General Original Article

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A comparative study of the effectiveness of an osteopathic primary care sports medicine led intervention on performance in men's collegiate lacrosse players

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Abstract

Context: Comprehensive sports medicine care goes beyond the treatment of injuries resulting from athletic activities. Ultimately, it is a competence that includes knowledge in physical therapy, training, nutrition, coaching, motivation, competition, mentoring, psychology, and spirituality that allows the physician and patient to collaborate on promoting the patient's health goals. The current literature demonstrates a lack of knowledge in the Osteopathic Primary Care Sports Medicine Model's effectiveness in performance.
Objectives: To determine whether a comprehensive osteopathic primary care sports medicine approach can improve performance and health outcomes in collegiate athletes.
Methods: A randomized controlled trial commenced just prior to the start of the lacrosse season and concluded at the end of the season. All the New York Institute of Technology (NYIT) collegiate lacrosse players were educated first in a 1-day seminar of the core competencies, and all participants had access to ask questions on their own volition. Then they were randomized into two groups, either the experimental group receiving the direct osteopathic primary care sports medicine intervention (n=18) or the control group not having active intervention (n=19). Also, the overall team winning percentage for that season was computed and compared to that for the previous years and the following year. Participants were assessed before and after the intervention with the Patient Health Questionnaire (PHQ-9), the 36-Item Short Form Survey (SF-36), custom Osteopathic Primary Care Sports Medicine questionnaire, and body fat composition, and their changes were compared between the experimental group and the control group. Collected data were analyzed using the repeated-measures analysis of variance.
Results: Thirty-seven participants were enrolled in the study. After 14 participants were excluded due to being lost to follow-up, 23 athlete records were analyzed. The winning percentage of the team was highest during the year of the study period time than in the 3 previous years and the following year. The test group did not have any statistically significant change in the PHQ-9, SF-36, custom Osteopathic Primary Care Sports Medicine questionnaire, as well as in body fat composition.
Conclusions: When used during a collegiate lacrosse season, this Osteopathic Primary Care Sports Medicine intervention did not significantly improve health outcomes. This preliminary study, despite its limitations in compliance and study population size, did demonstrate improvement in overall team performance when comparing the intervention sport season to other seasons but was not statistically significantly. Therefore, further studies are warranted to improve the understanding in this approach to athlete health outcomes and performance.

Keywords: collegiate sports; family medicine; health; lacrosse; osteopathic medicine; performance; primary care; sports medicine.

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It is estimated that there are over 480,000 collegiate athletes competing in the United States [1]. Athlete performance success can be measured in terms of winning percentage or by an athlete's personal best [2]. According to the Team Physician Consensus Statement 2013 Update, one of the roles of the team physician is to be able to identify and educate athletes on issues that can affect athletic performance such as strength and conditioning, nutrition, and psychology [3]. Osteopathic philosophy further appreciates that a person is a product of the dynamic interaction between the body, mind, and spirit [4]. It is therefore possible to consider that an osteopathic primary care sports medicine intervention can have an effect on athletic performance. A literature review was conducted and studies investigating the effectiveness of a comprehensive approach based in the osteopathic philosophy vs. a problem-based approach in sports medicine were not found.

This study aims to establish that a comprehensive approach guided by a supervising physician based in the osteopathic philosophy may result in improvement in health outcomes and overall improvement of athletic performance.

Methods

This randomized controlled trial was approved by the New York Institute of Technology (NYIT) institutional board. It was conducted on the NYIT campus. Participant written consent was obtained (by H.Z.) within one week of the commencement of the intervention and stored in a secure location. H.Z. was the principal investigator from the IRB perspective in order to avoid any conflict of interest with the principal author. It was disclosed on the consent that N.C.R. may benefit from the study results, and therefore was not privy to the administering of the study, including the randomization of subjects.

Recruitment

Participants of the study were recruited from the men's lacrosse team at NYIT. The study took place from January 2017 to May 2017. A total of 37 subjects were recruited. The inclusion criteria were individuals between the ages of 18 and 22 who were capable of giving consent and were a member of the NYIT men's lacrosse team. There was no compensation to the participants of the study. There was no funding provided for conducting the study. The exclusion criteria consisted of not being able to participate throughout the season due to a medical problem or academic probation. There were no athletes excluded from the study.

Randomization

Thirty-seven subjects were randomized into the experimental group (n=18) and the control group (n=19) following the simple randomization procedures with the randomization sequence generated using Microsoft Excel.

Study design

Upon initiation to the study, all athletes (in both the experimental and control groups) were provided with patient education on topics including nutrition, physical therapy techniques, expectations of team physician and coach, training exercises, finding motivation to compete, mentorship via role models, psychological care, and spiritual guidance during a one-day in person seminar led by primary care sports medicine physicians, fellows, residents, and students who were proficient in understanding the topics. It was critical during this session for athletes to understand the role of the physician in the pursuit of their goals, not only as an advocate for the participants' health above everything else, but also as a coordinator for all the other roles necessary to ensure the athletes' success. For instance, if in a medical evaluation of a participant it was noted that a muscle weakness was present, the physician would recommend a supervised exercise program for the participant or refer the participant to physical therapy. Similarly, if a participant were struggling with motivation, the physician would seek out resources for the participant, such as spiritual counseling or mentorship programs. Each participant's needs for further resources or other interventions were determined on a case-by-case basis. Of note, no restrictions to access ancillary services were made to either group.

Participants were also provided with a workbook for easy reference to exercises, dietary recommendations, and so on. The workbook included recommended treatments for common ailments, links to videos demonstrating exercises to prevent injuries that the participants were recommended to perform 2–3 times per week, and as a sample nutrition plan. Additionally, the workbook provided guidance on how to measure performance subjectively, meditation techniques to support psychological well-being, ways to utilize spirituality in the sense of being part of something bigger than oneself to create a cohesive and unified program that supported all-around athletic performance and health. The workbook included:

(1) Instructions for how to develop a personal athletic mission statement.
(2) Educating the athletes on how to communicate with their team physician, which included a list of recommended self-care of common ailments.
(3) Links to videos of injury prevention exercises focusing on upper core, back, lower core, and proprioception, which the participants were recommended to perform two or three times per week.
(4) Links to videos demonstrating aerobic and anaerobic strength and conditioning exercises, with instructions to increase intensity in reps by 10% per week.
(5) A sample nutrition plan that was based on an 1,800-calorie diet with a macronutrient model of 56% carbohydrate, 23% protein, and 21% fat. The nutrition plan was customizable for each athlete's caloric needs and calculated via the Harris Benedict and basal metabolic rate formulas. Macronutrient guidelines were selected based on the American College of Sports Medicine guidelines for this category of sport [5, 6].
(6) Educating the athletes on how to communicate with their coach.
(7) Educating the athletes on how to use a competitor as a motivating energy.
(8) Educating the athletes on how to use a role model to improve performance.
(9) Sports psychology exercises, including meditation and focused attention.

(10) Tools to utilize spirituality in the sense of being a part of something bigger than oneself.

Osteopathic medical coaching intervention group

Participants in this group received monthly contact with the physicians. A contact was defined as either an in-person session or dialogue via email and/or texting. During the sessions, the athletes received individualized, specific guidance in support of their performance goals. Their custom workbook was used as a reference to reinforce the health and wellness topics. The physicians were available for any questions. Medically related questions were directed to the team physician.

Control group

Participants in this group did not have monthly contact with the physicians. However, the physicians were available for any questions initiated by the participants. In other words, the participants had access to the physicians but did not have active coaching sessions with the physicians.

In sum, all participants had access to and were educated on the Osteopathic Primary Care Sports Medicine–led intervention concepts, but only the experimental group had regular coaching with the physicians. To ensure keeping the control group from engaging in active coaching, the sessions were by invitation only, and the lacrosse coaching staff ensured that only those athletes in the experimental group were to participate while the control group engaged in specific coaching with the coaches of other sports. Both groups were expected to benefit from the concepts and exhibit changes in behaviors positively, except that the experimental group would display a great change in behavior, as measured by the surveys and testing. Collusion between the groups was minimized by instructing the experimental group via invoking the honor code in keeping any knowledge gained by the sports medicine coaching sessions for their own personal use.

Outcomes measurement

The team winning percentage for the season was recorded as a measure of overall team performance. The following surveys were issued pre- and poststudy to all participants: the Patient Health Questionnaire (PHQ-9), the 36-Item Short Form Survey (SF-36), and the custom Osteopathic Primary Care Sports Medicine questionnaire. The PHQ-9 was assessed to measure depression among the participants. Scores >4 were considered positive for mild-moderate depression, and scores >14 were indicative of moderate-severe depression. The SF-36 was assessed as a measure of health-related quality of life, with the eight subscales including physical function, limitations due to health, limitations due to emotional problems, social interaction, emotional health, energy levels, pain levels, and perception of general health. The custom Osteopathic Primary Care Sports Medicine questionnaire was developed by the authors with 10 questions to assess how well the participants understood the athletic mission statement and the nine roles of team physician, physical therapist, trainer, dietitian, coach, competitor, role model/hero, psychologist, and spiritual leader. Its face- and content-validity has been checked by the authors, the content experts. The participants' body fat composition was also measured as a sports medical outcome.

Specific aims

The five specific aims of this study are:

(1) The overall performance of the team who competes at the collegiate level will improve in the experimental year with a comprehensive sports medicine approach compared to the performance in the other years with standard care only.
(2) The overall performance of the experimental group will be greater than that of the control group as measured by body fat composition.
(3) There will be a difference in the measures of stress and depression, as per the PHQ-9, between the experimental and control groups.
(4) The subjects' perception of their own health, as per the SF-36, will be improved in the experimental group compared to the control group.
(5) The subjects' understanding of the athletic mission statement and nine roles, as per the custom Osteopathic Primary Care Sports Medicine questionnaire, will be improved in the experimental group compared to the control group.

Statistical analysis

To describe the data, the mean and standard deviation were computed for continuous scale outcomes and the frequency and percent for categorical outcomes. Repeated-measures analysis of variance was employed to compare the outcomes change from pre- to postseason between the experimental vs. control groups. Statistical significance was evaluated at alpha=0.05. All analyses were performed using IBM SPSS Statistics Version 26.

Results

Among 37 total participants at the start of the study (all male; age range, 18–22 years [mean age, 20.2 years]), 23 participants completed the study, whereas 14 were lost to follow-up. Those lost to follow-up chose to leave the study prior to completion of the postseason surveys. There were no adverse effects, but the main reason for 14 being lost to follow-up was that their sport season had ended and they were unable to be reached because they had left campus. The control group included 10 subjects, all males ages 18–22 (mean age, 20.1 years). The experimental group included 13 male subjects (age range, 18–22 years; mean age, 19.9 years).

Table 1: Body composition measurements from pre- to postseason between the control and experimental groups.

Body composition measurement	Control group		Experimental group		p-Value
	Pre (n=10)	Post (n=10)	Pre (n=13)	Post (n=13)	
Total mass	166.8 (34.1)	162.1 (24.6)	196.0 (35.8)	186.8 (29.9)	0.63
% Fat	18.6 (6.8)	14.7 (4.5)	24.2 (8.4)	21.0 (8.2)	0.85
LBM	128.5 (19.0)	114.0 (57.6)	140.6 (16.2)	140.5 (18.7)	0.31
Trunk %bf	17.8 (9.0)	12.7 (4.8)	25.2 (10.6)	21.5 (9.8)	0.86
Trunk LBM	59.9 (8.6)	63.0 (11.3)	64.5 (7.2)	64.2 (8.7)	0.20
Right leg LBM	22.1 (3.9)	22.0 (3.7)	25.1 (3.5)	25.1 (3.7)	0.78
Right leg %bf	20.2 (5.8)	17.3 (6.1)	24.3 (6.8)	21.2 (8.2)	0.91
Right leg ratio	1.02 (0.03)	1.03 (0.02)	1.01 (0.05)	1.02 (0.04)	0.57
Left leg LBM	21.5 (3.6)	21.4 (3.7)	24.9 (3.8)	24.7 (3.9)	0.94
Left leg %bf	20.0 (5.6)	16.9 (5.1)	24.2 (7.2)	21.3 (7.7)	0.54
Left leg ratio	0.98 (0.03)	0.97 (0.02)	0.99 (0.04)	0.99 (0.04)	0.51
Right arm LBM	8.8 (1.6)	9.2 (1.3)	9.3 (1.2)	9.4 (1.5)	0.53
Right arm %bf	16.2 (5.4)	12.7 (3.3)	20.6 (8.3)	16.9 (7.1)	0.99
Right arm ratio	1.05 (0.09)	1.03 (0.04)	1.05 (0.03)	1.02 (0.05)	0.70
Left arm LBM	8.5 (1.7)	8.9 (1.1)	8.9 (1.1)	9.3 (1.6)	0.81
Left arm %bf	16.3 (5.6)	12.7 (3.0)	21.6 (8.2)	17.4 (7.2)	0.42
Left arm ratio	0.96 (0.08)	0.97 (0.04)	0.95 (0.03)	0.98 (0.05)	0.56

bf, body fat; LBM, lean body mass.

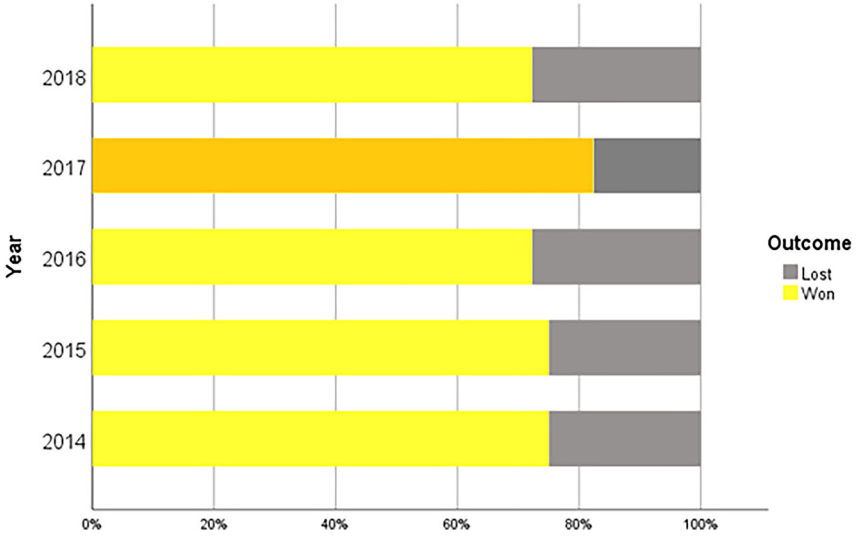

Figure 1: Bar graph of the winning vs. losing percentage by year of season.

The overall performance of the team demonstrated improvement, as measured by the number of games won, over the course of the intervention season compared to previous seasons and the following season (Figure 1). The winning percentage was 82%, with 14 games won and three games lost in the intervention season of year 2017. This is noticeably higher than the winning percentage (72–75%) in any other seasons of the three preceding years or the following year when the intervention was not implemented. Body fat composition measurements were reported in Table 1. The change of any body fat composition measurement was not significantly different between the experimental group and the control group.

PHQ-9 and SF-36 scores are reported in Table 2. For both the questionnaire and the survey, the score changes are not significantly different between the experimental group and the control group.

The subject responses to the Osteopathic Primary Care Sports Medicine questionnaire are reported in Table 3. The response changes are not significantly different between the experimental group and the control group.

Table 2: Subject responses to SF-36 and PHQ-9 from pre- to postseason between control and experimental groups.

Outcome	Control group		Experimental group		p-Value
	Pre (n=10)	Post (n=10)	Pre (n=13)	Post (n=13)	
PHQ-9	3.3 (4.0)	0.6 (0.8)	2.2 (2.3)	1.1 (2.0)	0.23
SF-36					
Physical functioning	100.0 (0.0)	100.0 (0.0)	98.8 (2.2)	98.8 (3.0)	1.00
Role limit in physical health	100.0 (0.0)	100.0 (0.0)	100.0 (0.0)	100.0 (0.0)	1.00
Role limit in emotional problem	100.0 (0.0)	100.0 (0.0)	92.3 (27.7)	94.9 (18.5)	0.37
Energy/fatigue	72.0 (10.3)	72.5 (14.4)	75.0 (12.4)	73.8 (16.3)	0.94
Emotional well-being	80.4 (11.2)	81.2 (10.3)	88.0 (10.4)	82.2 (16.4)	0.41
Social functioning	95.0 (10.5)	93.8 (8.8)	88.5 (20.1)	91.3 (17.2)	0.65
Pain	88.0 (13.5)	85.0 (18.1)	92.9 (9.8)	88.7 (15.2)	0.78
General health	74.5 (17.6)	83.0 (13.4)	76.9 (15.3)	74.2 (16.7)	0.07

PHQ-9, Patient Health Questionnaire; SF-36, 36-Item Short Form Survey.

Table 3: Subject responses to the Osteopathic Primary Care Sports Medicine from pre- to postseason between the control and experimental groups.

Osteopathic primary care sports medicine: participants understanding of	Control group		Experimental group		p-Value
	Pre (n=10)	Post (n=10)	Pre (n=13)	Post (n=13)	
Athletic mission statement	4 (40.0%)	7 (70.0%)	9 (69.2%)	11 (84.6%)	0.65
Role of[a]					
Team physician	1.0 (0.9)	1.4 (1.5)	1.7 (1.5)	2.2 (1.2)	0.58
Physical therapist	1.7 (1.7)	1.6 (1.6)	3.4 (1.2)	3.3 (1.1)	0.63
Trainer	3.5 (1.3)	2.8 (1.8)	3.5 (1.0)	3.9 (0.4)	0.41
Dietitian	1.6 (1.2)	1.8 (1.3)	2.3 (1.4)	2.5 (1.6)	0.63
Coach	2.6 (1.3)	2.9 (1.4)	3.2 (0.9)	3.8 (0.4)	0.97
Competitor	2.6 (1.1)	3.0 (1.4)	3.6 (0.7)	3.1 (1.3)	0.32
Role model/hero	1.6 (1.4)	2.6 (1.5)	1.9 (1.6)	2.9 (1.6)	0.77
Psychologist	2.8 (1.3)	2.9 (1.6)	3.4 (0.8)	2.7 (1.6)	0.43
Spiritual leader	2.2 (1.3)	2.1 (1.7)	2.4 (1.3)	2.6 (1.6)	0.85

[a]The score for the participants understanding of each role ranges from 0 to 4, with the higher score associated with better understanding.

Discussion

In the current study, the goal was to establish that a comprehensive approach to sports medicine as guided by osteopathic principles was superior to a problem-based approach in that it would improve overall patient health and lead to achievement of patients' athletic goals. Compliance was a key factor in the intervention, as it was dependent upon monthly meetings between the experimental group and physicians. As a result, there were no statistically significant findings in this study.

Attendance by the student athletes was very poor; less than 50% of the experimental group attended their assigned appointment times. Subjective assessment of compliance with incorporation of the Osteopathic Primary Care Sports Medicine–led intervention principles was also unfavorable in the experimental group. Additionally, throughout the course of the season, support from team leadership appeared to begin to waver as the demands on the athletes increased. For instance, team practices were often scheduled during times designated for appointments. It is also of note that NYIT is a commuter school, so most student athletes do not live on campus, which may have led to difficulty in attending appointments. These athletes also had to contend with a rigorous undergraduate curriculum in addition to their training as a division II lacrosse team. They had little time to prepare healthy meals for themselves, and the resources available in the NYIT cafeteria did not support the dietary principles that the physician advised. Finally, 32% of the study population was lost to follow-up at the end of the study, which further limited the study data.

Therefore, it is clear that multiple factors impacted patient compliance, and we cannot establish whether the lack of statistical significance in this study was due to compliance

alone or due to a failure in the intervention. Further research may be warranted to establish the critical factors impacting patient compliance, as well as the factors that impact the establishment of a successful doctor–patient relationship. A way to minimize the dropout rate is to have an app/digital-based tool or telemedicine to communicate with the participants on their smartphones to conduct the sports medicine coaching as well as administer the surveys. It is also reasonable to use digital diaries to monitor adherence to the protocol.

It is important to note that the team winning percentage improved during the time of intervention, as compared to wins and losses over the three previous years (data prior to that were unavailable), and returned to baseline the year after when this intervention was not done. This may indicate that the initial seminar of the Osteopathic Primary Care Sports Medicine–led intervention concepts may have had a positive influence on the team as a whole, although this was not one of our hypotheses. It is noted, however, that this result could be an incidental finding, because team composition year to year was not controlled in this study. Future studies should incorporate athlete performance metrics to better establish how the Osteopathic Primary Care Sports Medicine–led intervention concepts impact team and individual athlete performance as a whole. Furthermore, although randomization of the team was sufficiently performed, it would be useful to control for upperclassmen vs. lowerclassmen, all-conference players vs. non–all-conference players, and other skill level measurements in order to avoid bias in the interpretation of the data.

The osteopathic primary care sports medicine–led intervention proposes that one of the keys to athletic success is to empower the athlete by becoming proficient in understanding and applying the concepts of the nine fundamental roles: team physician, physical therapist, trainer, dietitian, coach, competitor, role model, psychologist, and spiritual leader. The supervising physician plays a critical role because he/she will assess every health aim and injury in the context of the athlete and guide patients to make decisions that support their unique requirements for performance, which includes the establishment of the eight remaining roles [6]. With the support of a supervising physician and with the whole-person approach in place, athletes would be able to achieve the goals they set forth and achieve improved health outcomes as one piece of their overall health picture instead of viewing that aspect independent from the others. In the formation of such a partnership, the physician can lead the athlete in improving their health and performance in their activity of choice. In a previous study that looked at the effect of 87 studies of personalized medicine on patient care, the impact of a physician on psychological and medical treatment efficacy, patient satisfaction, and treatment compliance was demonstrated [7].

Collegiate team physicians, who are osteopathic physicians who practice in the osteopathic philosophy, have resources available for comprehensive care, such as at the Division 1 level. However, not all collegiate sports programs have osteopathic physicians who practice in the osteopathic philosophy or have comprehensive services readily available, suggesting that this model may be a potential solution to improve athletic performance for those who lack the resources.

There is literature on the study of peak performance that exist in disciplines other than the osteopathic team physician. A meta-analysis of 997 studies showed that there is evidence that coach-delivered intervention can have a greater effect on sports performance among psychological and psychosocial interventions [8]. A systemic review of studies involving masters swimmers showed that there was a positive effect on performance when energetics and swim technique were the intervention [9]. A prospective study looking at recovery protocols in baseball players demonstrated a potential for decreased injuries and therefore improved pitching performance [10]. A prospective study of 101 athletes showed that there was a positive association between nutrition knowledge and diet quality that can lead to improved performance [11]. A prospective study of 356 elite youth athletes looked at psychological determinants associated with burnout and correlated them with decreased performance [12]. On the Olympic level, Gould et al. studied performance from a sport psychology perspective and concluded that there are multiple factors that can play a role, such as "psychological, physical, social, and organizational factors." Specifically, they interviewed eight Olympic teams and found that four teams met/exceeded the expected sport performance measures and four did not [13]. Bytomski published a clinical review studying the impact of nutrition on performance and found that athletic performance would benefit from customized daily and activity-specific nutrition goals [14]. However, we had not identified any studies that approach peak performance from the perspective of an osteopathic team physician through a direct comprehensive intervention. Of note, it is important to understand the different philosophical approaches between osteopathic medicine and allopathic medicine. Although the osteopathic medical doctor utilizes the 'whole person' approach, the allopathic medical doctor utilizes a reductionist approach that focuses on symptoms and disease [5]. Further studies are being planned in an attempt to offer an opportunity for the team physician to have a greater impact on the care of the athlete, especially because the effectiveness of a coach in the outcomes of the athlete's performance is also based on matching the coach's intention with the needs of the athlete [15].

Conclusion

This study attempted to study a novel approach to increasing performance and health outcomes based upon the osteopathic philosophy that can be integrated into an existing collegiate sports program. With this study being a preliminary report, additional studies will help and are currently being planned to validate this protocol with stricter control of the variables and compliance in the field of performance.

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Competing interests: Dr. Rao is the author of and owns the intellectual property related to *Step Up Your Game*, a book referenced in the article.

Ethical approval: This study was reviewed and approved by: Institutional Review Board, Office of Sponsored Program and Research, New York Institute of Technology, Old Westbury, NY (Protocol #BHS-1261).

Informed consent: All participants in this study provided written informed consent prior to participation.

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