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ORIGINAL STUDY

Randomized crossover study investigating resident retention of menopause-related knowledge after completion of learning modules

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Abstract

Objective: The aim of this study was to evaluate residents' retention of menopause-based knowledge immediately after, and 3 months after completion of, self-administered modules that varied by menopause-related topic and delivery format.

Methods: Prospective crossover study of Obstetrics and Gynecology and Family Medicine residents at one institution over the 2017 to 2018 academic year. Residents were randomized to a series of three PowerPoints (Microsoft, Redwood, WA), each <30 slides, administered during regularly scheduled didactics. Each series contained three subjects (Menopause Basics [MB], Hormone Therapy [HT], and Genitourinary Syndrome of Menopause [GSM]) delivered through three different presentation styles (typical presentation [typical], pictures and a narration [pictures], and interactive to reveal information [interactive]). Knowledge and comfort were assessed through baseline, immediate postexposure, and 3-month follow-up surveys containing 24 knowledge questions (multiple choice) and 10 comfort and satisfaction questions (5-point Likert scale and multiple choice). Statistical tests were applied with $P<0.05$ considered significant.

Results: Thirty-three residents completed the 3-month follow-up. Immediately postexposure, knowledge and comfort increased from baseline for all topics ($P < 0.05$). When formats were grouped together to investigate retention by topic, the HT topic demonstrated a sustained increase in knowledge on 3-month follow-up ($P = 0.047$). The typical format of the GSM topic had significantly better retention than the picture format ($P = 0.027$). All formats were associated with a significant increase in comfort (all $P < 0.01$).

Conclusions: Participation in this specialized menopause curriculum led to short-term increases in objectively assessed menopause-related knowledge. Tailoring self-administered learning modules to learning styles did not, however, effectively enhance overall knowledge retention on 3-month follow-up, though comfort in managing menopause remained increased.

Key Words: Learning styles – Menopause – Resident education.

Video Summary: http://links.lww.com/MENO/A474.

Menopause is one of the most prevalent conditions affecting patients who present to Obstetrician–Gynecologists (OBGYN) and Family Medicine (FM) physicians. The average woman in the United States spends over 30 years of her life peri- or postmenopausal, with this population accounting for millions of healthcare dollars spent each year by those seeking treatment, reassurance, and support regarding their symptoms. It is crucial that OBGYN and FM physicians training in these specialties be facile at providing competent care that optimizes health outcomes for this increasingly large portion of the population.

The majority of graduating OBGYN residents, however, express discomfort in their level of knowledge regarding various aspects of menopause medicine.[1] Furthermore, FM residents and physicians have varying approaches to common conditions.[2] Self-perceived discomforts and knowledge gaps create missed opportunities for evaluation and treatment of symptoms and age-appropriate screening and interventions.

Previous studies have investigated the use of lectures and laboratory sessions to improve resident knowledge of menopause and its management.[3] Learning style theory, however, maintains that learners have unique preferences in how they

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acquire knowledge, and these differences in learning styles have been correlated with different educational outcomes based on setting, content, and delivery of information.[4,5] Using the VARK (Visual, Aural, Read/Write, Kinesthetic) model, learners can be categorized by their preferred learning modality, and learning tools can be tailored to these preferences.[6] PowerPoint (Microsoft, Redwood, WA) has flexible formatting amenable to customization of content for various learning styles. The purpose of this study was to evaluate residents' menopause-based knowledge immediately after, and 3 months after completion of, self-administered learning modules delivered through PowerPoint presentations that varied by menopause-related topic and learning style-based format of delivery (Supplemental digital content, http://links.lww.com/MENO/A475).

METHODS

This was a randomized crossover study that investigated resident retention of menopause-related knowledge after completion of learning modules. This prospective study was open to OBGYN and FM residents at one institution over the 2017 to 2018 academic year. Inclusion criteria specified that participants be current OBGYN or FM residents present at regularly scheduled didactics on the date of study administration. For OBGYN residents, the study was offered at the regularly scheduled 55-minute session of didactics on a Wednesday morning. For FM residents, the study was offered at their regularly scheduled 90-minute session of didactics on a Tuesday afternoon. Exclusion criteria were those who did not consent, those who could not complete all 3 self-administered modules or the immediate postintervention assessment, and involvement in the development of the study. All residents were made aware that their participation would in no way impact their academic standing, individual results would not be seen by residency program administration, and the educational materials would be available regardless of participation in the study. The study was determined to be exempt by the Care New England—Women & Infants Institutional Review Board.

Residents of all years were consented for participation during regularly scheduled didactics and were randomized to a series of 3 PowerPoints, each less than 30 slides. Each series contained 3 different subjects delivered through 3 different presentation styles that were customized for the VARK learning styles (Table 1). Presentation styles included a typical presentation designed for read/write learners (typical), one with pictures and a narration designed for visual and aural learners (pictures), and one that required clicking on certain areas to reveal information designed for kinesthetic learners (interactive). Subjects included Menopause Basics (MB), Hormone Therapy (HT), and the Genitourinary Syndrome of Menopause (GSM).

The residents self-administered the presentations on laptops that already had the learning modules preloaded. The laptops were in the room where didactics regularly took place, and residents completed them at their own pace over the course of their regularly scheduled didactic time.

TABLE 1. *Outline of study groups*

Group A	Group B	Group C
GSM interactive	GSM pictures	GSM typical
HT typical	HT interactive	HT pictures
MB pictures	MB typical	MB interactive

Residents were randomized to one of three groups. Each group had a series of three PowerPoints each relating to a different subject (Menopause Basics [MB], hormone therapy (HT), and the Genitourinary Syndrome of Menopause [GSM]). The content was delivered through three different presentation styles that were customized for the VARK (Visual, Aural, Read/Write, and Kinesthetic) learning styles. Presentation styles included a typical presentation designed for read/write learners (typical), one with pictures and a narration designed for visual and aural learners (pictures), and one that required clicking on certain areas to reveal information designed for kinesthetic learners (interactive).

Resident knowledge and comfort were assessed through baseline, immediate postexposure, and 3-month follow-up paper-based in-person surveys. The surveys contained 24 objective knowledge-based multiple-choice questions that were uniform across the three assessment points. In addition, there were 10 subjective questions assessing comfort in managing menopause symptoms, self-identified learning style, and satisfaction with the content and delivery of the didactic material as rated on a 5-point Likert scale or through multiple-choice selection. Learning style was asked only at baseline, whereas preferred topics and formats were asked only on immediate and 3-month follow-up. Participants who were not available to complete the 3-month follow-up surveys in the paper format were given a link to complete the follow-up survey online through a REDCap (Research Electronic Data Capture, Nashville, TN) hosted online survey tool that directly input their responses to their study identification number.[7]

All eligible residents were included to optimize investigators' ability to detect the most effective way to deliver the educational material to this population. A blocked randomization list stratified by residency program was generated on the Sealed Envelope website (London, United Kingdom).[8] Each resident was randomly assigned to one of the three sequences of PowerPoint slides in accordance with a uniform three-group, three-period crossover design to allow for evaluation of potential period and sequence effects. Participants were enrolled and assigned by study personnel (JS, RE). The main outcome was change in objective knowledge scores from pretest to posttest for each subject and format. Mean changes in scores were compared between groups by ANOVA or t test and within participants by paired t test. The existence of period and sequence effects was examined by multiple linear regressions with a random participant effect to account for within-participant correlation. Satisfaction or confidence questions and participant characteristics were compared by Chi-square or Fisher's exact test. Changes in confidence level within participants were compared by McNemar's test. Data analysis was performed with SAS version 9.4 (SAS Institute, Cary, NC). A $P < 0.05$ was considered statistically significant.

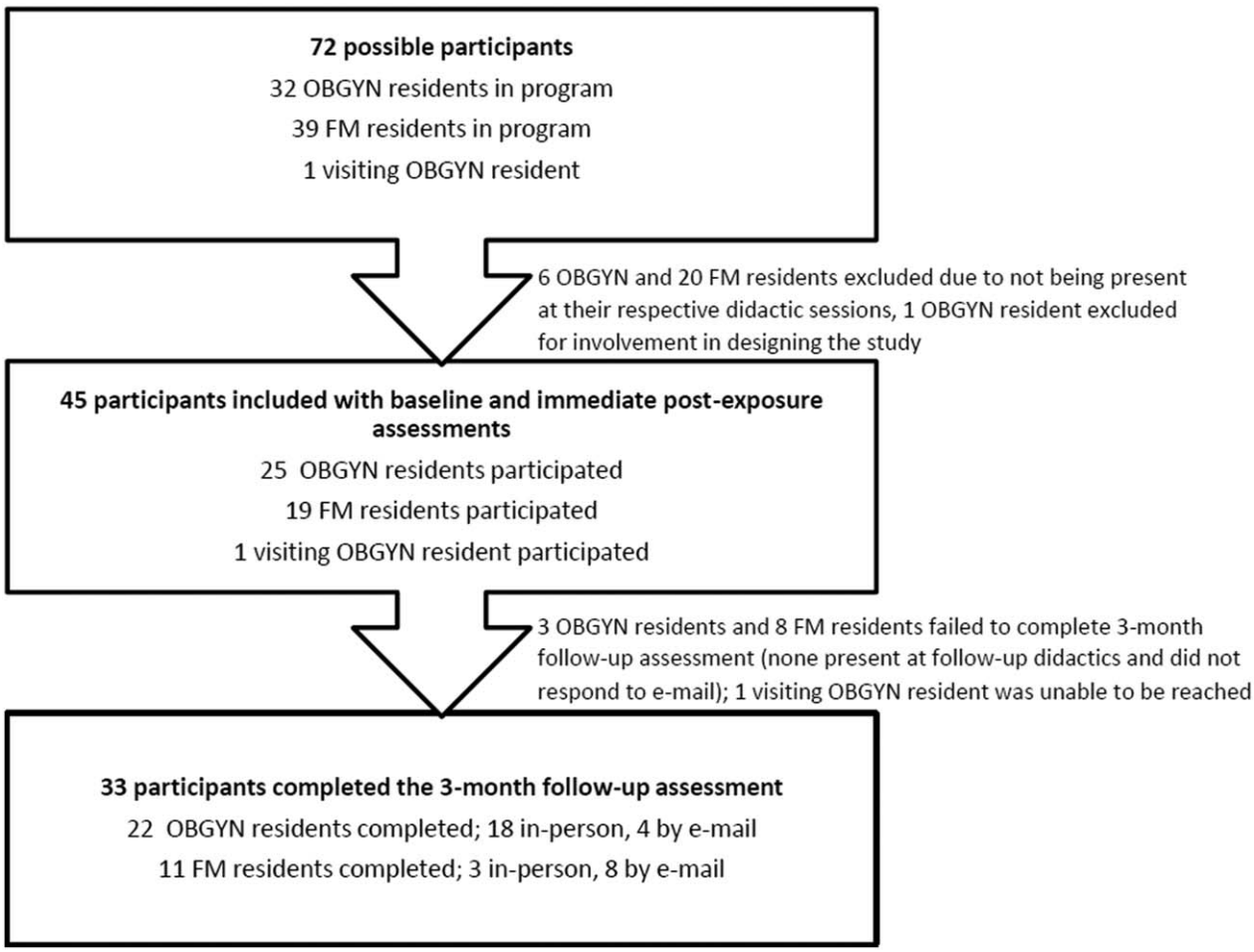

FIG. 1. Participant inclusion flow chart.

RESULTS

Forty-five residents were included in the study out of 72 possible participants (Fig. 1). All residents present at the didactic session when the study was conducted were approached, and all approached residents consented for participation. Self-identified learning styles were predominantly visual and read/write, and <20% of residents felt very confident or confident in managing the included menopause-related subjects (Table 2). Of the 33 residents who completed the 3-month follow-up, 22 were OBGYN and 11 were FM, with no significant change in the distributions of postgraduate year ($P = 0.79$), learning style ($P = 0.67$), or baseline confidence ratings ($P = 0.08$ for MB, $P = 0.56$ for HT, $P = 1.0$ for GSM) of those who followed up versus those who did not. There were significantly more OBGYN residents who completed the 3-month follow-up than FM residents ($P = 0.035$). There were significantly fewer participants in group C (21.2%) who completed the 3-month follow-up when compared with group A (34.1%) and group B (34.1%) ($P = 0.043$).

At baseline, objective knowledge scores varied by topic (Fig. 2). The GSM topic had a mean baseline objective knowledge score of 3.84 out of 8 points (SD 1.41, IQR 3-4), with HT having a mean of 1.96 (SD 1.00, IQR 1-3), and MB having a mean of 3.40 (SD 1.37, IQR 2-4). There were no significant differences between study groups. OBGYN residents had higher scores than the FM residents on the baseline assessment for the GSM topic ($P = 0.013$). There were no significant differences in baseline knowledge or confidence by year of training.

Overall, scores increased significantly from pretest to the immediate posttest for all three topics (paired t tests <0.05; Table 3). GSM had the smallest change (0.78 points, SD 1.41, $P < 0.001$), whereas HT had the largest (3.67 points, SD 1.68, $P < 0.001$). The typical format of HT was associated with significantly greater improvements in objective knowledge scores than the pictures format of HT (4.25 vs 2.86 points, $P = 0.023$). When assessing mean changes in scores by format, adjusting for topic by linear regression, the typical format had the greatest mean change in score, whereas the picture format had the least (0.68 point difference in mean change, $P = 0.057$).

On 3-month follow-up, there were no significant changes in objective knowledge scores when grouped by format to investigate topic, with the exception of significant improvement in objective knowledge regarding HT (0.73 points, $P = 0.047$). Within the GSM topic, there was, however, a significant difference in scores by format. The typical format

TABLE 2. *Group characteristics*

	Total	Group A	Group B	Group C
Total, *n* (row %)	45	16 (36)	15 (33)	14 (31)
Residency, *n* (%)				
OBGYN	26 (58)	8 (56)	9 (60)	8 (57)
FM	19 (42)	7 (44)	6 (40)	6 (43)
Sex, *n* (%)				
Female	35 (78)	12 (81)	12 (80)	10 (71)
Male	10 (22)	3 (19)	3 (20)	4 (29)
Medical training, *n* (%)				
United States Allopathic Medical School	41 (91)	14 (94)	14 (93)	13 (93)
Unites States Osteopathic Medical School	4 (9)	2 (13)	1 (7)	1 (7)
PGY, *n* (%)				
1	14 (31)	3 (19)	6 (40)	5 (36)
2	12 (27)	6 (38)	4 (27)	2 (14)
3	12 (27)	5 (31)	3 (20)	4 (29)
4	7 (16)	2 (13)	2 (13)	3 (21)
Learning style, *n* (%)				
a. Visual	19 (44)	6 (43)	5 (33)	8 (57)
b. Auditory	2 (5)	1 (7)	1 (7)	0
c. Verbal/read/write	15 (35)	4 (29)	7 (7)	4 (29)
d. Kinesthetic	7 (16)	3 (21)	2 (13)	2 (14)
Baseline confidence managing menopause Very confident/confident, *n* (%)				
a. GSM	9 (20)	3 (19)	4 (27)	2 (14)
b. MB	9 (20)	4 (25)	3 (20)	2 (14)
c. HT	3 (7)	1 (6)	1 (7)	1 (7)

Each group had a series of three PowerPoints each relating to a different subject and delivered through a different format tailored to one of the VARK (Visual, Aural, Read/Write, and Kinesthetic) learning styles. FM, Family Medicine; GSM, Genitourinary Syndrome of Menopause; HT, hormone therapy; MB, Menopause Basics; OBGYN, obstetrics and gynecology; PGY, postgraduate year.

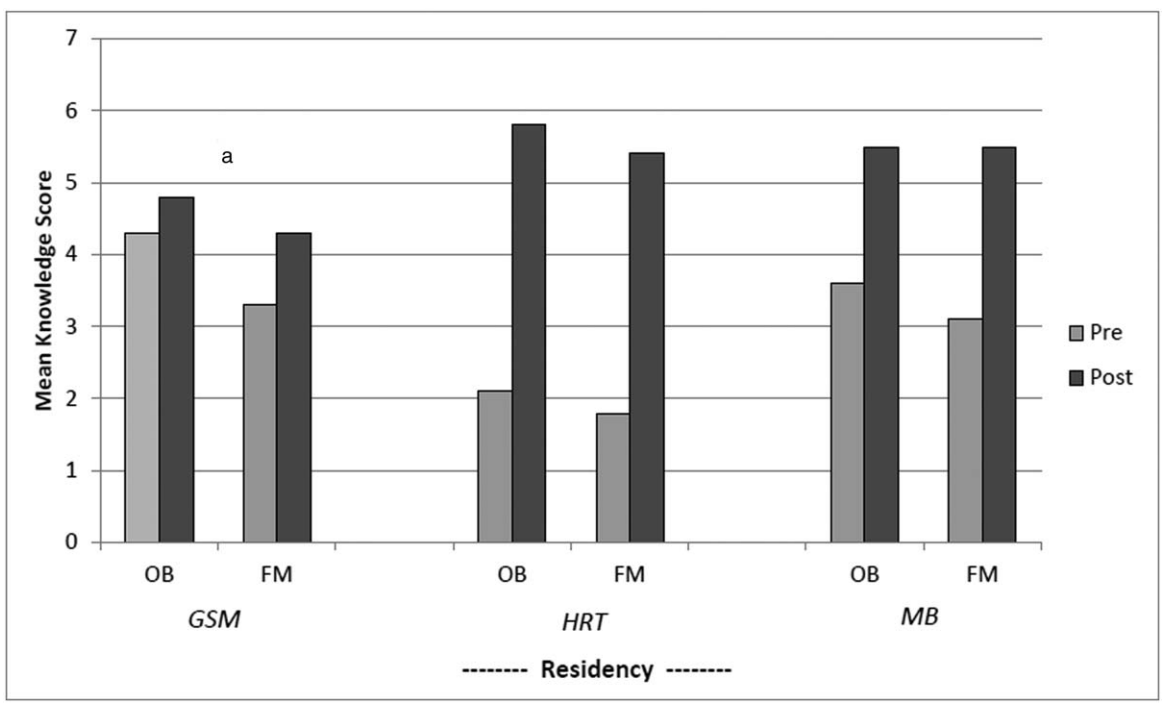

FIG. 2. Pre- and immediate postexposure objective knowledge assessment scores by type of residency. Residents were exposed to three PowerPoints each relating to a different subject and delivered through a different format tailored to one of the VARK (Visual, Aural, Read/Write, and Kinesthetic) learning styles. Objective assessments of knowledge containing 24 multiple-choice questions were obtained pre- and postexposure. $n =$ Group for group A is 16, for group B is 15, and for group C is 14. FM, Family Medicine; GSM, Genitourinary Syndrome of Menopause; HT, hormone therapy; MB, Menopause Basics; OBGYN, obstetrics and gynecology; PGY, postgraduate year. [a]$P < 0.05$.

TABLE 3. *Change in objective knowledge assessment scores from baseline compared to immediate postexposure and 3-month postexposure*

	Total	Group A	Group B	Group C
Change from baseline to immediate postexposure assessment[a]				
N	45	16	15	14
GSM mean (SD)	0.78 (1.41)	0.81 (0.91)	0.53 (1.77)	1.00 (1.52)
HT mean (SD)	3.67 (1.68)	4.25 (1.88)	3.80 (1.57)	2.86 (1.29)
MB mean (SD)	2.11 (1.92)	2.13 (2.03)	2.33 (1.54)	1.86 (2.25)
Change from baseline to 3-month follow-up assessment[b]				
N	33	13	13	7
GSM mean (SD)	−0.06 (1.56)	−0.08 (1.50)	−0.62 (1.56)	1 (1.29)
HT mean (SD)	0.73 (2.02)	1 (2.27)	0.92 (2.02)	−0.14 (1.46)
MB mean (SD)	−0.21 (1.36)	−0.15 (1.82)	−0.23 (1.17)	−0.29 (0.76)

Resident knowledge was assessed through baseline, immediate postexposure, and 3-month follow-up paper-based in-person surveys. The surveys contained 24 objective knowledge-based multiple-choice questions that were uniform across the three assessment points. GSM, Genitourinary Syndrome of Menopause; HT, hormone therapy; MB, Menopause Basics.

[a]All changes from baseline to immediate postexposure assessments have $P < 0.05$ with the exception of GSM in group B where $P = 0.26$.

[b]All changes from baseline to 3-month postexposure assessments have $P > 0.05$ with the exception of the composite of HT where $P = 0.047$.

of the GSM topic had a sustained 1-point increase in objective knowledge score, whereas the pictures format had a 0.62-point decrease from the baseline score ($P = 0.027$).

When stratified by learning style, objective scores of self-identified visual and kinesthetic learners demonstrated the greatest increases after presentations in the picture format, whereas auditory and read/write learners demonstrated significantly lower increases in knowledge after exposure to the picture format ($P = 0.001$). Learners who self-identified as having the read/write learning style had significantly greater improvements in objective knowledge immediately after exposure to interactive and typical formats when compared with picture formats ($P = 0.014$). This finding was sustained on 3-month follow-up ($P = 0.037$).

Most learners rated that they were either satisfied or very satisfied with the learning style, length, ease of use, and content of the PowerPoints. The pictures format was, however, the only format that less than 50% of learners rated that they were very satisfied or satisfied with the learning style (44.19%) and length (46.51%). On 3-month follow-up the interactive format had a slight increase in percent satisfied or very satisfied when it came to learning style (60.47% vs 75.76%, $P = 0.05$) and the traditional format had a slight decrease in satisfaction (62.79% vs 54.55%, $P = 0.05$). Self-rated enjoyment, preferences, and self-perceived increases in knowledge are presented in Table 4. Greater than 50% of learners endorsed that they would use the interactive format of PowerPoint on their own time, and recommend it to a peer, on both the immediate postexposure assessment and the 3-month follow-up. There was a significant increase in confidence levels across all subjects from baseline to both immediate postexposure and 3-month follow-ups (all $P \leq 0.010$).

DISCUSSION

Residents' menopause-based knowledge as measured by objective assessment significantly increased immediately after self-administered learning modules on menopause-related topics that varied by topic and format of delivery. On 3-month follow-up, objective knowledge scores, however, returned to near baseline levels, with the only significant topic-based change in objective assessment scores being a nearly 9% increase in HT-based knowledge. HT-based

TABLE 4. *Responses to subjective questions regarding preferences by self-identified VARK learning style*

	Total		Visual		Read/Write		Kinesthetic	
	0m	3m	0m	3m	0m	3m	0m	3m
What format of PowerPoint did you enjoy the most? *N* (%)	(*n* = 43)	(*n* = 33)	(*n* = 19)	(*n* = 13)	(*n* = 15)	(*n* = 12)	(*n* = 7)	(*n* = 6)
Pictures	10 (23)	6 (18)	4 (21)	2 (15)	3 (20)	2 (17)	3 (43)	1 (17)
Typical	17 (40)	10 (30)	11 (58)	6 (46)	4 (27)	4 (33)	1 (14)	0 (0)
Interactive	16 (37)	17 (52)	4 (21)	5 (38)	8 (53)	6 (50)	3 (43)	5 (83)
What format of PowerPoint do you think you learned the most from? *N* (%)	(*n* = 43)	(*n* = 33)	(*n* = 19)	(*n* = 13)	(*n* = 15)	(*n* = 12)	(*n* = 7)	(*n* = 6)
Pictures	10 (23)	4 (12)	4 (21)	1 (8)	3 (20)	1 (8)	3 (43)	1 (17)
Typical	19 (44)	12 (36)	12 (63)	7 (54)	5 (33)	4 (33)	1 (14)	1 (17)
Interactive	14 (33)	17 (52)	3 (16)	5 (38)	7 (47)	7 (58)	3 (43)	4 (67)
What format of PowerPoint would you prefer for future lectures? *N* (%)	(*n* = 43)	(*n* = 33)	(*n* = 19)	(*n* = 13)	(*n* = 15)	(*n* = 12)	(*n* = 7)	(*n* = 6)
Pictures	10 (23)	2 (6)	4 (21)	1 (8)	3 (20)	0 (0)	3 (43)	1 (17)
Typical	18 (42)	10 (30)	11 (58)	6 (46)	5 (33)	4 (33)	1 (14)	0 (0)
Interactive	15 (35)	21 (64)	4 (21)	6 (46)	7 (47)	8 (67)	3 (43)	5 (83)

Educational content was delivered through three different presentation styles that were customized for the VARK (Visual, Aural, Read/Write, and Kinesthetic) learning styles. Presentation styles included a typical presentation designed for read/write learners (typical), one with pictures and a narration designed for visual and aural learners (pictures), and one that required clicking on certain areas to reveal information designed for kinesthetic learners (interactive). Two self-identified auditory learners not represented due to small sample size. Learners indicated preferences immediately postexposure to the learning modules (0m) and 3 months after completing the learning modules (3m).

knowledge had the lowest baseline scores on objective assessment, with a 50% average increase in score when assessed immediately after administration of the intervention.

The persistent increase in HT-related knowledge, though smaller than the initial gain, is likely due to the magnitude of the initial knowledge gain made possible by demonstrated low baseline HT knowledge. Prior studies have also demonstrated low baseline knowledge and confidence in approaching HT.[9,10] Previously, Hess et al found that experiential learning had the greatest influence on HT-related knowledge retention in a cohort of internal medicine residents, and specifically noted that didactic teaching did not influence HT-related knowledge.[11] This study was, however, a cross-sectional survey and did not expose residents to either learning modality. The results were based on residents' reporting of knowledge and prior experiences, which can be confounded by misattribution and recall bias.

Although experiential learning is undoubtedly valuable, resident access to menopause clinics is variable by training program.[3] A survey study published by Christianson et al found that only 16% of residents endorsed having a menopause-focused clinic as part of their training.[1] It is important that physician trainees have access to alternative modalities of menopause-related learning to supplement when learning opportunities through patient care are not sufficient. Unfortunately, the same survey found that only 20% of residency programs had a dedicated menopause curriculum.[1] Our study supports that didactic teaching can be associated with small gains in HT-related knowledge, and adds to the data supporting didactic teaching of this topic.

Interestingly, on 3-month follow-up GSM and MB scores were lower than baseline. These small differences likely represent return to baseline knowledge, as averages remain well within the standard deviations of the initial values. It is not uncommon for studies to report diminished knowledge on long-term follow-up in medical education.[12-15] Despite return to baseline levels of knowledge, the gains in self-reported confidence approaching menopause-related subjects persisted. This finding echoes that of Nelissen et al who noted that obstetric simulation-based training resulted in short-term increases in knowledge, skills, and confidence.[16] At 9-month follow-up, skills and knowledge diminished, with sustained gains in confidence.

Despite the tailoring of the formats of the PowerPoints to different learning styles, knowledge retention and preferred formats of delivery were not correlated with self-identified learning style. This supports the argument that tailoring educational materials to learning styles does not necessarily correlate with sustained knowledge retention. There is scant data to support a physiologic basis of the VARK learning styles, and this limited data suggests that the efficacy of various forms of knowledge delivery is unencumbered by the influence of learning style.[17] The findings of this study may fuel the emerging argument that learning styles are not as important as once thought, as they are not closely correlated with outcomes.[18-20] Such a conclusion should, however, be made with tremendous caution, as the relationship between learning styles and the delivery of educational materials is likely complex and dynamic, with few validated instruments available to utilize in high-quality research.

Interestingly, the format of PowerPoint that learners perceived themselves to have gained the most knowledge from was not always correlated with the greatest increase in objective knowledge scores. Furthermore, their perceptions varied by the time-point of assessment. Initially, visual learners perceived themselves to have learned the most from the traditional format, though their objective scores were increased the most after picture formats. Moreover, self-identified kinesthetic learners believed they learned equally from pictures and interactive formats, though their objective scores were increased the most after picture formats both initially and at 3-month follow-up. This shows that the learner's perceptions of effective teaching tools are not always aligned with objective results. Moreover, the picture format tended to be the least popular modality, despite often being more effective.

Of note, when residents were asked their preferred PowerPoint format at the 3-month follow-up, their preference changed from the typical format initially to the interactive format on follow-up. This is interesting in its parallel to another study where adult learners specified that they prefer traditional lecture-based formats for educational activities, though they believed interactive modalities had greater efficacy.[21] Being 3 months removed from the exposure at the time of the second assessment likely played a role in this change in preference, as learners may not have recalled details of the modules. This late preference for interactive formats is likely reflective of the idea of an interactive PowerPoint being preferred, whereas the immediate preference for the typical format was likely related to these specific PowerPoints.

This study achieved 73% 3-month follow-up of those who completed the baseline and immediate postexposure assessment. There was a relatively large proportion of FM residents lost to follow-up, likely due to the small number of participating residents at the follow-up didactic session where the 3-month follow-up assessment was administered. This is because attendance at didactics is largely dependent on residents' rotations in the FM program, whereas nearly all OBGYN residents are expected at all didactic sessions.

One weakness of this study was that learners self-identified their learning style, rather than have it determined by a validated instrument. This decision was made because the curriculum was designed to have multiple delivery formats for the same content, with the goal of learners being able to pick the format of delivery they felt would be the most effective. Ideally, learners would pick their preferred format and review the content at home, thus enabling subsequent didactics to have a flipped classroom model. It was felt that learners would likely opt for the format suited to their self-perceived learning style. The decision was made for learners to designate their own learning styles as this is what would happen if the curriculum were implemented in its intended fashion.

Another weakness of this study was the inability to validate the novel formatting of the PowerPoint presentations, as well as the lack of user familiarity with the logistics of the interactive PowerPoint. Despite their carefully planned designs, there is no way to confirm that the different formats of PowerPoint effectively catered to the needs of the VARK learning styles. In addition, not all participants may have optimized their learning with the interactive format, as some may have not been accustomed to clicking certain areas to navigate through content. Despite detailed slides at the beginning that instructed participants on how to use the interactive tools, it was noted during the intervention that some participants clicked through the PowerPoint as if it were a typical PowerPoint, which was not the intention. This would, however, likely happen in a nonstudy setting as well and is an important factor to consider when designing future learning modules, and makes these findings more generalizable.

Strengths of this study include the initial increases in objective knowledge and high learner satisfaction. Initially, objective knowledge scores were significantly increased for all topics. This supports the conclusion that the educational material was effectively delivered short term, but methods to enhance long-term retention need to be further studied. Satisfaction was very high, with more than three-quarters of residents satisfied or very satisfied with the content of the PowerPoints. This demonstrates that learners enjoyed the self-administered modules, which is further supported by the fact that approximately half of the participants also indicated that they would be likely or very likely to use the traditional and interactive formats of PowerPoint on their own time and would recommend them to a peer.

Furthermore, the importance of this study is underscored by the fact that no significant differences were found in baseline knowledge or confidence by postgraduate year of training. One would expect knowledge in most fields of women's health increase over the course of residency training. This study, however, found that menopause-related knowledge did not increase. This highlights the deficit in menopause-related knowledge transmission that has been recognized in postgraduate medicine across specialties. It is crucial that those involved in resident education continue to troubleshoot this need and seek evidence-based interventions to address this knowledge deficit seen among residents.

CONCLUSIONS

It is important to find effective delivery methods for menopause-related knowledge that will engage residents. These novel learning modules were designed to meet the educational needs of a diverse group of resident learners. Designing learning modules according to learning-style preferences may, however, not be necessary, as doing so was not associated with significant changes in long-term knowledge retention. Significant short-term improvements in objective knowledge scores were found regardless of topic or format of delivery, though there was return to near-baseline levels of objective knowledge on 3-month follow-up. It is important to further investigate delivery of content that optimizes long-term knowledge retention.

REFERENCES

1. Christianson MS, Ducie JA, Altman K, Khafagy AM, Shen W. Menopause education: needs assessment of American Obstetrics and Gynecology Residents. *Menopause* 2013;20:1120-1125.
2. Burg MA, Fraser K, Gui S, et al. Treatment of menopausal symptoms in family medicine settings following the Women's Health Initiative findings. *J Am Board Fam Med* 2006;19:122-131.
3. Christianson MS, Washington CI, Stewart KI, Shen W. Effectiveness of a 2-year menopause medicine curriculum for obstetrics and gynecology residents. *Menopause* 2015;23:275-279.
4. Pashler H, McDaniel M, Rohrer D, Bjork R. Learning styles: concepts and evidence. *Psychol Sci Public Interest* 2008;9:105.
5. Good JP, Ramos D, D'Amore DC. Learning style preferences and academic success of preclinical allied health students. *J Allied Health* 2013;42:e81-e90.
6. Fleming ND, Mills C. Not another inventory, rather a catalyst for reflection. *To Improve Acad* 1992;11:137.
7. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42:377-381.
8. Sealed Envelope Ltd. 2017. Create a blocked randomisation list. Available at: https://www.sealedenvelope.com. Accessed April 12, 2017.
9. Rolnick SJ, Kopher RA, Compo RB, Kelley ME, DeFor TA. Provider attitudes and self-reported behaviors related to hormone replacement therapy. *Menopause* 1996;6:257-263.
10. Hess R, Chang CC, Conigliaro J, McNeil M. Understanding physicians' attitudes towards hormone therapy. *Womens Health Issues* 2005;15:31-38.
11. Hess R, Chang CC, Consigliere J, Elnicki DM, McNeil M. Experiential learning influences residents' knowledge about hormone replacement therapy. *Teach Learn Med* 2004;16:240-246.
12. Doomernik DE, van Goor H, Kooloos JGM, Ten Broek RP. Longitudinal retention of anatomical knowledge in second-year medical students. *Anat Sci Educ* 2017;10:242-248.
13. Matos J, Petri CR, Mukamal KJ, Vanka A. Spaced education in medical residents: an electronic intervention to improve competency and retention of medical knowledge. *PLoS One* 2017;12:e0181418.
14. Vadnais MA, Dodge LE, Awtrey CS, Ricciotti HA, Golen TH, Hacker MR. Assessment of long-term knowledge retention following single-day simulation training for uncommon but critical obstetrical events. *J Matern Fetal Neonatal Med* 2012;25:1640-1645.
15. Chan WP. Assessment of medical students' knowledge retention in a diagnostic radiology course: lecture attendees versus absentees. *Ann Acad Med Singapore* 2009;38:237-239.
16. Nelissen E, Ersdal H, Mduma E, et al. Helping Mothers Survive Bleeding After Birth: retention of knowledge, skills, and confidence nine months after obstetric simulation-based training. *BMC Pregnancy Childbirth* 2015;15:190.
17. Thepsatitporn S, Pichitpornchai C. Visual event-related potential studies supporting the validity of VARK learning styles' visual and read/write learners. *Adv Physiol Educ* 2016;40:206-212.
18. Husmann PR, O'Loughlin VD. Another nail in the coffin for learning styles? Disparities among undergraduate anatomy students' study strategies, class performance, and reported VARK learning styles. *Anat Sci Educ* 2019;12:6-19.
19. O'Mahony SM, Sbayeh A, Horgan M, O'Flynn S, O'Tuathaigh CM. Association between learning style preferences and anatomy assessment outcomes in graduate-entry and undergraduate medical students. *Anat Sci Educ* 2016;9:391-399.
20. Newton PM, Miah M. Evidence-based higher education—is the learning styles 'myth' important? *Front Psychol* 2017;8:444.
21. Stephens MB, McKenna M, Carrington K. Adult learning models for large-group continuing medical education activities. *Fam Med* 2011;43:334-337.