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**The mini Clinical Evaluation Exercise (mini-CEX) in a pre-registration osteopathy program:
exploring aspects of its validity.**

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ACCEPTED MANUSCRIPT

ABSTRACT

Workplace-based assessment is commonplace, particularly in medicine. These assessments typically involve the assessment of a student conducting a consultation, or part thereof, on a *real* patient in an authentic clinical practice setting. In disciplines such as medicine substantial work has been directed towards the evaluation of the processes and tools used to perform these assessments and understand their educational impact. At present, there is little literature on the tools used for workplace-based assessment in osteopathy yet they form a picture of the student's capability. The current study presents data from a new workplace-based assessment tool for osteopathy, the mini Clinical Examination (mini-CEX) and is used to inform the implementation of the mini-CEX more broadly. Data presented here suggest the mini-CEX in this cohort is feasible, efficient, acceptable to stakeholders, internally consistent, and can differentiate between students at different stages of an osteopathic teaching program. Further research into the use of the mini-CEX in osteopathy is required, particularly focusing on educational impact, the reliability of the tool and its generalisability to clinical learning environments in other osteopathy teaching institutions.

INTRODUCTION

Assessing osteopaths' clinical competence requires assessment of students' knowledge, skills and attributes during a number of different scenarios, using a variety of assessors who evaluate and comment on students' performance at the actual moment of patient care. Furthermore, there is no 'gold-standard' for the assessment of clinical competence in osteopathy.¹ The current study introduces an assessment tool can assist in the process of making a decision about a student's clinical competence.

Workplace-based assessments (WBAs) are a popular method for the assessment of clinical skill and competency across a range of health professions. These WBAs are designed to assess a students' clinical skills and competency at the 'does' level of Miller's clinical skills triangle,² that is, assess integration of knowledge during whole tasks an authentic clinical setting. There are a range of tools available to assess different aspects of the clinical encounter with the patient, or assess the students' global competency on a clinical placement *per se*. In other health disciplines various examples of these include the direct observed procedural skills (DOPS),³ the Leicester Assessment Package (LAP),⁴ the Longitudinal Evaluation of Performance (LEP),^{5, 6} the mini-peer assessment tool (Mini-PAT),⁷ and the mini clinical examination (mini-CEX).

The focus of the current paper is the clinical encounter tool to assess student's work at the point of patient care. In this study we focus on the mini-CEX because it is one of the most widely studied and used workplace-based assessment tools because it has been found to be a valuable tool to assess actual clinical performance with real patients in the workplace.⁸⁻¹⁵ The mini-CEX is designed to evaluate the student's history taking skills, examination skills, clinical

judgment, professionalism, and organisation of the clinical consultation during a nominal patient-student consultation. The student is rated on each of these domains and on their overall clinical competence. A key advantage of the mini-CEX is that the examiner is also asked to provide written and verbal feedback to the student based on the observed performance and this is of significant educational value to osteopathic faculty and students alike.

Another educational advantage of the mini-CEX is that multiple examiners assess multiple clinical encounters allowing a range of examiners to provide feedback to the student on their performance with different patients and presenting complaints. Research has demonstrated that student's performances with one patient/complaint are not a good predictor of their performance with other patients (case/content specificity), therefore assessment across multiple encounters is appropriate.¹⁶ Further work has also suggested that examiners are a substantial source of variance in mini-CEX scores¹⁷ and this reinforces the need for multiple, and different, examiners to assess a single student.¹⁸ The use of multiple examiners and multiple patient encounters contributes to the reliability of the mini-CEX,^{11, 13, 19, 20} particularly with one assessor per encounter and different assessors for each encounter.¹⁹ There are varying reports as to the number of encounters required to obtain a reliable result. Authors have reported between that 6 to 15 encounters are required^{8, 19-24} and this number appears to be feasible in different training settings.²⁵

As far as usability is concerned, the mini-CEX has been reported to be easily implemented into day-to-day practice and has broad applicability in a variety of settings and provides students with well-timed feedback.²¹ The mini-CEX is considered to be time efficient in that observation may last somewhere between 5 to 30 minutes depending on the goal of the observation.²⁶

Used formatively it is an example of assessment *for* learning in as much as it is an assessment *of* learning²⁷ and it can assist in tracking students' performance over time. The impact on learning is of paramount importance and it has been reported that the biggest gains demonstrated over the course of a year of training for medical students occurs in the dimensions of clinical judgment and organization/efficiency.¹¹ It is well known that the use of the mini-CEX encourages educators to observe student performance, and provides an opportunity to give immediate feedback about their performance²⁰ and we want this for osteopathy because such processes enhance the validity of the results and ensure that the student receives relevant and timely feedback to improve patient care.

There is a dearth of literature on the implementation of the mini-CEX in allied health *per se*, with one of the few examples being from chiropractic.²⁸ Regardless, in all professional disciplines assessment methods are subject to scrutiny. Accordingly, as osteopaths approach entry to practice, their education and assessment needs to be based on performance with *real* patients in the clinical setting. Moreover, they need to be observed on different occasions with different patients, and the inclusion of the mini-CEX in a programmatic approach to assessment of clinical skills is an avenue to explore student's activities in complex and realistic clinical challenges. The inclusion of the mini-CEX is expected to produce reliable conclusions about a student's overall osteopathic competence. To date there is no published research that has investigated the use of the mini-CEX in a pre-registration osteopathy teaching program. The current study presents data from the use of the mini-CEX that allows for the exploration of aspects of its validity in a pre-registration osteopathy program.

METHOD

This study was approved by the Victoria University (VU) Human Research Ethics Committee as part of a larger investigation into the assessment practices in the osteopathy program.

Participants

Data were collected from the mini-CEX forms completed during semester 1 and semester 2 of the 2014 academic year (March – November 2014). Students who were assessed were enrolled in the Clinical Practicum subjects in the VU Master of Health Science (Osteopathy) program. The clinical educator (herein 'examiner') completed the mini-CEX during the students' allocated weekly or biweekly session in the VU Osteopathy Clinic, and each student was required to have at least 4 mini-CEX forms completed over the academic year.

The examiners were registered osteopaths and another registered health professional that were involved in the supervision of students providing osteopathic treatment in the clinic. Each examiner in the cohort was provided with a guide to the mini-CEX. This guide contained information about the process of using the mini-CEX including providing student feedback, along the mini-CEX form itself (Figure 1) and the associated marking rubric (Supplementary File 1). There was no further training for the examiners in the use of the mini-CEX.

Assessment tool

The mini-CEX form is presented as Figure 1. The mini-CEX form contains a range of sections related to student details and details of the consultation and patient presenting complaint for administrative purposes, and to assist in identifying potential sources of variance in the mini-CEX scores.²² The examiners were also asked to rank the difficulty of the patient presentation.

The form was designed to be used for all aspects of the osteopathic consultation: 1) clinical history, 2) examination, and 3) management. The management component included osteopathic treatment, provision of advice to the patient as well as exercise prescription. The marking section covers 6 domains: 1) information gathering; 2) clinical skills; 3) counselling & communication; 4) clinical judgement; 5) professionalism; and 6) organisation & efficiency, along with a global rating.

The rating scale was a criterion-based scale similar to that used by Hill et al.²² and Yeates et al.²⁹ Each domain and the global rating is marked on a scale, erring towards the positive in that the option is to mark the student's performance either on the scale from *Well below expectation* (1) to *Well above expected level* (6) (Figure 1).

Figure 1. The mini-CEX.**Mini Clinical Examination (mini-CEX) - Osteopathy**

Student name: _____ Assessor name: _____

Year level: ☐ 3 ☐ 4 ☐ 5 Date of assessment: ____ / ____ / ____ Case type: ☐ New patient ☐ Return patientPatient complaint: _____ Case difficulty: ☐ Low ☐ Medium ☐ HighPatient age: _____ Gender: ☐ Male ☐ Female Observed component: ☐ History ☐ Exam ☐ Management*Rate the following areas of the consultation (based on student year level):*

	Well below expectation	Below expectation	Borderline	Meets expectation	Above expectation	Well above expectation	Not observed
Information gathering	1	2	3	4	5	6	X
Clinical examination	1	2	3	4	5	6	X
Counselling & communication skills	1	2	3	4	5	6	X
Clinical judgement	1	2	3	4	5	6	X
Professionalism	1	2	3	4	5	6	X
Organisation & efficiency	1	2	3	4	5	6	X
Overall clinical competence	1	2	3	4	5	6	

Aspects of the consultation were performed well**Aspects of the consultation for development and improvement****Agreed actions and learning plan**

Time taken for assessment: _____ mins

Time taken for feedback: _____ mins

Examiner satisfaction using mini-CEX	(Low)	1	2	3	4	5	6	(High)
Student satisfaction using mini-CEX	(Low)	1	2	3	4	5	6	(High)

Examiner signature: _____ Student signature: _____

Data from this form is collated for the purpose of evaluating the mini-CEX. Identifiable data will not be presented in any published reporting.

Where a domain was not observed during the assessment, the examiner was asked to circle this option on the form. The next section allows the examiner to identify the areas of the consultation that were performed well, in addition to those that require improvement. At the end of the observation of performance, the examiner and student were required to develop a learning plan following the observation. Finally, the examiner and student are asked to rate their satisfaction with the use of the mini-CEX (on a scale of 1 to 6) as part of the evaluation process as their input will inform continued improvements.

Data analysis

Data were entered into SPSS for Mac Version 21 (IBM Corp, USA) for analysis. Descriptive statistics were generated for each of the domains on the mini-CEX form. Inferential statistics were used to ascertain whether there were differences in each of the 6 domains on the mini-CEX along with the global rating, when looking at the student year level, portion of the consultation being observed, presenting complaint, and the complexity of the case presentation. Alpha was set at $p < 0.05$ and effect sizes were calculated using Cohen's d with the equation (1):

$$\text{Cohen's } d = \frac{M_1 - M_2}{SD_{\text{pooled}}} \quad (1)$$

Effect sizes were interpreted as small (0.2), medium (0.5), large (0.8), and very large (1.2).³⁰

The adjusted R-squared statistic (coefficient of determination) was calculated to investigate the relationship between the global rating and the total mini-CEX score. Inter-grade discrimination and internal consistency were also calculated for the mini-CEX domains. The cost of

undertaking a mini-CEX examination was also calculated.^{31, 32} Internal consistency was calculated using Cronbach's alpha (α) with a value of 0.80 or greater being acceptable. The standard error of measurement (SEM) was calculated for the mini-CEX domains using the equation $SEM = SD \times \sqrt{(1-\alpha)}$.³³

Spearman's correlation coefficient (ρ) was used to investigate the relationship between the quality assurance items and the following:

- mini-CEX domains
- mini-CEX global rating
- Consultation component being assessed (history, examination or management)
- Patient type (new or return)
- Case difficulty (low, medium or high)

Inter-item correlations for the mini-CEX domains were also calculated using Spearman's coefficient. Correlation coefficients were interpreted according to Hopkins:³⁴ <0.10 (trivial); 0.10-0.30 (small); 0.30-0.50 (moderate); 0.50-0.70 (large); 0.70-0.90 (very large); 0.90-1.0 (perfect). Cohen's d was also calculated for each correlation using the following equation (2) and interpreted as previously described:

$$d = \frac{2r}{\sqrt{1-r^2}} \quad (2)$$

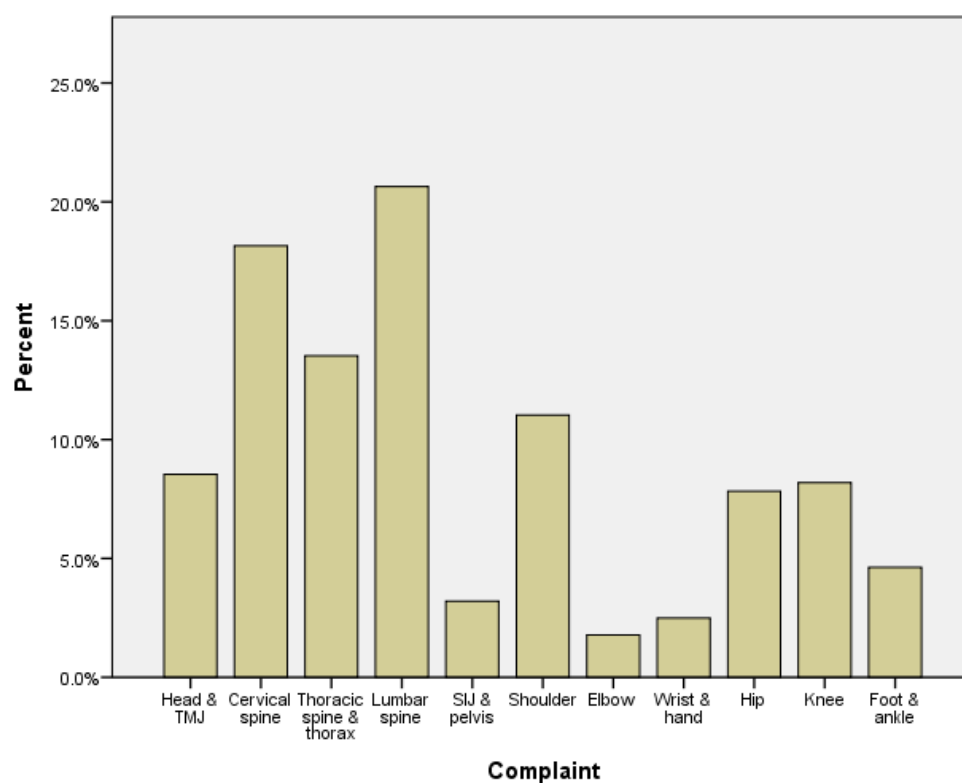
RESULTS

Three hundred and thirty-five (N=335) mini-CEX assessments were received in the 2014 academic year for the 96 students enrolled in Clinical Practicum 7-10 subjects. Two hundred and eighty-seven (n=287) mini-CEX assessments were available for the evaluation. Forty-eight assessments were excluded from the analysis as multiple components of the consultation were assessed using the one mini-CEX form.

Descriptive statistics

Students completed between 1 and 9 mini-CEX assessments with 63 assessments performed on 4th year students and 223 performed on year 5 students. The majority of the assessments were performed with return patients (n=248, 86.4%) with a spread across the case history (n=130, 45.3%), examination (n=104, 36.2%) and management (n=52, 18.1%) components of the osteopathic consultation. The majority of patients were female (n=179, 62.4%) with a mean age of 33.34 years (+/- 13.01, range 15-70). The presenting complaints are depicted in Figure 2, and just over half of the consultations were rated as 'medium' difficulty (n=147, 51.2%) by the examiners.

Figure 2. Patient presenting complaints.



Descriptive statistics for the mini-CEX domains, global rating, assessment/feedback times and satisfaction ratings are presented in Table 1.

Table 1. Descriptive statistics for the mini-CEX domains and quality assurance items.

	Mean	St Dev	Median	Min	Max	NO*
mini-CEX domains						
Information gathering	4.66	0.75	5	2	6	54
Clinical examination	4.59	0.88	5	2	6	123
Counselling & communication skills	4.92	0.72	5	2	6	6
Clinical judgement	4.67	0.78	5	2	6	17
Professionalism	4.92	0.72	5	3	6	0
Organisation & efficiency	4.76	0.75	5	3	6	3
Overall clinical competence	4.75	0.75	5	2	6	
Quality assurance items						
Time spent assessing (mins)	13.26	5.47	10	5	40	
Time spent providing feedback (mins)	6.98	3.80	5	2	20	
Student satisfaction with mini-CEX	4.75	0.74	5	2	6	
Examiner satisfaction with mini-CEX	4.81	0.81	5	2	6	

* Number of 'Not observed' indicated on mini-CEX form

Between group differences

There was no significant difference for student gender for any of the mini-CEX domains or global rating. Only the *Professionalism* domain was significantly different with male examiners awarding higher mean scores ($F_{(1, 4.98)}=10.03$, $p = 0.002$, $d=0.38$). Significant differences were observed for whether the student was assessed on a new or return patient. Both *Clinical Examination* ($F_{(1, 3.88)}=5.06$, $p = 0.026$, $d=0.48$) and *Organisation & Efficiency* ($F_{(1, 4.87)}=8.82$, $p = 0.003$, $d=0.68$) demonstrated lower mean ratings for new patient consultations. The difficulty of the consultation did not demonstrate any significant difference across the mini-CEX domains or global rating expect for *Clinical Examination* ($F_{(2, 3.88)}=3.21$, $p = 0.021$, $d=0.71$). Students received higher mean scores for high difficulty patients compared to low difficulty patients. No significant differences were identified by patient presenting complaint. Differences between year level were observed for all but the *Clinical Examination* and *Clinical judgement* areas (Table 2).

Table 2. mini-CEX domains and global rating by year level.

Domain	Year 4	Year 5	p-value	Cohen's <i>d</i>
Information gathering	4.40 (\pm 0.63)	4.66 (\pm 0.80)	0.013	0.36
Clinical examination	4.33 (\pm 0.82)	4.51 (\pm 0.91)	0.141	0.21
Counselling & communication skills	4.73 (\pm 0.70)	4.95 (\pm 0.71)	0.005	0.31
Clinical judgement	4.33 (\pm 0.82)	4.68 (\pm 0.88)	0.102	0.41
Professionalism	4.87 (\pm 0.64)	5.03 (\pm 0.75)	0.002	0.23
Organisation & efficiency	4.53 (\pm 0.83)	4.78 (\pm 0.79)	0.001	0.31
Overall clinical competence	4.27 (\pm 0.80)	4.74 (\pm 0.80)	0.006	0.59

Quality assurance items

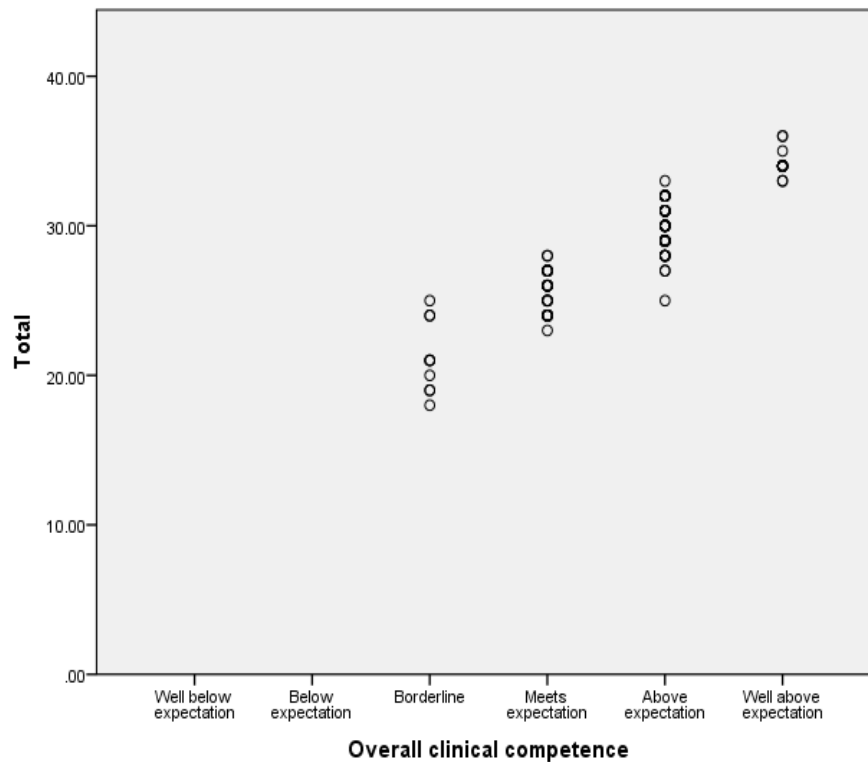
All Spearman correlation coefficients for the relationship between the quality assurance items and the mini-CEX domains, and global rating, were trivial to small ($p < 0.30$). The same result was observed for the quality assurance items and consultation component, case difficulty and whether the patient was new or returning.

Clinical Educators (the examiners) in the VU osteopathy program were paid AUD\$56.85 per hour at the time of the study. The mean cost of conducting a mini-CEX was determined by using the combined mean assessment and feedback time of 16.87 minutes. Cost per mini-CEX was calculated to be AUD\$15.85.

Psychometrics

The plot of each student's global rating against the total score is at Figure 3. The adjusted R-squared coefficient was calculated for correlations between the global rating and total score for the assessment and was equal to 0.88. This statistic demonstrates the 88% of change in the global rating is due to a change in the mini-CEX domain scores.³⁵

Figure 3. Scatterplot of the mini-CEX global rating versus total score.



Inter-grade discrimination is the slope of the regression line and represents the average increase in the criteria mark that corresponds to an increase of one mark on the global rating scale. The slope of the regression line was 4.32 and the percentage change was 12%.

Inter-domain correlations (Table 3) were small to moderate however the effect sizes were moderate to very large. The mini-CEX demonstrated acceptable internal consistency ($\alpha=0.88$) and this value did not improve if any of the mini-CEX domains were removed. The SEM for the mini-CEX domains (excluding the global rating) was ± 0.27 .

Table 3. mini-CEX inter-domain correlation coefficients.

mini-CEX Domain	1.		2.		3.		4.		5.		6.	
	ρ	d	ρ	d	ρ	d	ρ	d	ρ	d	ρ	d
1. Information gathering	1.00											
2. Clinical examination	0.61	1.54	1.00									
3. Counselling & communication skills	0.54	1.28	0.33	0.69	1.00							
4. Clinical judgement	0.60	1.50	0.70	1.96	0.49	1.12	1.00					
5. Professionalism	0.52	1.22	0.49	1.12	0.60	1.50	0.48	1.09	1.00			
6. Organisation & efficiency	0.68	1.85	0.58	1.42	0.46	1.03	0.53	1.25	0.57	1.38	1.00	
Overall clinical competence	0.80	2.60	0.75	2.26	0.65	1.71	0.74	2.20	0.65	1.71	0.73	2.13

Note: all correlations are significant at the 0.01 level (2-tailed). ρ - Spearman correlation coefficient, d - effect size

DISCUSSION

The aim of the present study was to present data on the use of the mini-CEX in an Australian osteopathy teaching program as part of a project to develop and implement this tool as part of a programmatic approach.³⁶ This is the first time that the mini-CEX has been described in the non-US osteopathic education literature albeit in one teaching institution. The mini-CEX has been used widely in medicine as a valid, reliable, and feasible assessment method in both pre- and post-professional education and training settings.

The VU osteopathy program has implemented the mini-CEX as part of a programmatic approach to clinical practicum assessments³⁶ and as such, is designed to complement other assessment methods such as a portfolio, written examination and the Objective Structured Clinical Examination,³⁷ so that a variety of assessment methods are used to determine a student's clinical competence. The mini-CEX is the key 'observed performance in workplace settings'³⁸ assessment method in the VU program, and the following discussion provides some evidence to argue for the validity of the scores derived from the mini-CEX in osteopathic education. In doing so, the five identifiable features of effective clinical competency assessments:³⁹ validity; reliability; acceptability; educational impact; efficiency; and affordability, will also be addressed.

Validity

Contemporary validity theory suggests that a test or measure cannot in itself be valid but evidence can be presented to support the validity of the scores derived from the test or measure. Evidence for the content validity of the assessment includes the type of presenting complaints that were encountered during each assessment,¹⁴ and the presentation type (new

or return patient). The presenting complaints that were assessed are relatively consistent with data from private Australian osteopathic practices⁴¹ supporting the appropriateness of the student-led, on-campus clinic as an environment to conduct the assessments. The accuracy of the rating of the complexity of the presenting complaint is difficult to verify however they are consistent with data from the study by Hatala et al.¹⁴ where the majority of presentations were ranked as low or medium difficulty.

Across the mini-CEX domains *Clinical Examination* had the highest number of 'not observed' responses and this is consistent with the work by Hill et al.²² Less than 20% of the encounters were for the management component of the osteopathic consultation. These two issues may limit the content and face validity, a key concern of osteopathic educators.⁴² Norcini et al.⁸ contend that the mini-CEX "...more closely models actual clinical practice" when compared to the long case or traditional clinical examination, a position supported by Hawkins et al.²⁴ in their review of the mini-CEX. The fact that the assessment takes place in an environment somewhat resembling daily practice may go some way assuaging concerns about content validity. It may also be that in the future students will be required to have a certain number of assessments on each component of the consultation. The results of other analyses will provide guidance as to the number of encounters required to make a reliable judgement and this will inform the number of components of the consultation that require assessment. Further, we caution against using the mini-CEX as the sole determinant of clinical competency in an osteopathic program – the results of multiple mini-CEX encounters should contribute information to this competency decision when combined with results from other assessment types.^{21, 43}

Internal consistency was calculated to be 0.88 and is within the range reported in previous studies.^{14, 20, 25} This value was acceptable and did not indicate item redundancy, particularly as other authors have reported that item redundancy may be a concern with the mini-CEX. The inter-item coefficients for the mini-CEX domains were small to medium, however the effect sizes were medium to very large. Compared to other mini-CEX studies,^{8, 10, 11} the coefficients in the present study were lower. The medium to very large effect sizes suggest with larger samples these correlations may improve towards those reported in the literature. These correlations also provide evidence that the mini-CEX domains are all assessing the same construct. The relationships between the overall clinical competence score and each mini-CEX domain were large to very large with very large effect sizes, and more consistent with the literature.^{8, 10, 11}

The mean mini-CEX total scores increased with each global rating. The adjusted R-squared calculation was 0.88 suggesting that 88% of the variation in the global rating is due to the variation in the total domain score.³⁵ This R-squared value was acceptable as Pell et al.³⁵ suggests that correlations of greater than 0.5 indicate a good relationship. In accounting for the remaining variance of 12%, assessors may be using their own professional judgement biases to make their global rating decision⁴⁴ and/or making a judgement relative to other students at the same level of training.²⁹ These are entirely acceptable results as examiners are used on the basis of their professional background and competency.

The inter-grade discrimination provides an overview of the average increase in the total score for each increase in the global rating.³⁵ The slope of the regression line was 7.71 therefore an average increase of just under 8 marks on the criteria was needed to improve one rating on the global rating scale. This represents approximately 16% of the total score and is higher than the

10% recommended by Pell et al.³⁵ However as these authors point out, there is nothing within the literature that allows for the interpretation of the inter-grade discrimination level. Further investigation using the mini-CEX may assist in determining the appropriate level of inter-grade discrimination. This information will assist in ensuring that the global rating scale is being used by the examiners in an acceptable manner, that is, as the total domain score goes up so does the global rating. The internal consistency, inter-item correlations, R-squared and inter-grade discrimination all provide evidence for the scores derived from the mini-CEX as part of the validity argument. These statistics suggest that in the current student/examiner cohort the mini-CEX domains and global rating are being used in a consistent manner. More research is required to determine if these statistics are similar in different cohorts and at different institutions.

As part of developing the validity argument for the mini-CEX in osteopathy, understanding whether the assessment can differentiate between different levels of training is warranted. Previous research has demonstrated such a difference^{11, 45} and the present research concurs. The mean values for all mini-CEX domains and the global rating were higher for year 5 students compared to year 4 students. Small to medium effect sizes were observed for the mini-CEX domains and a medium effect size for the global rating. *Clinical examination* and *Clinical judgement* were not significantly different however with larger samples a difference may be demonstrated. The *Clinical examination* domain may not demonstrate a difference for year level as the students are expected to be able to perform, and been previously assessment performing, examinations on patients. Contrast this with *Clinical judgement* where it would be expected that a students' reasoning skills would improve over time.²⁴

Reliability

A number of authors have investigated the reliability of the mini-CEX using generalizability analysis. This type of analysis also allows researchers to determine the contribution of different sources of variance that impact on assessment scores (G-study), and provides an opportunity to determine the number of assessments required in order to obtain a reliable result (D-study). Approximately 8 mini-CEX encounters need to be completed in order to obtain such a result of 0.80 or greater.^{46, 47} The present study did not investigate the reliability however this will be the subject of future research. The SEM has been advocated for calculation in high-stakes assessments as a quality indicator alongside reliability.³³ The interpretation of the SEM is smaller values indicate greater accuracy of the measurement or score. For the present study the accuracy of the score obtained by the student is interpreted that score ± 0.24 . The student's *true* score would likely be with ± 0.24 of the score awarded if the assessment was repeated ad infinitum with no change to the patient, examiner or conditions under which the student is being assessed. It is important to note that this SEM can only be used to interpret data in the present study however it may be a useful guide for future studies in different cohorts.

Acceptability

The acceptability of an assessment is important to evaluate to ensure that all stakeholders are willing implement it. Both the students and examiners were asked to rate their satisfaction with the mini-CEX at each assessment (Figure 1). The two groups were largely satisfied with the mini-CEX as demonstrated by the median score of 5 out of 6. Other investigators have also demonstrated that both students and examiners are moderately to highly satisfied with the

mini-CEX.^{8, 10, 11, 28, 48} Qualitative investigations would also add valuable information about the acceptability of the mini-CEX and is an avenue for future research.

Educational impact

The mini-CEX has been shown to be related to other educational outcomes such as written examination results and other performance assessments⁴⁵. The present study did not investigate the educational impact of the mini-CEX – the effects on students learning approaches and behaviours, however this is part of the evaluation strategy for the mini-CEX and will be published in the future.

Beside the relationship with other assessments, the mini-CEX has been advocated as a formative assessment method. As multiple assessors rate the student at the point of patient care, there is an opportunity to receive to provide immediate, focused feedback from multiple practitioners²⁸. At the completion of each encounter, the student and examiner discussed the feedback from the observed performance and developed learning goals. Whether these goals were followed through and achieved cannot be determined and will be the subject of future research.

Very few students in the current cohort 'failed' a mini-CEX. Whilst this may be an accurate reflection of the performance observed, it may also be that examiners are unlikely to fail a student given their close educational relationship.²² Students in the VU program participate in a 'longitudinal' approach to clinical education where they are with the same Clinical Educator(s) for a 13-week period or longer. Over time there is the potential for this professional relationship

to develop and subsequently bias the mini-CEX results awarded by the examiner. This potential source of bias requires further investigation.

Efficiency

The mean assessment time was under 14 minutes and the mean time spent providing feedback was approximately half the assessment time at just under 7 minutes. This is consistent with previous work indicating variable lengths of time for the mini-CEX encounter from 1 to 180 minutes dependent on the context.^{8, 10, 47} The time spent providing feedback to the student was on average half the length of time to observe the performance in the present study and this is also consistent with previous work.^{10, 47, 49} The mini-CEX appears to be an efficient method of assessing student's workplace performance in osteopathic education and does not impose a significant impost on the examiner's time in the teaching clinic.

Affordability

The cost of conducting a mini-CEX encounter has received little attention in the literature even though Walsh advocates that cost should be considered when evaluating an assessment. Each assessment in the present study cost approximately AUD\$16 to conduct, including paper and administrative costs. Given the typical number of assessments needed to obtain a reliable result is 10, it would cost approximately AUD\$160 to undertake the assessments in an academic year. This suggests that the mini-CEX is affordable to implement in an Australian osteopathy program.

Challenges & limitations

There were a number of issues encountered with the use of the mini-CEX. Firstly, there were substantial amounts of missing data from the completed mini-CEX forms. This was not restricted to one aspect of the form. Secondly, there were instances where the examiner assessed multiple aspects of the consultation (e.g. assessing both the examination and management together). These forms were removed from the analysis as it was unclear as to which aspect of the consultation was being rated. Both of these issues have subsequently been addressed in examiner training workshops, and it is anticipated this will also reduce the amount of missing data. Thirdly, some examiners anecdotally reported that completing the mini-CEX took them away from their core role of supervision of students, and was time consuming – a concern shared by clinical supervisors in the study by Al-Kadri et al.⁵⁰

Examiners also reported that they felt the mini-CEX was not a valid assessment method as it was not possible to observe how a student conducted an entire patient consultation, and that the long-case assessment would be more appropriate. The converse opinion was identified in the work by Hill et al.²² Together, these issues highlight the need for further training of the examiners in the use of the mini-CEX, and to reinforce that an expected role of a clinical educator is that of an examiner of workplace performance.⁵¹

The generalisability of the results is limited given that the data was derived from one student cohort at one institution and costs associated with the mini-CEX, for example, will vary between institutions. The present study was on a small scale compared to other mini-CEX investigations where over 1000 encounters have been used in the data analysis,²² and larger numbers of assessments may change the results from those presented here. The nature of the student-led clinic environment at VU means that one student may be assessed by the same examiner multiple times and this could influence the results. From a logistical standpoint,

it would be difficult to have the student assessed by 8-10 different examiners in the on-campus clinic environment, however it is possible to limit the number of times an examiner rates a student to 2 or 3. This will ensure that students receive feedback from multiple examiners, and reduce the impact of examiner bias on the outcome of the mini-CEX.

CONCLUSION

As an inclusion in the overarching assessment strategy in the pre-professional osteopathic curriculum, the mini-CEX appears to be a promising workplace-based formative assessment tool in the on-campus clinical learning environment. The mini-CEX facilitates well-timed feedback to students during moments of patient care and therefore has potential impact on student learning, patient care and patient safety. Future research will focus on exploring the educational impact of the mini-CEX in this setting, specifically, how well particular dimensions of student performance are tracked and where the biggest gains are found. More research is needed to determine, in osteopathy, how many mini-CEX encounters are required to obtain a reliable result, as well as further exploration of its efficiency and affordability as an assessment tool as these aspects impact not only on the quality of the educational experience, but also on decisions about resource allocation.

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AUTHOR CONTRIBUTION STATEMENT

Both authors were involved in the literature review. BV conducted the data analysis. Both authors contributed to the development of the manuscript and approved the final version.

ETHICAL STATEMENT

This study was approved by the Victoria University Human Research Ethics Committee as part of a larger investigation into the assessment practices in the osteopathy program. Students and clinical educators are informed at the beginning of each academic year that de-identified data from assessments undertaken in the osteopathy program will be collated, analysed and published. They are informed that there is an option to indicate that their data not be used as part of the analysis.

STATEMENT OF COMPETING INTERESTS

Brett Vaughan is a member of the Editorial Board of the International Journal of Osteopathic Medicine but was not involved in review or editorial decisions regarding this manuscript.

IMPLICATIONS FOR PRACTICE

- Osteopathic educators are encouraged to explore the use of workplace-based assessment tools as part of a multi-method approach to assessment of clinical competency
- The mini-CEX is feasible, efficient and acceptable in a pre-professional osteopathy program
- Where possible, a range of examiners should be used to assess students thereby ensuring the assessment is fair and reliable, and that the student receives feedback on their performance from multiple people.

Components of the mini-CEX

Student, case and patient information

Ensure that all details at the top of the assessment sheet are completed. This information is important for the student along with the academic staff for research and teaching purposes.

Student name: write the first and surname of the student in the space provided

Assessor name: write your first and surname in the space provided

Year level: tick the box to indicate the year level of the student

Date of assessment: write the date that the assessment took place

Case type: tick the box to indicate whether the assessment was performed on a new or return patient

Patient complaint: provide a brief statement about the presenting complaint

Case difficulty: tick the box that corresponds with your judgement of the complexity of the case

Patient age and gender: complete the relevant details

Observed component: tick the box related to the component of the consultation being assessed

History – New Patient

This component involves the clinical interview where the student establishes the patient details, presenting complaint, medical history and systems history. Initially the student should discuss with the patient how the consultation will be undertaken and how long they expect the consultation to be. During this time the patient should be comfortable. The questioning employed by the student during the clinical should be appropriate for the presenting complaint.

History – Return Patient

This component involves the clinical interview where the student reviews the patient's progress and establishes whether there have been any changes in the medical history. The details about any new presenting complaints are also established. The questioning employed by the student during the clinical should be appropriate for the presenting complaint.

Examination – New Patient

The examination should include some form of screening assessment along with a structured osteopathic and orthopaedic examination of the relevant areas. Clinical examinations (e.g. cranial nerve exam, cardiovascular exam) should also be performed where indicated by the clinical history.

Examination – Return Patient

The examination should focus on the reassessment of the patient based on patient progress, the response to the previous treatment and the previous examination findings. Clinical examinations (e.g. cranial nerve exam, cardiovascular exam) should also be performed where indicated by the clinical history.

Management – New and Return Patient

Management includes establishing informed consent, application of osteopathic techniques (where indicated), provision of exercise or rehabilitation advice (where indicated) as well as lifestyle and ergonomic advice (where indicated).

Domains

There are 6 Domains on the mini-CEX:

1. Information gathering

The student is assessed on their ability to gather information about the patient, their presenting complaint, relevant medical history, progress to date and any other information that would assist the student to manage the patient. Questioning should be appropriate for the presenting complaint and can include assessment of the patient's comprehension about informed consent and the advice provided. This domain will be assessed for all three components of the osteopathic consultation.

2. Clinical examination

The student is assessed on their ability to examine the patient. This includes the osteopathic and orthopaedic examination along with performing any clinically indicated examinations such as the cranial nerve exam or cardiovascular examination. The examination should be relevant for the presenting complaint, taking into account patient comfort and consent. This domain may not be observed when assessing the management component of the osteopathic consultation.

3. Counselling & communication skills

The student is assessed on their ability to communicate with the patient. Communication should be sensitive to the patient's needs and delivered at a level appropriate for the patient. The question strategy employed should be appropriate for the patient (i.e. use of open or closed questions) and include informed consent. This domain will be assessed for all three components of the osteopathic consultation.

4. Clinical judgement

The student is assessed on their ability to develop appropriate differential diagnoses and manage the patient. This includes: the application of relevant, safe and effective osteopathic treatment techniques; relevant, safe and effective exercise and rehabilitation strategies; and advice about dietary, lifestyle and ergonomic considerations.

5. Professionalism

The student is assessed on their overall professionalism during the consultation. The student should be dressed appropriately, the treatment presented in a neat and tidy manner, and the boundaries between the patient and practitioner observed. The student behaves in an ethical manner and demonstrates an awareness of the relevant medicolegal aspects of practice as well as the clinic policies and guidelines. This domain will be

assessed for all three components of the osteopathic consultation.

6. Organisation and efficiency

The student is assessed on their ability to organise the consultation in such a way as to minimise patient discomfort and avoid moving the patient more than necessary. The consultation should be efficient but not neglect relevant questioning, examinations or discussion with the patient about the management strategy. This domain will be assessed for all three components of the osteopathic consultation.

Scoring

Each domain MUST be scored. Circle only one option for each domain and circle a number. Do not circle in between numbers. Where the domain has not been observed during the consultation, the Not observed ('X') is used. Where possible this should only be used when a student has not had an opportunity to demonstrate any skills or behaviours that are assessed under a particular domain.

Each domain is scored on the following scale based on their year level:

Score of 1 or 2 (well below and below expectation)

The student cannot demonstrate any desirable behaviours or competencies for the domain. A score of one would be a matter of immediate importance and warrant considered feedback (both verbal and written) to provide the student with avenues to achieve competence for the domain.

Score of 3 (borderline)

Competence in the assessed domain is not yet adequate. If a score of 3 is awarded for an domain, feedback on specific behaviours that require development must be provided to the student, along with strategies to achieve this.

Score of 4 (meets expectation)

The student has achieved a level of competency that would be expected of a student. A score of 4 indicates that for this domain, the student has met this standard based on their experience or year level.

Score of 5 or 6 (above and well above expectation)

The student demonstrates most performance indicators to above an expected level for their year level and reflects that the student is 'comfortable' with that aspect of their performance. To be awarded a score of 6, the student demonstrates above expected competence for that domain and could perform the behaviours or skills independently and/or with limited supervision.

Global Rating Scale (GRS)

Clinical Educators are asked to rate the student's overall clinical competence based on what was observed during the consultation. It is recommended that the GRS is completed after individual domains have been graded.

Well below or Below expectation

This rating would be used when in the educator's opinion, the student's performance overall was not adequate.

Borderline level

When reflecting on the student's performance overall in the consultation, a borderline student may be good at some things and not so good at others. The student will need feedback and potentially structured learning activities in order to assist them to improve their performance.

Meets expectation

The student at this level managed the patients in a safe, effective, efficient and respectful manner. Demonstrates an awareness of their own limitations.

Above or Well above expectation

Students at this level competently and professionally manage the consultation and the patient. Demonstrates an awareness of their own limitations and how these can be managed or improved. The student would be capable of independent practice under limited supervision.