



AOA Critical Issues in Education

Barriers and Resources to Optimize Bone Health in Orthopaedic Education

Own the Bone (OTB): Bone Health Education in Residency

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Introduction: Osteoporosis is a critical public health issue with substantial morbidity and healthcare costs. Resident education on osteoporosis is not standardized. Little is known about the barriers to osteoporosis treatment and the usefulness of educational programming from the perspective of orthopaedic residency program directors (PDs).

Methods: This study aims to evaluate the current state and perception of bone health education from the perspective of orthopaedic residency PDs. Therefore, a self-designed 29-question online survey was sent to 129 PDs in the United States to assess bone health education. The information, collected from August to October 2020, included program characteristics, participation in the American Orthopaedic Association's Own the Bone (AOA/OTB) program or any fracture liaison service (FLS) program, availability of faculty, potential barriers, and educational resources. Data collection was performed anonymously with a 47% response rate.

Results: The results were compared between programs that used the AOA/OTB program (30%) or any FLS program (28%) (58% OTB or any FLS) vs. programs that did not have any program (42%). Subsequent subanalysis was performed comparing AOA/OTB vs. any FLS vs. no program. Programs that did not have any FLS were least likely to have a formal education syllabus ($p = 0.01$). When comparing clinical education of residents on bone health, 64% of programs without

continued

Authorship was determined using the ICMJE criteria.

No external funding was received for any aspect of this work. Dr. Ponce is a committee member of the American Orthopaedic Association Council of Orthopaedic Residency Directors (AOA/CORD) Academics Committee. Dr. Razi is a committee member of the AOA/CORD Own the Bone (OTB) program. Dr. Kates is the Chair of the AOA/CORD OTB program. Dr. Patt is the Chair of the AOA/CORD Academics Committee.

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (<http://links.lww.com/JBJSOA/A316>).

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any system did not provide any formal clinical exposure such as a bone health clinic vs. assessment in patients with fracture compared with 24% of OTB programs and 44% of programs with any FLS ($p = 0.02$). When asked about desired resources, 47% would find a bone health rotation useful. Among all PDs, 60% support the concept of a 5-year AOA Council of Orthopaedic Residency Directors (CORD)/OTB osteoporosis curriculum.

Discussion: The key findings were that institutions including OTB or any FLS in their programs had better availability of specialty consultants, faculty, and a FLS coordinator.

Osteoporosis is a common musculoskeletal condition affecting nearly 25% of women (65 years and older) and 5% of men (65 years and older) with known challenges to implementation of treatment¹. The increasing age of the population with a disproportionate growth of patients older than 65 years is contributing to the increase in osteoporosis diagnosis². Bone health education represents potential to improve the future practice of orthopaedic surgeons and positively affect the bone health of this at-risk population. The total annual expense of providing care for osteoporotic fractures among Medicare beneficiaries, including direct medical costs and indirect societal costs related to productivity losses and informal caregiving, has been estimated at \$57 billion in 2018, with an expected increase to more than \$95 billion in 2040³. The perspectives of program directors (PDs) on this significant public health issue are central to promoting bone health in orthopaedic education. The attitudes represented in this study suggest that potential barriers can overcome with emphasis on an approach that is grounded in strong leadership, multidisciplinary care, and cost-effective fracture liaison services (FLSs).

One systematic, effective approach is the American Orthopaedic Association (AOA) Own the Bone (OTB) program that was created in 2009^{4,5}. This initiative was well suited to respond to the US Surgeon General's 2004 special report⁶ on bone health and osteoporosis, calling attention to a rapidly increasing healthcare problem. Previous interventional studies of practicing orthopaedic surgeons had not demonstrated durable improvement in the quality of postfracture metabolic bone care for patients with osteoporotic fractures⁷. OTB offers simple tools and has 10 prevention measures toward the goal of improving bone health⁸. By 2015, OTB was an established national postfracture, systems-based, multidisciplinary fragility fracture prevention initiative of AOA with early success (53% of patients had a bone mineral density test ordered and/or pharmacologic therapy for osteoporosis) at 177 sites⁹. As of January 2020, more than 260 institutions from all 50 states and the District of Columbia had enrolled in and implemented OTB¹⁰. OTB is a key example of a systematic approach to the problem of fragmented care for patients with fragility fractures¹¹⁻¹³.

Bone health education in orthopaedic surgery training is not uniformly mandated or controlled¹⁴. Current research on the need for prevention, identification, and treatment of bone health is abundant¹⁵⁻²⁰; however, little is known about the barriers and resources for implementation of an orthopaedic

residency osteoporosis curriculum. Orthopaedic surgeons had low rates (9%-53%) of initiating comprehensive care for this metabolic bone disease postfracture^{7,9}. Multiple groups care for these patients, including primary care, obstetrics/gynecology, orthopaedics, physical medicine, endocrinology, rheumatology, and physical medicine and rehabilitation. Discrepancies exist between recommendations, and it is unclear which clinical specialties are best suited to conduct the screening, manage the patient care, and follow up on long-term outcomes. Previous research including a report on a week-long musculoskeletal education training activity for internal medicine residents demonstrated significant improvements in obtaining dual-energy x-ray absorptiometry (DXA) scans, diagnosis of osteoporosis, and initiation of fracture-reducing medications²¹. These results demonstrate that there is a model for improvement in bone health education with a low time and economic investment. As studies have demonstrated the challenge to change care patterns in practicing orthopaedic surgeons, the question presented itself as to whether more standardized education at the foundational level of orthopaedic residency is warranted and could have a positive long-term impact on osteoporotic care for our aging population.

The purpose of this study was to investigate the current state of bone health education in orthopaedic residency training and to identify the areas of improvement in orthopaedic graduate medical education through a survey of orthopaedic PDs. We hypothesized that attitudes and potential resources for bone health would be related to OTB osteoporosis education available at individual training programs.

Methods

Study Design

An invitation to participate in an anonymous, electronic survey was distributed by the American Orthopaedic Association Council of Orthopaedic Residency Directors Own the Bone (AOA/CORD/OTB) program. The target study population consisted of 129 potential PDs.

The study group asked PDs to forward the survey to their residents to assess the resident perspective as well. Sixty-six responses were received from residents. This number was small, and the number of residents who actually received the survey was unknown, so it was not possible to draw conclusions based on these data. The information provided by the residents is included as supplementary tables but was not formally analyzed.

Survey Instrument

The 29-question survey focused on the program characteristics, use of programs/availability of faculty and syllabus, potential barriers, and educational resources (see Appendix). The survey was developed, and the questions were formatted to ensure a proper survey format and to minimize response bias²². The information was collected between August and October, 2020. Completion was determined based on >80% questions completed²². Likert scales from 0 to 10 were used for questions about the usefulness (0 = not useful to 10 = useful) and agreement (0 = completely disagree to 10 = completely agree)²³.

No compensation for involvement was provided. The survey was administered using Survey Hero (Survey Hero). Survey Hero is a secure web application designed to support data collection²⁴. Given the use of anonymous data exclusively, this study was deemed not to require ethics board review based on the policy of the Office of Human Subjects Research Protections under the revised Common Rule.

Statistical Methods

Analyses were performed using JMP Pro 14 statistical software (SAS Institute). Best practices for survey research evaluation were used²². Descriptive statistics were completed for all complete responses. Means and medians were used for central tendency. Tests of association among the PDs were completed using chi-square tests. Independent sample *t* tests assuming unequal variances were used to assess differences in Likert-type items between the groups²⁵.

Results

A total of 60 PDs completed the survey. With a known target population size of 129 PDs, this was a 47% (60/129) response rate. Because of the low response rate from the resident population with 66 responses, no conclusions could be drawn. The descriptive information of the resident responses is found in Supplementary Tables A and B. Statistical analyses were completed for the 2 cohorts of PDs grouped by their response to the question about “current bone health clinic or FLS.” Subsequent subanalysis was performed comparing AOA/OTB vs. any FLS vs. no program.

Use of Programs/Availability of Faculty and Syllabus

Most (58%) of the programs responding to the survey have a bone health clinic or FLS (“OTB or any FLS”) (Table I). Among all PDs, approximately half (47%) would find a bone health rotation useful. Responses were obtained from all 5 US regions with the largest number of PD responses from the midwest (27%), northeast (25%), and southeast (23%). Orthopaedic residencies that participate in OTB or any FLS program had on average a larger number of faculty than programs that do not have a formal program (32 vs. 22 faculty, $p = 0.04$). The mean number of residents per program was comparable between the groups (24 vs. 20 residents, $p = 0.14$).

A higher proportion of programs with OTB or any FLS had a bone health education syllabus (60 vs. 28%, $p = 0.01$) and

found a bone health rotation useful (57 vs. 32%, $p = 0.05$). There was also a higher proportion of responders who said “yes” to welcoming a bone health rotation in the OTB or any FLS group (54 vs. 32%, $p = 0.08$). The mean number of lectures on “osteoporosis, secondary fracture prevention, and interpretation of diagnostic imaging per year” was 3 lectures in each group. Residency characteristics regarding OTB participation are given in Table I. The programs with OTB or any FLS commonly have advanced practice providers (50%) who perform the fracture assessment, among those who responded (13/35 no response/don’t know) (Fig. 1).

Potential Barriers

Residency programs without any formal program expressed stronger agreement with potential barriers to bone health education (Table II). The top barriers were lack of time, leadership, and consultants/resources (Table II). The idea that “lack of time within a busy clinical program for a non-operative rotation” would be a barrier to implementing a new rotation was supported, regardless of OTB or any FLS involvement. Differences were found in comparisons of the PD groups on the topics of (1) consultants and experts to provide osteoporosis care ($p = 0.008$), (2) poor reimbursement for osteoporosis care ($p = 0.1$), and (3) institutional leadership on the issue ($p = 0.01$).

One factor that had low scores, suggesting that it is not a barrier, was availability of DXA testing. PDs did not agree with the statement, “Not an important topic because of minimal testing on OITE and ABOS” being a barrier (mean = 3). Approximately 1 in 4 (28%) agreed with the statement that osteoporosis is not within orthopaedic sphere of care, whereas most of the group did not believe “scope of care” is a barrier.

Educational Resources

There was no difference between PDs with and without OTB or any FLS regarding the usefulness of specific bone health education programming, with more than half (60%) supporting the concept of a 5-year AOA/CORD/OTB osteoporosis curriculum (all comparisons $p > 0.05$). The overall responses of the PDs show moderate usefulness of the 5-year AOA/CORD/OTB osteoporosis curriculum (median = 6.5). The most desired educational resources were resident-focused webinar series on osteoporosis and review of several best practices regarding osteoporosis care and education (Table III). Video case studies on osteoporosis management for resident viewing had an overall neutral utility.

Comparison of OTB Versus Any FLS

There were no statistically significant differences between PD responses from programs with the proprietary OTB program vs. any FLS. The most striking difference between the 2 groups was when looking at having no formal clinical exposure to bone health assessment through either bone health clinic or assessment of bone health in patients with fracture (Fig. 2). Sixty-four percent of non-FLS systems had none, 44% of any FLS had none, but only 24% of OTB programs had no formal clinical

TABLE I Characteristics and Program Information

Characteristic	No Formal Program No. (%)	OTB or Any FLS (n = 35, 58%)		P Value
		Any FLS No. (%)	OTB No. (%)	
Program directors (n = 60)	25 (42)	18 (30)	17 (28)	
Program location				0.46
Northeast	6 (24)	4 (22)	5 (29)	
Midwest	6 (24)	5 (28)	5 (29)	
West	5 (20)	0 (0)	1 (6)	
Southeast	4 (16)	6 (33)	4 (24)	
Southwest	4 (16)	3 (17)	2 (12)	
No. of clinical/teaching faculty in program, mean	22	31	33	0.17
No. of residents in program, mean	20	25	24	0.37
Current resident training				
Syllabus for bone health education*				0.03
No	18 (72)	6 (33)	8 (47)	
Yes	7 (28)	12 (67)	9 (53)	
Clinic days that residents attend the bone health clinic or perform bone health assessments in patients with fracture				0.97
1-3 days	66	74	62	
4-21 days	17	13	15	
>28 days	17	13	23	
Lectures on osteoporosis, secondary fracture prevention, and interpretation of diagnostic imaging per year, mean	3	3	4	0.51
Do residents attend a specific bone health clinic or assess bone health in patients with fracture?*				0.02
Yes, both bone health clinic and assessment of bone health in patients with fracture	0 (0)	2 (12)	3 (17)	
Yes, attend bone health clinic only	0 (0)	0 (0)	0 (0)	
Yes, assess bone health in patients with fracture only	6 (24)	8 (44)	10 (59)	
No, neither bone health clinic nor assessment of bone health in patients with fracture	16 (64)	8 (44)	4 (24)	
Don't know	3 (12)	0 (0)	0 (0)	
The bone health clinic or fragility assessment is done by*				0.01
A fracture liaison service coordinator (NP/PA)	0 (0)	5 (28)	6 (35)	
An orthopaedic surgeon	3 (12)	3 (17)	3 (18)	
Another medical specialist, such as an endocrinologist, rheumatologist, or gerontologist	2 (8)	2 (11)	4 (23)	
No response/don't know	20 (80)	8 (44)	4 (24)	
Bone health rotation in orthopaedic surgery program				
Would a bone health rotation be useful?				0.13
No	68	39	47	
Yes	32	61	53	
Would you welcome a bone health rotation?				0.20
No	68	50	41	
Yes	32	50	59	

*Statistical significance indicates p value < 0.05.

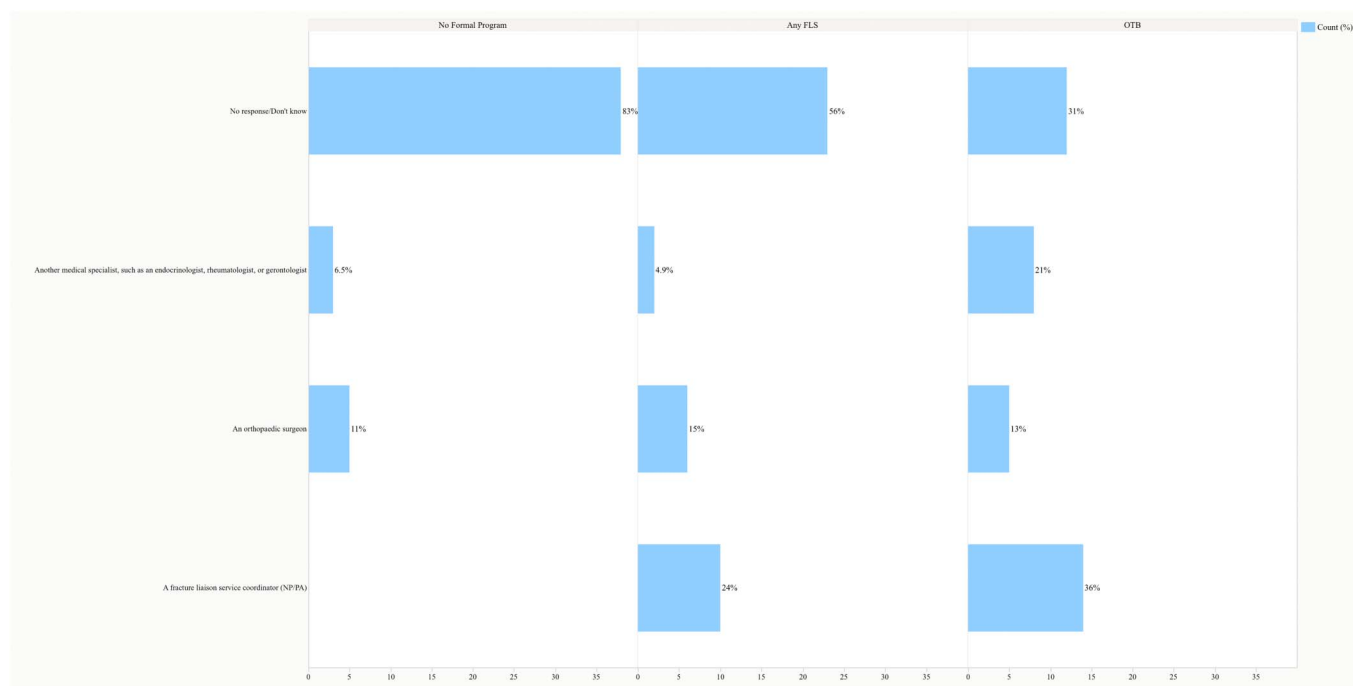


Fig. 1
The bone health clinic or fragility assessment is done by.

exposure ($p = 0.02$). This suggests that having any formal system is better than none but regarding this specific question, the OTB programs performed better than any FLS.

Discussion

Bone health education in the United States is an understudied topic in the orthopaedic training environment with substantial room for improvement. The key findings were that institutions including OTB or any FLS in their programs

had better availability of specialty consultants, faculty, and advanced practice providers. Programs without any formal program agreed that lack of time, leadership, and resources were potential barriers. We identify the top 3 most desired resources including a resident-focused webinar series on osteoporosis, a review of several best practices regarding osteoporosis care and education, and a 5-year AOA/CORD/OTB osteoporosis curriculum. Program leaders can improve education/care with partnership in multidisciplinary

TABLE II Perceptions of Potential Barriers to Osteoporosis Care Among Program Directors

Characteristic	No Formal Program (Mean)	OTB or Any FLS (Mean)	Mean Difference	P Value
Lack of time within a busy clinical program for a nonoperative care rotation	7	7	0	0.39
Absence of institutional leadership on this issue	7	4	3*	<0.001
Lack of consultants and experts to provide osteoporosis care and hands-on education	7	5	2*	0.01
Poor reimbursement for osteoporosis care	7	5	2*	0.01
Poor motivation of faculty to teach and learn about osteoporosis care	6	6	0	0.07
Poor motivation of residents to learn about osteoporosis care	5	5	0	0.31
Perception that osteoporosis is not within orthopaedic sphere of care	5	3	2	0.09
Inadequate availability of DXA testing	2	3	-1	0.35
Not an important topic because of minimal testing on OITE and ABOS	3	3	0	0.94

*Statistical significance indicates p value < 0.05; responses to a 10-point Likert scale on agreement (0 = completely disagree to 10 = completely agree); ABOS = American Board of Orthopaedic Surgery, DXA = dual-energy x-ray absorptiometry, OITE = Orthopaedic In-training Examination, and OTB = Own the Bone.

TABLE III Usefulness of Resources for Implementation of an Orthopaedic Residency Osteoporosis Curriculum*	
Educational Programming	Median
Resident-focused webinar series on osteoporosis	7
Review of several best practices regarding osteoporosis care and education	7
5-year AOA/CORD/OTB osteoporosis curriculum	6.5
Journal list or bibliography of articles	6
Recorded video case studies on osteoporosis management	5

*Likert scale for usefulness (0 = not useful to 10 = useful); AOA/CORD/OTB = American Orthopaedic Association's Council of Orthopaedic Residency Directors Own the Bone.

programs to address osteoporosis, prevent secondary fractures, and promote bone health.

When reviewing the content of the last 8 years of questions from the OITE, the combined topic of osteoporosis and bisphosphonates would be the sixth most tested topic while clinical questions, including femoral neck, intertrochanteric, and periprosthetic hip fractures, would be the most commonly tested topic²⁶, emphasizing the importance of this topic for our trainees. The central importance of education surrounding bone health is also evident in the rates of surgery related to poor bone quality. The study by Molina et al.²⁷ looking at the National Surgical Quality Improvement Program database showed that 8 of the most common 18 orthopaedic procedures performed were directly linked to poor bone health, but more importantly,

they were 8 of the top 9 on a list of procedures with the most frequency of complications, making them high priorities for quality improvement and resident education.

Based on the results of this study, it is clear that there is a gap in structured osteoporosis education seen in orthopaedic training programs. Development of an educational curriculum for orthopaedic residents could add a significant value to the continuum of osteoporosis care for our nation's aging population. One barrier to enrollment in formal management programs such as the OTB program is perceived value, time commitment, and cost because the medical world increases its focus on operational efficiency and cost containment^{28,29}. Implementing educational programming focused on the orthopaedic resident has the potential to create a new level of value for institutions^{30,31}. Ultimately, these educational modules could be adapted to other educational programs, such as internal medicine, rheumatology, and endocrinology.

Significant differences between the 2 cohorts of PDs highlighted the potential barrier of limited time, personnel, and institutional leadership to provide osteoporosis education and care. A major barrier to implementing a bone health rotation is the issue of time commitment for a nonoperative rotation. The OTB program represents a targeted program designed to improve osteoporotic care by defining the role of the orthopaedic surgeon in osteoporosis management, establishing institutional leadership on the issue, and enhancing multidisciplinary collaboration while collecting data to demonstrate efficacy^{9,32}. Establishing congruity among clinical specialties who manage this condition may be informed using our findings. FLS programs, where patients with recent fractures may be referred for care coordination and transition management, have demonstrated improvement in

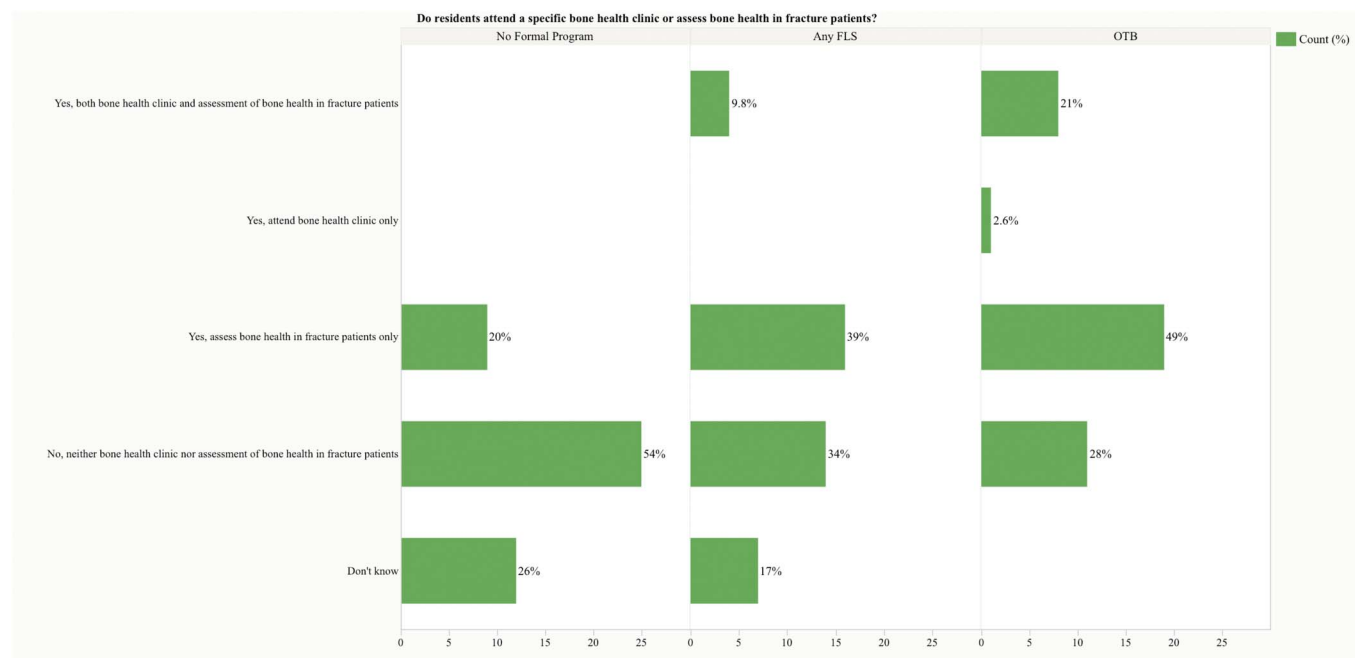


Fig. 2 Do residents attend a specific bone health clinic or assess bone health in patients with fracture?

the quality of care delivered¹⁷. In the cohort with OTB or any FLS (50%), the fracture assessment was often performed by an advanced practice provider, including nurse practitioners and physician assistants. Educational initiatives to champion the current guidelines^{17,18,33} for preventative measures are needed.

There was general agreement on the usefulness of each component of education, regardless of involvement in OTB. There is an opportunity to elevate and standardize resident osteoporosis education through the OTB program, resident-focused webinar series on osteoporosis, and a review of several best practices regarding osteoporosis care and education. A collaborative educational program between CORD and OTB has the potential to establish postfracture osteoporosis care as the primary domain of the orthopaedic surgeon. Follow-up questionnaires could be administered to see whether there is significant change in enrollment, change in attitudes, and short-term impacts on health and health care. The large national registry maintained by OTB facilitates evaluation of the long-term impact of measurable trends in osteoporosis management by practicing surgeons^{34,35}.


We acknowledge the limitations of cross-sectional survey research to draw conclusions. The first limitation is potential bias related to the relatively low response rate, volunteer bias, and generalizability. Previous studies have described that a low response rate does not necessarily mean that the study results have low validity, but rather a greater risk^{36,37}. Individuals completing this survey may have more interest in this topic and be more positive about future programming. Another potential source of bias was current institutional participation in the OTB program. The relative balance of participating and nonparticipating programs (58% participating) provided a reasonable balance in the survey sample. The differences in the responses between these groups also contrast the perceptions of the 2 cohorts. Despite the limitations inherent in survey research, this topic is of critical educational importance without other more robust approaches to answer our research questions.

Conclusions

Our findings identified general agreement about useful educational programming and bone health rotations for residents in orthopaedic surgery. These findings provide an assessment of bone health education in the United States to

guide improvement in the orthopaedic curriculum. It is clear that a knowledge and skill set needed to care for patients with suboptimal bone health is essential to our trainees based on current standardized testing and common orthopaedic procedures. Optimizing education in this realm will benefit our patients and society and provide the foundation on how to lead multidisciplinary efforts to improve value-based care. Participation in OTB or any formal FLS can improve resident education and provide more educational resources during training. Although the OTB program represents an easy-to-implement process with institutional support, participation in any FLS will ultimately benefit residency education and will integrate risk-fracture assessments and an understanding of longitudinal bone health into resident education with the potential to positively affect our patients.

Appendix

 Supporting material provided by the authors is posted with the online version of this article at <http://links.lww.com/JBJSOA/A317>, <http://links.lww.com/JBJSOA/A318>, and <http://links.lww.com/JBJSOA/A319>. This content was not copy-edited or verified by JBJS. ■

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