Score Relationship of COMLEX-USA Level 1, COMSAE Phase 1, and COMAT FBS Comprehensive Examinations

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INTRODUCTION

The Comprehensive Osteopathic Medical Licensing Examination of the United States (COMLEX-USA) is a three-level national standardized licensure examination for osteopathic medicine. Among the three levels, COMLEX-USA Level 1 (COMLEX-L1), typically given at the end of a student's second year of osteopathic medical school, is a problem- and symptom-based assessment that integrates foundational biomedical sciences and other areas of medical knowledge. The Comprehensive Medical Self-Assessment Examination Phase 1 (COMSAE-P1) is built from the same blueprint as COMLEX-L1 and is a self-assessment tool for COMLEX-L1 examination readiness. The COMAT Foundational Biomedical Sciences Comprehensive Examination (FBS-C) became available to the COMs in December 2018. FBS-C allows COMs and students to receive robust feedback on their knowledge in the basic science disciplines and biomedical domains taught in the first two years of medical school. Both COMSAE-P1 and FBS-C are typically taken prior to COMLEX-L1, which can help COMs evaluate their students' readiness to take this licensure examination. According to the Standards (AERA, APA, & NCME, 2014), validity is the most fundamental consideration in assessments. For measures intended to assess the same or similar constructs, predictive relationships between the measures provide an important source of validity evidence.

Objective

The study examined the effectiveness of FBS-C and COMSAE-P1 in predicting future performance on the COMLEX-L1 examination.

METHOD

Data

First-time test takers in their second year of osteopathic medical school were included in the study. The final sample size of the students who took both the FBS-C and 2019-2020 COMLEX-L1 was 1,575. The final sample size for those who took both the 2019 COMSAE-P1 new forms under the timed setting and the 2019-2020 COMLEX-L1 examinations was 6,304. All students took the FBS-C and/or the COMSAE-P1 exams prior to taking the COMLEX-L1 examination.

Analysis

Six variables were involved in the analysis: COMLEX-L1 score, FBS-C score, COMSAE-P1 score, COMLEX-L1 years-in-school, FBS-C years-in-school, and COMSAE-P1 years-in-school. The years-in-school variables were created to capture the timing of when the students took the exams. Years-in-school was defined as the amount of time, in years, that the student had been in osteopathic medical school when the exam took place. They were calculated with the assumption that the osteopathic medical programs began on August 1, four years prior to the expected graduation year. For example, if a student takes the FBS-C on November 1 of his/her second year of medical school, then FBS-C years-in-school is 1.25.

Pairwise correlations among the six variables were calculated. Then, multiple regressions were used to investigate the relationship between the three examination scores. The multiple linear regression used to model the FBS-COMLEX relationship was:

COMLEX-L1 Score ~ FBS-C Score + COMLEX-L1 Years-in-School + FBS-C Years-in-School.

In addition, using the *polr* function in the *MASS* package in R (Venables & Ripley, 2002), multiple ordinal logistic regression models were built to estimate the odds of attaining different COMLEX-L1 scores within the 7 ranges defined by the cutoff thresholds 400 through 650, by 50 points. The regression models were written as:

Model 1: COMLEX-L1 Score Category ~ FBS-C Score,

Model 2: COMLEX-L1 Score Category ~ FBS-C Score + COMLEX-L1 Years-in-School,

Model 3: COMLEX-L1 Score Category ~ FBS-C Score + FBS-C Years-in-School, and

Model 4: COMLEX-L1 Score Category ~ FBS-C Score + COMLEX-L1 Years-in-School + FBS-C Years-in-School.

For both multiple regression and ordinal logistic regression, the FBS-C score and the FBS-C years-in-school variables were replaced by COMSAE-P1 score and the COMSAE-P1 years-in-school variables to study COMSAE-COMLEX relationships. Likelihood ratio tests were used for model selection. For each of the ordinal logistic models, the proportional odds assumption was confirmed graphically by comparing the model- and data-derived probabilities of attaining scores within each of the COMLEX-L1 score ranges.

RESULTS

The correlations show that the three exams had moderate to strong correlations with one another (see Table 1). Furthermore, students who took COMLEX-L1 later in their education tended to take COMSAE-P1 later and received lower COMLEX-L1 scores compared to other students. In contrast, FBS-C scores tended to increase when that exam was taken later in the students' medical education.

Table 1. Descriptive Statistics and Correlations

	1	2	3	4	5	*N*	*Mean*	*SD*
1. COMLEX-L1 score	-					7,437	534.3	87.5
2. FBS-C score	.66	-				1,575	202.0	9.4
3. COMSAE-P1 score	.69	.67	-			6,304	437.0	85.7
4. COMLEX-L1 years-in-school	-.14	-.24	-.12	-		7,437	1.91	0.08
5. FBS-C years-in-school	.01	.33	.03	.02	-	1,575	1.47	0.12
6. COMSAE-P1 years-in-school	-.05	.02	.31	.69	.17	6,304	1.76	0.09

Predicting COMLEX-L1 Scores from FBS-C Scores

Figure 1 shows that there was a linear positive relationship between the FBS-C and COMLEX-L1 scores. The residual plots confirmed the homoscedasticity and normal distribution of the regression errors. Multiple regression estimates for all of the coefficients were statistically significant at the .001 level (R^2 = .53, adjusted R^2 = .53; see Table 2). The results showed that students with higher FBS-C scores tended to have higher COMLEX-L1 scores when the values of the years-in-school variables were held constant.

Figure 1. Scatterplot of COMAT FBS-C and COMLEX-USA Level 1 scores.

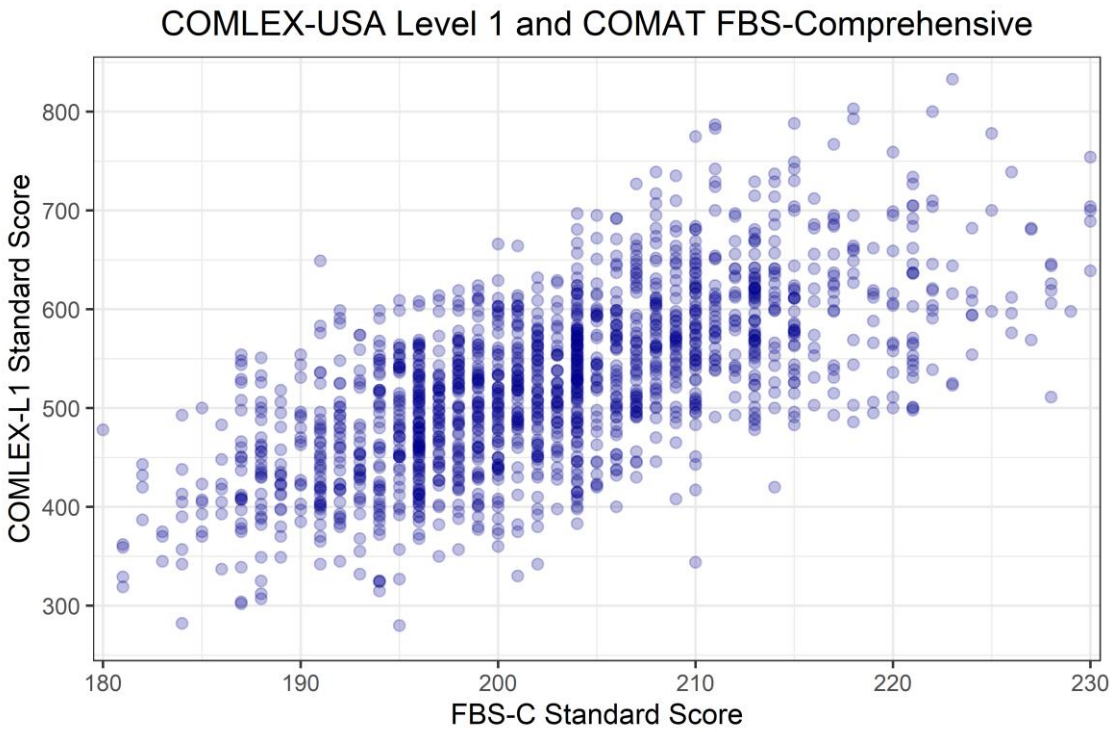


Table 2. Multiple Regression Coefficients for Predicting COMLEX-L1 Scores from COMAT FBS-C Scores

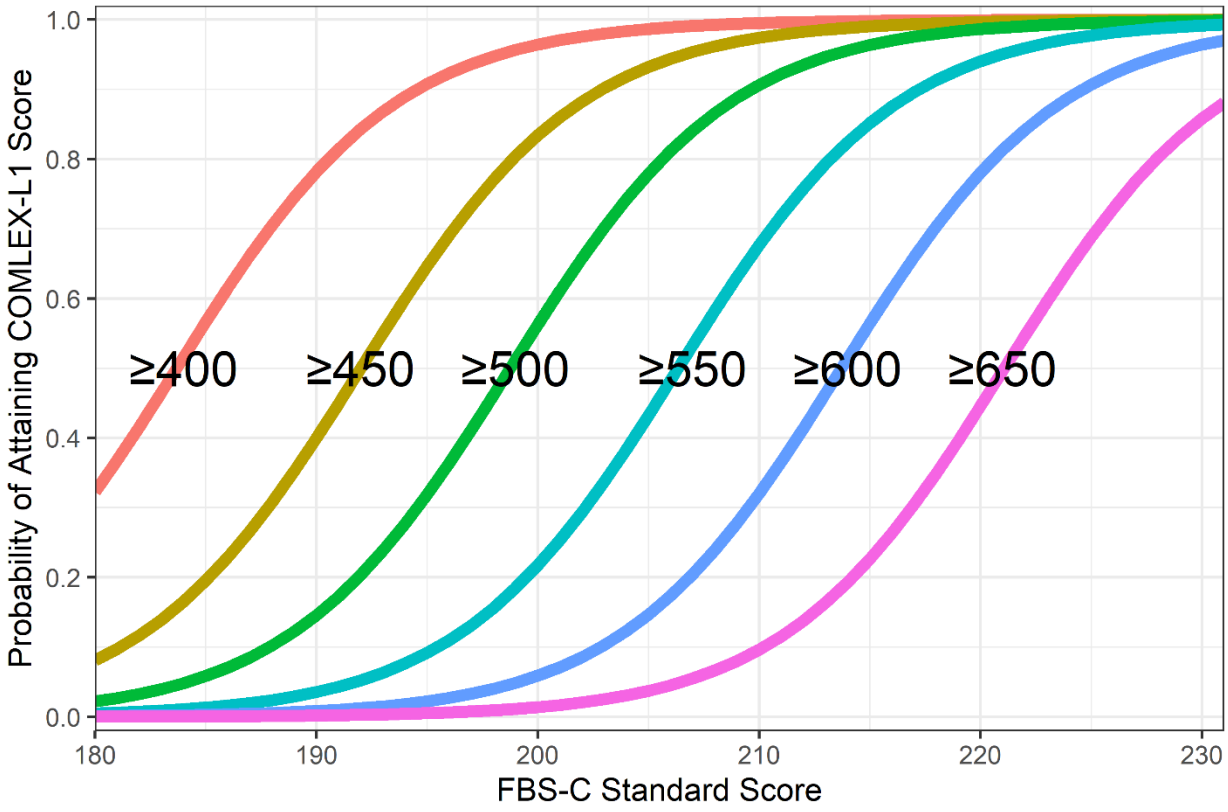
	Coefficient	SE	t	p
(Intercept)	-277.29	58.7	-4.73	< .001
FBS-C score	6.92	0.18	38.05	< .001
FBS-C years-in-school	-216.43	14.2	-15.3	< .001
COMLEX-L1 years-in-school	-146.79	21.5	-6.83	< .001

For the ordinal logistic model predicting COMLEX-L1 scores from FBS-C, including FBS-C years-in-school and L1 years-in-school as predictors significantly improved the ordinal logistic regression model, in comparison to the model including only the FBS-C score predictor ($\chi 2$ = 267.3, df = 2, $p < .001$). Holding the years-in-school predictors constant, every 10-point increase in FBS-C scores multiplied the odds of attaining any given COMLEX-L1 score category by 7.54 times ($p < .001$). Also, for any given FBS-C score, COMLEX-L1 performance tended to be higher for those who took the FBS-C and/or COMLEX-L1 at an earlier date ($p < .001$).

Table 3. Ordinal Logistic Regression Results to Predict COMLEX-L1 Scores from FBS-C Scores

	Coefficient	SE	t	p
Slopes				
FBS-C score	0.20	0.01	35	< .001
FBS-C years-in-school	-6.32	0.45	-14.13	< .001
L1 years-in-school	-4.55	0.41	-11.17	< .001
Intercepts				
Attain 400	19.09	0.12	161.89	< .001
Attain 450	20.78	0.17	120.84	< .001
Attain 500	22.14	0.19	114.75	< .001
Attain 550	23.67	0.21	110.41	< .001
Attain 600	25.16	0.24	106.56	< .001
Attain 650	26.65	0.26	101.56	< .001

Figure 2. Probability of attaining COMLEX-L1 score thresholds by FBS-C score based on the ordinal logistic regression model. FBS-C years-in-school and COMLEX-L1 years-in-school were fixed at their mean values.



Predicting COMLEX-L1 Scores from COMSAE-P1 Scores

According to Figure 3, there was a linear relationship between COMLEX-L1 and COMSAE-P1 scores. Table 4 shows the results for the linear regression of COMLEX-L1 scores on COMSAE-P1 scores, together with COMSAE-P1 years-in-school and COMLEX-L1 years-in-school. The residual plots confirmed the homoscedasticity and normal distribution of the regression errors. Multiple regression estimates for all of the coefficients were statistically significant at the .001 level (R^2 = .57, adjusted R^2 = .57; see Table 4). The results showed that students with higher COMSAE-P1 scores tended to have higher COMLEX-L1 scores when the values of the years-in-school variables were held constant.

Figure 3. Scatterplot of COMLEX-L1 and COMAT FBS-C scores.

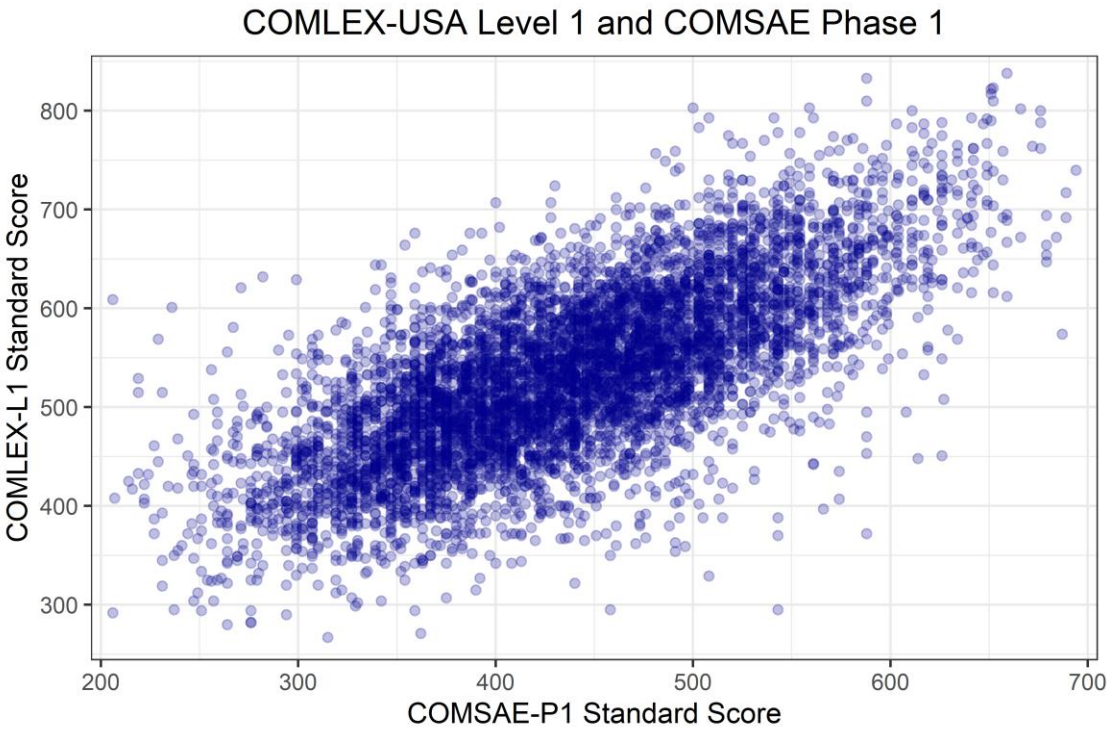


Table 4. Multiple Regression Coefficients for Predicting COMLEX-L1 Scores from COMSAE-P1 Scores

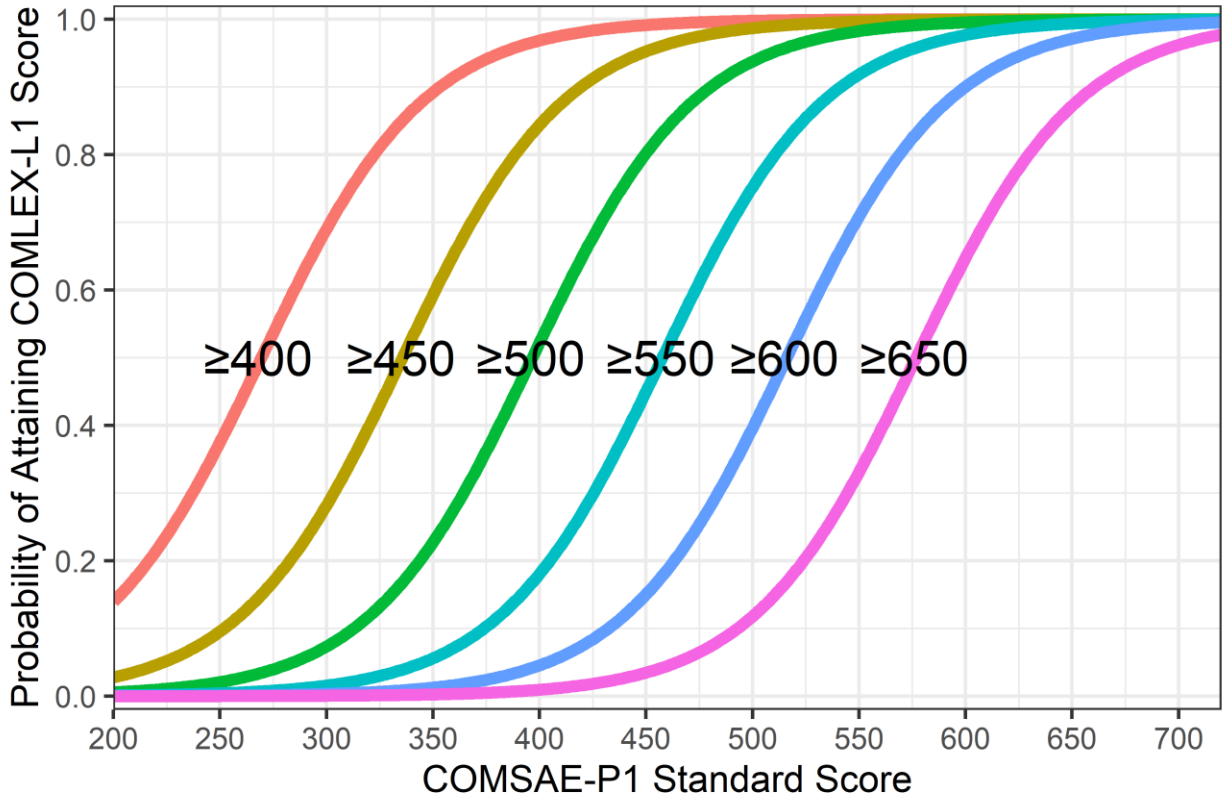
	Coefficient	SE	t	p
(Intercept)	744.42	20.86	35.68	< .001
COMSAE-P1 score	.78	.01	83.24	< .001
COMSAE-P1 years-in-school	-278.86	8.85	-31.50	< .001
COMLEX-L1 years-in-school	-31.33	10.74	-2.92	< .001

Including COMSAE-P1 years-in-school as another predictor significantly improved the ordinal logistic regression model, in comparison to the model including only the COMSAE-P1 score predictor ($\chi 2 = 1210.53$, df = 1, $p < .001$). According to the coefficients reported in Table 5, holding the COMSAE-P1 test date predictor constant, every 10-point increase in the COMSAE-P1 scores multiplied the odds of attaining any given COMLEX-L1 score category by 1.35 times ($p < .001$; see Figure 4). For a fixed COMSAE-P1 score, taking the COMSAE-P1 test earlier was associated with a higher COMLEX-L1 score. For any given COMSAE-P1 score and test date, the odds became smaller for obtaining a higher COMLEX-L1 score category.

Table 5. Ordinal Logistic Regression Results to Predict COMLEX-L1 Scores from COMSAE-P1 Scores

	Coefficient	**SE**	**t**	**p**
Slopes				
COMSAE-P1 score	0.03	.00	63.10	< .001
COMSAE-P1 years-in-school	-9.66	.07	-139.60	< .001
Intercepts				
Attain 400	-9.92	.04	-237.54	< .001
Attain 450	-8.18	.07	-120.49	< .001
Attain 500	-6.59	.08	-83.01	< .001
Attain 550	-4.99	.09	-54.65	< .001
Attain 600	-3.48	.10	-33.25	< .001
Attain 650	-1.86	.12	-15.58	< .001

Figure 4. Probability of attaining COMLEX-L1 score thresholds by COMSAE-P1 score based on the ordinal logistic regression model.



DISCUSSION

Results show that performance on FBS-C and/or COMSAE-P1 is positively related to COMLEX-L1 scores. Furthermore, including the years-in-school information in the models improved their predictive accuracy. This is likely a result of students' learning over time, as well as the earlier preparedness of high achievers. Given that COMLEX-L1 scores are one of the criteria for student performance, the results provide evidence of predictive validity for FBS-C and COMSAE-P1. COMSAE-P1 and COMAT FBS-C can be used to evaluate the level of readiness for COMLEX-L1.

Study has some limitations. The FBS-C examination is relatively new, released in December 2018. COMs likely do not yet have an established routine for using FBS-C. Therefore, the relationship between FBS-C and COMLEX-L1 may change depending on how COMs decide to use FBS-C in upcoming years. Also, the results from the COMSAE-P1 exam are heterogeneous. The COMSAE-P1 test forms can be purchased by individuals or COMs, the exam can be taken proctored or unproctored, and the test takers can take the test motivated or unmotivated. Thus the COMSAE-P1 scores may not reflect the test takers' ability levels in a consistent way. Consequently, the results we obtained on the COMSAE-COMLEX relationship should serve as a reference and be treated with some caution. The data included in the current study were

exclusively from the timed tests, so the results cannot be generalized to the untimed test setting. Further, the study was restricted to include only second-year osteopathic medical students. Therefore, the models reported in the current paper cannot be used to predict COMLEX-L1 performance using FBS-C and/or COMSAE-P1 scores obtained in the first year.

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