the practice is uncommon throughout daily clinical practice, the dissemination of data is essential to epidemiology and injury surveillance.[35] As a profession, we must educate future ATs and encourage practicing clinicians about the "how" and "why" of intraprofessional collaboration through the lens of injury surveillance.

Educating the Next Health Care Leader

One of the findings of this study demonstrated that ATs scored lower and felt less confident in their ability to evaluate social determinants of health, environmental factors, and health-related quality of life of their patients. If ATs are unable to appropriately determine factors that will influence their patients' health and overall health-related quality of life, they will not be able to inform, educate, or empower patients, nor will ATs be able to guide or connect patients to the appropriate needed health services.[71] Further, the inability of ATs to assess environmental conditions makes them unable to enforce laws and regulations in order to protect the environment and workplace for their patients.[72] Therefore, athletic training programs should consider integrating curriculum related to these concepts, specifically on how learners can engage with individual and population-level public health initiatives.

In professional education, we suggest that athletic training program administrators use a spiral curriculum method when addressing public health.[73] Although the requirement for foundational knowledge in public health and epidemiology is now listed in the CAATE standards, a program can be compliant with this standard by simply requiring it as a prerequisite course during the preprofessional phase. However, there is a strong likelihood that an introductory public health course will not specifically outline the intersection of public health and athletic training, thus leaving the student without a connection between the 2 fields. We suggest that public health topics be integrated throughout all aspects of the curriculum, rather than a singular class or experience, reinforcing previous learning outcomes while increasing in complexity.[73] During the spiral curriculum, we recommend

that educators seek to develop students' appreciation for population health while allowing them to practice individual-level public health in order for the students to achieve competence by exploring similar concepts in multifaceted situations.[73]

For the duration of the curriculum, educators must also consider instructional strategies and educational techniques relative to public health topics. It is most likely that real-time patient encounters and meaningful population health initiatives would emphasize the importance of public health during clinical practice. Previous research[74] has cited that practical experience related to health care delivery in community-based models provides a valuable opportunity to achieve practical application outside of the classroom. In addition, the use of simulation may serve as a supplement to clinical education with scenarios designed around social justice topics. For example, positive student learning outcomes have been noted with simulations for low socioeconomic status/poverty[75] and integrating the social determinants of health.[76]

The need to link people with health needs to community resources is the foundation of social determinants of health. The CAATE 2020 Standards for Accreditation of Professional Athletic Training Programs[12] list patient-centered care as a core competency. Under this core competency, standards 56, 57, and 60 highlight the need to advocate for population-based health needs, identify health literacy and social determinants concerns, and use the disablement model for patient care.[12] These standards require the athletic training student to appreciate the role of whole-person health care. Moreover, a professional athletic training student should have opportunities to read policy from the Centers of Disease Control and Prevention Foundation and the World Health Organization as a means to be exposed to the global impact of health and wellness. Finally, educators should consider instructional strategies that allow the athletic training student to inform, educate, and empower the public with regards to their health needs. Outside of didactic education, clinical preceptors must embody and deploy public health behaviors by enforcing laws and regulations, educating the community, and providing opportunities for student growth in public health. Although preceptorship status was not a criterion of the study, we did identify that practicing clinicians, who are all qualified to serve as preceptors, lacked the practice behaviors and knowledge of key public health topics. It is vital that this knowledge and practice gap be narrowed during clinical practice.

In postprofessional athletic training programs, educators should consider incorporating several of the concepts we described in the professional education section with the emphasis of expanding the depth and breadth of students' base knowledge. Postprofessional athletic training students must be in an endless loop of integrating policy with practice. For example, the clinician must develop policies and plans with evaluation tactics. The American Association of Colleges of Nursing sets similar standards for the doctor in nursing practice (DNP) degree, requiring that graduates be able to develop and evaluate care delivery on a system level to entire patient panels, not just individual patients.[77] Further, DNP graduates are expected to use health policy to develop practice-level and system-level initiatives to improve the quality of care.[77] There is a need to evaluate their (DNPs and ATs) health care services through quality improvement and point-of-care analyses.[78] And finally, postprofessional athletic training students should mobilize community action. Throughout this process, the educator can maximize the clinical education opportunities of the practicing clinician. There should be emphasis placed upon exploring and challenging the status quo of health care with regards to community service learning opportunities[79] by intermingling the daily patient panel with community health tactics to implore behavioral change.

Finally, with regards to residency and fellowship programs in athletic training, we must be cognizant of the specialty area with a direct link to public health. The CAATE has identified 8 specialty competency areas of focus for athletic training residency programs, with one area being prevention and wellness. As of 2019, there are no residency programs accredited in this focused area of practice. The authors recommend that educators and clinicians wishing to create a prevention and wellness residency program ensure that the AT be able to develop advanced practice behaviors consistent with the focused area of practice. In medicine, the preventative medicine specialty area is assessed using the public health and general preventive medicine milestones that are fully described in Table 5.[80] Through these milestones, we believe an AT with specialty preparation in this area of focus should be able to diagnose and evaluate health problems, mobilize community action, monitor the health of the population, and empower the public.

Becoming an Agent of Change Versus a Passive Observer

Educational theory has supported the concept that the more involved a learner is, the greater the amount of memory and replication that will be able to occur. Athletic training programs should be preparing students to engage in and practice these public health topics as change agents rather than as passive observers. A *change agent* has been defined as one who takes on the role for initiation and management of change, whereas a passive observer does not engage with the process and initiation of change.[81] For example, as ATs record and document as passive observers, they are completing a key aspect of patient care, yet the data remain only in the electronic medical record.[82,83] To become a true change agent, the AT should consider downloading and analyzing the patient's medical record to create specific prevention and wellness plans based on risk and previous injury. Finally, ATs should consider compiling injury data from their clinical site to initiate prevention policies based on their findings.[84,85] The final step is how an AT accomplishes both population-level public health practice and being a change agent in the profession.

The modeling of these behaviors, which is rooted in social learning theory,[13] to other ATs and students can socialize those around them to the importance of implementing not only individual-level but population-level public health initiatives. It is also key that the athletic training student be not only observing, but also actively engaged in authentic experiences that are facilitated by preceptors, which is a trademark of experiential learning.[86] As such, athletic training programs should consider preparing students to take on the role of becoming change agents by practicing public health

Table 5. The Preventive Medicine Milestone Project

Milestone	Description
Patient care	Apply skills in emergency preparedness and response
	Monitor, diagnose, and investigate community health problems
	Inform and educate populations about health threats and risks
	Develop policies and plans to support individual and community health efforts
	Evaluate population-based health services
	Descriptive epidemiology: able to characterize the health of a community
	Analytic epidemiology: able to design and conduct an epidemiologic study
	Disease outbreak: investigate and respond to a cluster or outbreak
	Design and operate a surveillance system
	Clinical preventive services: analyze evidence regarding the performance of proposed clinical preventive services for individuals and populations
	Conditions of public health significance: implement appropriate clinical care for individuals with conditions of public health significance
	Select and provide appropriate evidence-based clinical preventive services
Medical knowledge	Behavioral health
	Environmental health
	Biostatistics
Systems-based practice	Work and coordinate patient care effectively in various health care delivery settings and systems
	Incorporate considerations of cost awareness and risk-benefit analysis in patient and/or population-based care, as appropriate
	Work in interprofessional teams to enhance patient safety and improve patient care quality; advocate for quality patient care and optimal patient care systems; participate in identifying system errors and implementing potential systems solutions
Practice-based learning and improvement	Identify strengths, deficiencies, and limits in one's knowledge and expertise; set learning and improvement goals and identify and perform appropriate learning activities using information technology, evidence from scientific studies, and evaluation feedback; systematically analyze practice using quality improvement methods, and implement changes with the goal of practice improvement
Professionalism	Compassion, integrity, and respect for others, as well as sensitivity and responsiveness to diverse patient populations, including diversity in gender, age, culture, race, religion, disabilities, and sexual orientation; knowledge about, respect for, and adherence to the ethical principles relevant to the practice of medicine, remembering in particular that responsiveness to patients that supersedes self-interest is an essential aspect of medical practice
	Accountability to patients, society and the profession
Interpersonal communication and skills	Communicate effectively with patients, families, and the public, as appropriate, across a broad range of socioeconomic and cultural backgrounds; communicate effectively with physicians, other health care professionals, and health-related agencies; work effectively as a member or leader of a health care team or other professional group; act in a consultative role to other physicians and health professionals
	Maintain comprehensive, timely, and legible medical records, including electronic health records

topics at both the individual and population levels. Specifically, ATs can accomplish this through modeling behaviors.

Limitations and Future Considerations

The limitations of this study are respective to the participants we studied. For the purpose of the study, we examined practicing clinicians. The new standards will be deployed for upcoming athletic training students, yet are not required for the already practicing clinician. We believe the knowledge and practice behaviors for the public health topics could be based on educational background, previous clinical practice experiences, media exposure, and other contextual factors. While the call to action in previous literature was to explore ATs' knowledge and integration of population health, we sought to study the knowledge and integration of individual-level public health topics. The goal now is to take the individual-level data collected from this study accompanied by the curricular recommendations for athletic training programs in the discussion on how we, as a profession, can leverage our foundational knowledge of public health into a population health model. As such, future research should explore the successes and barriers to population health implementation for the practicing clinician.

CONCLUSIONS

In an effort to improve clinicians' knowledge and practice of public health, ATs should seek out continuing education related to the Healthy People 2020 areas and the preventative medicine milestones, and should deploy actionable steps in their daily practice related to community-based health

promotion. Athletic trainers lacked the knowledge and practice behaviors of 3 key public health areas, including the social determinants of health, environmental factors, and assessing health-related quality of life. The participants lacked baseline knowledge recall and use of public health principles. Additionally, the participants held a higher perception of their knowledge before taking the knowledge assessment than afterward, emphasizing the move from unconscious incompetence to conscious incompetence as they were able to identify what public health entails yet did not have specific knowledge in the public health topic areas. Moreover, it is key that ATs recognize the intersection of athletic training practice and public health topics. As postbaccalaureate athletic training programs begin requiring foundational knowledge in public health and epidemiology, practicing clinicians, preceptors, and educators must work diligently to improve their knowledge and practice of public health.

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