Adequacy of Education in Musculoskeletal Medicine

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Background: Basic musculoskeletal knowledge is essential to the practice of medicine. A validated musculoskeletal cognitive examination was given to medical students, residents, and staff physicians in multiple disciplines of medicine to assess the adequacy of their musculoskeletal medicine training.

Methods: The examination was given to 334 volunteers consisting of medical students, residents, and staff physicians. Analysis of the data collected and comparisons across disciplines were performed.

Results: The average cognitive examination score was 57%. Sixty-nine participants (21%) obtained a score of ≥73.1%, the recommended mean passing score. Of the sixty-nine with a passing score, forty (58%) were orthopaedic residents and staff physicians with an overall average score of 94%. Differences in the average scores for the orthopaedic residents compared with all other specialties were significant ($p < 0.001$). The average score was 69% for the 124 participants who stated that they had taken a required or an elective course in orthopaedics during their training compared with an average score of 50% for the 210 who had not taken an orthopaedic course ($p < 0.001$). When the scores of those in orthopaedics were excluded, the average score for the participants who had taken an orthopaedic course was 59%; this difference remained significant ($p < 0.001$).

Conclusions: Seventy-nine percent of the participants failed the basic musculoskeletal cognitive examination. This suggests that training in musculoskeletal medicine is inadequate in both medical school and nonorthopaedic residency training programs. Among the nonorthopaedists, scores were significantly better if they had taken a medical school course or residency rotation in orthopaedics, suggesting that a rotation in orthopaedics would improve the general level of musculoskeletal knowledge.

Basic musculoskeletal knowledge is essential to the practice of medicine. Many disciplines in medicine treat patients with musculoskeletal problems on a routine basis. In 2002, the Centers for Disease Control reported that musculoskeletal problems are second only to upper respiratory illness as reasons why people seek medical attention in the emergency department[1]. Musculoskeletal symptoms are also the most common reason for visits to outpatient departments[2].

In 1998, Freedman and Bernstein developed a musculoskeletal examination to test health-care providers with respect to their basic cognitive understanding of musculoskeletal problems[3]. This examination was previously described as a "competency examination"; however, it was renamed a "cognitive examination" to better reflect the depth of knowledge that it was able to test[4]. This examination was developed and validated by both orthopaedic and internal medicine chairpersons, and a passing score was set at ≥73.1%[3,5]. The examination was administered to eighty-five residents in their first postgraduate year of training[3]. Seventy (82%) of the eighty-five residents failed to demonstrate basic cognitive understanding of musculoskeletal problems, with an overall mean score of 59.6%. Residents who had taken an elective course in orthopaedic surgery during medical school had an average score of 68.4% compared with 57.9% for those who had taken the required course in orthopaedics and 55.9% for those who had not had a rotation in orthopaedics[3].

Jones administered the same musculoskeletal cognitive examination to twenty-two medical students in their last month of their final year of training at the University of the West Indies, Barbados[6]. Eighty-two percent failed to score over 73.1%. The questions were also categorized into three groups: anatomy, trauma, and general orthopaedics. All students failed to score over 73.1% in anatomy, 64% failed in trauma, and 45% failed in general orthopaedics[6].

Education in musculoskeletal medicine has been shown to be inadequate in some medical school curricula[7,8]. Regardless of specialty training, physicians, residents, and students in most areas of medicine should know the basic elements of musculoskeletal history and physical examination and basic musculoskeletal pathology. The purpose of this study was to

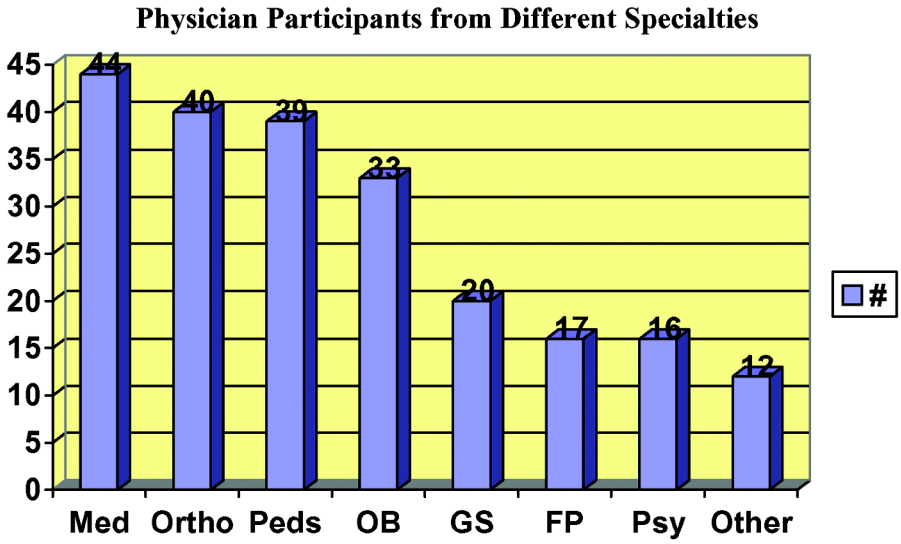

Fig. 1
The physician participants according to the different specialties. Med = internal medicine, Ortho = orthopaedics, Peds = pediatrics, OB = obstetrics-gynecology, GS = general surgery, FP = family practice, Psy = psychiatry, Other = anesthesia (2 participants), emergency medicine (2), ophthalmology (1), radiology (2), and transitional (5).

determine the adequacy of musculoskeletal education by testing medical students and physicians in several fields of medicine at a university-based training hospital and a United States Army Medical Center.

Materials and Methods

The validated basic cognitive examination[3] consisting of twenty-five short-answer questions, scored on a scale of 0 to 100 points, was administered prospectively to medical students, residents, and staff physicians over a twelve-week period. Before the examination was administered, the institutional review boards of the involved institutions approved the study. Each packet contained the cognitive examination, a cover letter explaining the purpose of the study, and a demographic questionnaire (see Appendix). Verbal informed consent was obtained prior to administration. Inclusion criteria included all second and fourth-year medical students, resident physicians, and staff physicians who were available to hear the instructions given in the cover letter. The instructions and the examination were given during a one-hour block of medical school lectures or during a weekly conference in the respective specialty. All participants took the basic examination voluntarily. Exclusion criteria included those individuals who were not present during their lecture block or were not participating in their weekly conference and those who voluntarily chose not to take the examination. The examination was administered in the same fashion to all participants and was collected promptly after completion. Written answers to the examination were made available after all had taken it, to prevent the circulation of either the questions or the answers prematurely.

The examinations were scored anonymously after collection. Each question was worth a maximum of 1 point. Raw scores were multiplied by four to obtain a score from 0 to 100 points. Partial credit was given for some questions that required multiple answers. The overall unweighted examination score was calculated as described by Freedman and Bernstein[3], with a recommended passing score of ≥73.1%.

A power analysis was performed, and differences between groups of subjects were analyzed according to the type of outcome variable. Categorical data (outcomes) were analyzed with use of chi-square or Fisher exact tests. Independent sample t tests and one-way analysis of variance were used to analyze total scores and subscores (continuous data) between groups. When the analysis-of-variance results showed significant differences, multiple pairwise comparisons were performed with use of the Bonferroni method. The level of significance was set at 0.05. Statistical analysis was performed with use of SPSS software (version 10.1; SPSS, Chicago, Illinois).

Results

Participant Characteristics

The examination was administered to 113 medical students, 167 residents, and fifty-four staff physicians for a total of 334 participants; ninety-five were active-duty military personnel, and 239 were civilians. A breakdown of the resident and staff specialties is shown in Figure 1. Of the 113 medical students, forty had completed two years of medical school didactics and seventy-three were completing fourth-year clinical rotations.

One hundred and twenty-four participants (37%) had taken an elective or required course in orthopaedics, and 155 participants (46.4%) were comfortable with their skills in performing a clinical musculoskeletal examination. Twenty-seven participants (8.1%) stated that they had taken a musculoskeletal examination before.

Overall Scores

The average cognitive examination score was 56.9%. Only sixty-nine (20.7%) of the participants obtained a score of ≥73.1%. Two hundred and sixty-five participants (79.3%) failed. Of the sixty-nine participants with a score of ≥73.1%, forty (58%) were from orthopaedics, with an overall average

score of 94%. Excluding the scores of those in orthopaedics, the overall mean cognitive score was 52%.

Scores by Discipline

The average score for each group was 48.8% for medical students, 58.1% for residents, and 70.4% for staff physicians. Eleven percent of the residents and 41% of the staff physicians were in orthopaedics. The mean score for the staff was significantly better than that of the residents and the students ($p < 0.001$ for both), and the residents scored significantly better than the students ($p < 0.001$). A score of ≥73.1% was achieved by 21% of the residents (including those in orthopaedics) compared with 5% of the students and 52% of the staff physicians.

The average scores by specialty are shown in Figure 2. The difference in the mean scores for the orthopaedic residents compared with all other specialties was significant ($p < 0.001$). The average scores for the second and fourth-year medical students were 39.9% and 53.7%, respectively ($p < 0.001$).

Scores According to Whether a Required or an Elective Course in Orthopaedics Had Been Taken

The average score was 69% for the 124 participants who stated that they had taken a required or an elective course in orthopaedics during their training compared with 50% for the 210 who had not taken an orthopaedic course ($p < 0.001$). Excluding the scores of orthopaedic residents and staff physicians, the average score for those who had taken an orthopaedic course was 59% and this percentage remained significantly greater than the percentage for those who had not taken a course ($p < 0.001$). Medical students who had participated in an orthopaedic rotation had an average score of 58.8% and those who had not participated had an average score of 47% ($p = 0.001$). A significant correlation was found between the year in medical school and the examination score, with fourth-year students scoring significantly better than second-year students ($p < 0.001$). With the numbers available, no significant correlation was found between the number of years in practice or residency year and the score on the basic musculoskeletal cognitive examination ($r = 0.43$).

Scores According to Whether the Participants Were Comfortable with Their Ability to Perform a Musculoskeletal Examination

One hundred and fifty-five participants (46.4%) who stated that they were comfortable with regard to their ability to perform a musculoskeletal examination had an average score on the cognitive examination of 66%. One hundred and seventy-nine participants who stated that they were not comfortable with regard to their ability to perform a musculoskeletal examination had an average score of 49% ($p < 0.001$). The most common reasons why participants were not comfortable performing the examination were as follows: "training in musculoskeletal medicine inadequate" (58%), "never did a rotation in orthopaedics" (16%), "not required or taught during my training" (8%), and "other reasons" (18%).

Percentage of Participants Who Answered Each Question Correctly

The questions on the basic musculoskeletal cognitive examination were numerically placed in order of importance as rated by 157 orthopaedic chairpersons[3]. Question 1 was deemed more important to basic musculoskeletal cognition than was question 25. The percentage of the participants who answered each question correctly is shown in the Appendix. The overall percentage of participants who answered correctly ranged from 94% for question 2 (compartment syndrome) to 13% for questions 6 (low-back pain) and 17 (common sources of cancer metastatic to bone). When only the participants with a passing score were considered, it was found that 100% of them answered questions 2, 7 (treatment of compartment syndrome), and 10 (carpal tunnel) correctly compared with 42% who answered question 17 correctly. Excluding orthopaedists, participants with a passing score also answered questions 2, 7, and 10 correctly 100% of the time, and question 17 was answered correctly 13.8% of the time. When the scores of

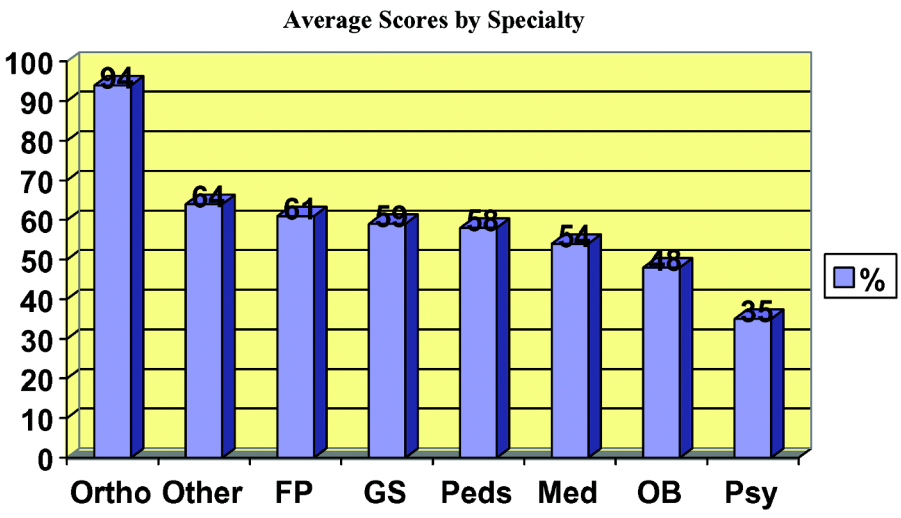

Fig. 2

Average scores by specialty. Med = internal medicine, Ortho = orthopaedics, Peds = pediatrics, OB = obstetrics-gynecology, GS = general surgery, FP = family practice, Psy = psychiatry, Other = anesthesia (2 participants), emergency medicine (2), ophthalmology (1), radiology (2), and transitional (5).

orthopaedists were considered, the lowest score was also seen for question 17 (66%).

Comparison of Civilian and Military Training Facilities

The mean score was 62% for the ninety-five participants who were active-duty military personnel compared with 55% for the civilians ($p < 0.001$). The mean score for the military residents was 67% compared with a mean score of 54% for the civilian residents ($p < 0.001$).

Discussion

Cognitive recognition of musculoskeletal problems is important in a clinical practice. Practitioners must know how to treat basic musculoskeletal symptoms, when to refer patients with such symptoms, and what constitutes an orthopaedic emergency. The foundation of musculoskeletal knowledge must stem from appropriate medical school and residency training curricula.

Primary care physicians have been evaluated with regard to their level of understanding of musculoskeletal problems[9]. Fowler and Regan reported that, for 95% of patients with symptomatic, chronic tears of the anterior cruciate ligament, the condition was misdiagnosed by the primary care physician[9]. Forty-nine percent of those patients were able to provide an accurate description of the injury consistent with an anterior cruciate ligament disruption[9]. Our study likewise found this area to be poorly understood. Questions 16 and 20 on the cognitive examination tested the level of understanding with regard to the diagnosis of an anterior cruciate ligament tear. Only 40% and 54%, respectively, of those in the primary care specialties provided a correct response to questions 16 and 20. In 1990, there were fifteen million office visits because of mechanical low-back pain, making it the fifth most common reason for all physician office visits[10]. Fifty-six percent of those visits were to primary care physicians[10]. Questions 6, 11, and 14, which pertained to this topic on the cognitive examination, were answered correctly by 10%, 24%, and 27%, respectively, of the participants who were in the primary care specialties.

The underlying deficiency of musculoskeletal medical knowledge may be due, in part, to the lack of exposure to basic anatomy and to musculoskeletal medicine as a whole. The average score on the eight basic anatomy questions on the examination was 49%. Anatomy is one of the core courses of medical education, but the time devoted to anatomic dissection and other traditional methods of instruction is decreasing[11-13]. Medical students have recognized the importance of anatomy and laboratory dissection as the foundation for their clinical clerkships[12], and, for physicians, anatomy is an essential element of patient care.

Pinney and Regan noted a marked discrepancy between the necessary skills and knowledge required to treat patients with musculoskeletal disorders, as determined by a survey of primary care physicians, and the amount of time devoted to teaching these skills in Canadian medical schools[8]. One hundred and forty-one practitioners in family medicine stated that, on the average, 27.4% of their practice involved musculoskeletal disorders, yet <3% of all curricular hours in the typical Canadian medical school are devoted to musculoskeletal education[7]. DiCaprio et al. found that only twenty-five (20.5%) of 122 medical schools in the United States required a formal musculoskeletal clerkship (averaging 2.4 weeks) in the clinical years[7]. They determined that almost half of the American medical schools do not require any formal clinical or basic musculoskeletal course prior to graduation[7]. The findings in our study reinforce the assumption that there is a lack of exposure to musculoskeletal medicine in medical schools, as the majority of respondents who were not comfortable with performing a musculoskeletal examination claimed that their training in the area had been inadequate or nonexistent.

Sneiderman, in a survey of 302 family physicians in North Carolina, found that half thought that their training in orthopaedics was inadequate and they recommended one to three months of postgraduate training in this area[14]. This was also supported by Reznick et al., who stated that family doctors in practice would have benefited from more training in orthopaedics[15]. Matheny et al. surveyed 351 graduating family practice residents and noted that residents who spent eight weeks or more on an orthopaedic service had substantially higher confidence in their ability to perform a physical examination and radiographic evaluation and to diagnose and treat musculoskeletal conditions[16]. Hergenroeder et al. showed that the skills of pediatric residents in performing a physical examination of the knee and ankle were significantly ($p < 0.001$) improved after an educational intervention, which included a video demonstration of the proper examination techniques, a demonstration of physical examinations, and evaluations of the residents' follow-up examination techniques[17]. Our study supports these ideas. Medical students and residents who had participated in a required or an elective course in orthopaedics demonstrated significantly better scores on the examination compared with those who had not. This indicates that a required course in orthopaedics should be considered essential for adequate musculoskeletal training. The orthopaedic course should be tailored to commonly seen musculoskeletal problems, musculoskeletal anatomy, and orthopaedic emergencies seen in an outpatient setting.

Despite the consensus in the literature that primary care physicians are inadequately trained to treat musculoskeletal problems, clinics dedicated to such care can excel. Alcoff and Iben reported on the data from a family practice orthopaedic trauma clinic at a military medical center[18]. Fractures accounted for 79.2% of the injuries, sprains accounted for 17.7%, and contusions made up 3.1%. Only 16.2% of the 540 patient visits required an orthopaedic consultation, indicating that the majority of nonsurgical, acute musculoskeletal injuries can be effectively managed in a family practice clinic[18]. Musculoskeletal problems are common in the active military population, and physicians in the primary care specialties must be able to diagnose and treat them on a regular basis. The greater exposure to musculoskeletal problems among the residents at the military medical training facility may account

for the overall better scores that they had compared with those in the civilian residency program in the present study.

The limitations of this study are the cognitive examination itself and its open-ended response format. Validation of the examination was performed by clinicians who may not necessarily have been experts in educational testing. Even though this was not a perfect examination, the overall scores suggest a discrepancy between the problems that the physicians see in their practices and their basic education regarding these problems. A more representative examination should have scores approaching 100%. Given the fact that this examination was validated by experienced clinicians, that the scores of the orthopaedic physicians approached 100%, and that the scores may have been independent of experience level, we believe that it is a good representation of basic musculoskeletal knowledge. The strengths of this study are that it evaluated basic cognitive musculoskeletal knowledge of medical students and physicians from all specialties and levels of training and correlated this knowledge with exposure to orthopaedics.

This study is the first, as far as we know, to assess basic cognitive musculoskeletal knowledge in multiple disciplines of medicine at all levels of training. Deficits in musculoskeletal knowledge were found at all levels, excluding the orthopaedists. As such, this study strongly suggests that there is a lack of basic musculoskeletal education in medical school and during nonorthopaedic residency training. Improvements in education in musculoskeletal medicine should be pursued in all medical schools and residency training programs.

Appendix

eA Tables presenting the basic competency examination and its demographic data sheet and a figure showing the percentage of participants answering each question correctly are available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on "Supplementary Material") and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). ■

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