Original Article

Association of esophageal motility disorder symptoms with Chicago classification versions 3.0 and 4.0 using high-resolution esophageal manometry: A single-center experience from Saudi Arabia

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Abstract

Background: Esophageal motility disorders (EMDs) can significantly impact patients' quality of life. The Chicago Classification (CC) was developed as a robust framework to enable clinicians to better understand and classify the nature of motility disorders. Previous studies have primarily focused on the CC version 3.0 (CCv3.0), and data regarding the correlation between symptoms and CC version 4.0 (CCv4.0) in the Saudi Arabian population are lacking. This study aimed to assess the correlation between symptoms and CCv3.0 and CCv4.0 using high-resolution esophageal manometry (HRM) in Saudi Arabia, to evaluate the diagnostic performance of both classifications.

Methods: A total of 182 patients presenting with esophageal symptoms were included in this study. HRM was performed to assess esophageal motility, and patients' reported symptoms were recorded. The association between HRM findings and symptomatic variables was analyzed using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

Results: Variability was observed in the diagnostic performance of symptomatic variables for major EMDs. CCv4.0 demonstrated a higher sensitivity for dysphagia than CCv3.0; however, it exhibited lower sensitivity to atypical gastroesophageal reflux disease (GERD) symptoms. Noncardiac chest pain (NCCP) exhibited the highest specificity and PPV, whereas typical GERD symptoms showed lower specificity.

Conclusion: CCv4.0 demonstrated potential improvements in sensitivity for dysphagia, but lower sensitivity for atypical GERD symptoms, compared with CCv3.0. These insights provide guidance for clinicians in Saudi Arabia and contribute to understanding the diagnostic performance of CCv3.0 and CCv4.0.

Keywords: Chicago classification, dysphagia, esophageal symptoms, high-resolution esophageal manometry

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INTRODUCTION

Esophageal motility disorders (EMDs) represent a spectrum of conditions, characterized by abnormal movement and coordination of the esophagus, leading to various distressing symptoms such as dysphagia, chest pain, regurgitation, and heartburn.[1,2] These disorders significantly impact patients' quality of life and often require comprehensive evaluation and management.[1-4] High-resolution esophageal manometry (HRM) has emerged as a valuable diagnostic tool that enables a detailed assessment of esophageal motility patterns and aids in identifying the underlying pathophysiology.[5,6]

The Chicago Classification (CC) was developed as a robust framework to standardize the interpretation of HRM findings and facilitate communication among clinicians.[1] The CC categorizes esophageal motility patterns into various subtypes, enabling clinicians to better understand and classify the nature of motility disorders.[1,2] Over time, classification has evolved to incorporate new insights and advancements in the field, culminating in the most recent iteration, CC version 4.0 (CCv4.0).[7]

CC version 3.0 (CCv3.0), widely used until recently, provides insights into EMDs but has certain limitations. It primarily evaluates the peristaltic function and lacks specific parameters to assess other aspects, such as bolus transit and sphincter function. Recognizing these limitations, CCv4.0 was developed to address these gaps and offer a more comprehensive approach to characterize esophageal motility patterns.[1]

CCv4.0 introduced several fundamental changes and enhancements compared with its predecessor. Notably, it incorporates additional parameters such as distal contractile integral (DCI) and contractile front velocity (CFV) to provide a more nuanced evaluation of peristaltic function and bolus transit. Furthermore, it introduced a new parameter, the esophagogastric junction (EGJ) morphology, to assess the competence of the lower esophageal sphincter and better understand its role in motility disorders.[7]

In recent years, CCv4.0 has gained recognition and acceptance among clinicians and researchers as an updated and refined framework for interpreting HRM findings.[8-10] However, their utility and clinical implications remain areas of active investigation, particularly in specific populations. In Saudi Arabia, the prevalence of EMDs has been increasing, necessitating a deeper exploration of the diagnostic methods and classification systems employed to facilitate optimal patient care.[11,12]

Previous studies primarily focused on traditional manometry techniques or CCv3.0.[8,10,13] While these studies have provided insights into the local epidemiology and characteristics of EMDs, data regarding the correlation between symptoms and CCv4.0 in the Saudi Arabian population are lacking.

Therefore, the primary objective of this study was to assess the correlation between symptoms and CCv3.0 and CCv4.0 using HRM in a single-center setting in Saudi Arabia. By examining the association between HRM findings and patient-reported symptoms, we aimed to evaluate the diagnostic performance of both classifications and identify any potential improvements offered by CCv4.0.

PATIENTS AND METHODS

Study design and setting

This study utilized a retrospective cohort design and was conducted in a single-center setting in Saudi Arabia. The study received ethical approval from the relevant institutional review board.

Study participants

The study population consisted of patients who underwent HRM between 2019 and 2021. A total of 182 patients were included in the study, with 97 patients assessed using CCv3.0 in 2019 and 85 patients assessed using CCv4.0 in 2020 and 2021.

Data collection

The data for this study were obtained through a comprehensive review of medical records. Relevant demographic information, such as age and sex, was recorded for each patient. Additionally, the indications for HRM, including atypical gastroesophageal reflux disease (GERD) symptoms, dysphagia, GERD unresponsiveness to medications, noncardiac chest pain (NCCP), odynophagia, and pre-fundoplication, were documented. Symptomatic variables were also recorded, including atypical GERD symptoms, chest pain, dysphagia, and typical GERD symptoms.

High resolution esophageal manometry

All HRM procedures were performed by experienced clinicians using a standardized protocol. HRM involves the insertion of a catheter with multiple pressure sensors into the esophagus to measure esophageal motility. The recorded data were analyzed using the CC system, either CCv3.0 or CCv4.0, based on the year of the procedure.

Statistical analysis

Statistical analyses were conducted using the STATA Stata version 18 (2023. Stata Statistical Software: College Station, TX: StataCorp LLC) software. Descriptive statistics, such as means, medians, and interquartile ranges, were calculated for continuous variables, whereas frequencies and percentages were computed for categorical variables. The association between the HRM findings and symptomatic variables was assessed using Fisher's exact test or Mood's exact test, as appropriate. The sensitivity, specificity, PPV, and NPV were calculated to evaluate the diagnostic performance of symptomatic variables for major EMDs.

Ethical considerations

The study adhered to ethical principles and guidelines, and all patient data were anonymized and treated confidentially. Informed consent was obtained from all patients before the HRM procedure, and the study protocol was reviewed and approved by our institutional review board (IRB number: REC-16-3-2023).

RESULTS

Table 1 presents the characteristics of the entire study population and compares patients classified under CCv3.0 and CCv4.0. A total of 182 patients were included in the study, of whom 97 (53.3%) belonged to the CCv3.0 group and 85 (46.7%) belonged to the CCv4.0 group.

The median age of the study population was 38 years (interquartile range (IQR): 29–53). No significant difference was observed in age between the CCv3.0 and CCv4.0 groups ($P = 0.29$).

Regarding sex distribution, 56% of the study population were men and 44% were women. The proportions of men and women were comparable between the CCv3.0 and CCv4.0 groups ($P = 0.76$).

The indications for HRM varied among patients. The most common indications were GERD unresponsive to medications (48.9%), dysphagia (23.6%), and pre-fundoplication assessment (15.4%). There was a significant difference in the indications for HRM between the two groups ($P = 0.02$). The CCv4.0 group had a higher proportion of patients with dysphagia (30.6%) than the CCv3.0 group (17.5%).

This study also analyzed the reported symptoms of patients. Typical GERD disease (78.6%) and dysphagia (36.8%) were the most prevalent symptoms. No significant differences were observed in symptom distribution between the two groups.

Regarding the use of proton pump inhibitors (PPIs), 84.1% of the study population reported using PPIs, whereas 15.9% did not. No significant difference was observed in PPI use

Table 1: Characteristics of the whole study population

Characteristics	Total	Chicago version 3.0	Chicago version 4.0	*P*
	n=182	*n*=97 (53.3)	*n*=85 (46.7)	
Age, median (IQR), yrs	38 (29–53)	39 (33–54)	37 (29–50)	0.29[a]
Sex, no. (%)				
Men	102 (56)	53 (54.6)	49 (57.6)	0.76[b]
Women	80 (44)	44 (45.4)	36 (42.4)	
Indication of HRM, no. (%)				0.02[b]
Atypical GERD symptoms	17 (9.3)	11 (11.3)	6 (7.1)	
Dysphagia	61 (23.6)	17 (17.5)	26 (30.6)	
GERD unresponded to medications	89 (48.9)	56 (57.7)	33 (38.8)	
NCCP	3 (1.6)	–	3 (3.5)	
Odynophagia	2 (1.1)	1 (1)	1 (1.2)	
Pre-fundoplication	28 (15.4)	12 (12.4)	16 (18.8)	
Symptoms, no. (%)				
Atypical GERD symptoms	38 (20.9)	23 (23.7)	15 (17.6)	0.3[b]
Chest pain	17 (9.3)	11 (11.3)	6 (7.1)	0.4[b]
Dysphagia	67 (36.8)	31 (32)	36 (42.3)	0.1[b]
Typical GERD symptoms	143 (78.6)	78 (80.4)	65 (76.5)	0.5[b]
Chronic PPI usage? no. (%)				
No	29 (15.9)	12 (12.8)	17 (20)	0.2[b]
Yes	153 (84.1)	85 (87.6)	68 (80)	
PPI dosage, no. (%)				<0.001[b]
20 mg OD	35 (22.9)	10 (11.8)	25 (36.7)	
40 mg OD	52 (34)	23 (27.1)	29 (42.6)	
20 mg BID	37 (24.2)	26 (30.6)	11 (16.2)	
40 mg BID	29 (19)	26 (30.6)	3 (4.4)	

BID: twice daily; GERD: gastroesophageal reflux disease; HRM: high-resolution manometry; LES: lower esophageal sphincter; NCCP: noncardiac chest pain; PPIs: proton pump inhibitors; OD: once daily. a—Mood's test with the exact calculation. b—Fisher's exact test

between the CCv3.0 and CCv4.0 groups ($P = 0.2$). However, when analyzing PPI dosage, a significant difference was observed ($P < 0.001$). The CCv4.0 group had a higher proportion of patients on 20 mg OD and 40 mg OD dosages, whereas the CCv3.0 group had a higher proportion of patients on 20 mg and 40 mg twice daily (BID) dosages.

Table 2 presents the manometric diagnoses of the major symptoms of the study population. A total of 182 patients were included in this analysis. Among the indications for HRM, 23.1% of the patients were diagnosed with EGJ outflow disorders, 37.9% with peristaltic disorders, and 39% in a typical study.

Regarding the diagnosis of EGJ outflow disorders, 45.2% of patients had achalasia, whereas 54.8% were diagnosed with EGJ outflow obstruction (EGJOO). In terms of peristaltic disorders, 15.9% of patients had absent contractility and 84.1% had ineffective esophageal motility (IEM).

Analysis of the manometry diagnosis based on the major symptoms studied revealed that among patients with atypical GERD symptoms (n = 38), 10.5% were diagnosed with EGJ outflow disorders, 8.7% had peristaltic disorders, 27.3% had normal study results, and 21.1% had IEM.

For patients with dysphagia (n = 67), the diagnostic distribution was as follows: EGJ outflow disorders, 78.9%; peristaltic disorders, 47.8%; absent contractility, 36.4%; normal results, 27.6%; and IEM, 29.6%.

Among patients with NCCP (n = 17), 10.5%, 4.3%, 12.1%, and 9.9% had EGJ outflow disorders, peristaltic disorders, a normal study, and IEM, respectively.

Among the patients with typical GERD symptoms (n = 143), the distribution of diagnoses was as follows: 47.4%, 73.9%, 81.8%, and 85.9% had EGJ outflow disorders, peristaltic disorders, a normal study, and IEM, respectively.

Table 3 shows the sensitivity, specificity, PPV, and NPV of symptomatic variables for major EMDs. The analysis compared the overall performance of the symptomatic variables and their performance specific to the CCv3.0 and CCv4.0 systems.

Atypical GERD symptoms had an overall sensitivity of 20.7%, with the CCv3.0 and CCv4.0 groups showing sensitivity of 29.3% and 11.3%, respectively. Dysphagia had an overall sensitivity of 41.1%, with the CCv3.0 and CCv4.0 groups displaying sensitivities of 36.2% and 47.2%, respectively. NCCP exhibited a sensitivity of 9%, with the CCv3.0 and CCv4.0 groups demonstrating sensitivities of 12.1% and 5.66%, respectively. Typical GERD symptoms had the highest overall sensitivity (73.9%), with the CCv3.0 and CCv4.0 groups showing sensitivities of 81% and 66%, respectively.

Atypical GERD symptoms had an overall specificity of 78.9%, with the CCv3.0 and CCv4.0 groups demonstrating specificities of 84.6% and 71.9%, respectively. Dysphagia showed an overall specificity of 70.4%, with the CCv3.0 and CCv4.0 groups displaying specificities of 74.4% and 65.6%, respectively. NCCP had the highest overall specificity of 90.1%, with the CCv3.0 and CCv4.0 groups showing specificities of 89.7% and 90.6%, respectively. Typical GERD symptoms had an overall specificity of 14.1%, with the CCv3.0 and CCv4.0 groups having specificities of 20.5% and 6.25%, respectively.

In terms of the PPV, atypical GERD symptoms had an overall PPV of 60.5%, with the CCv3.0 and CCv4.0 groups showing PPVs of 73.9% and 40%, respectively. Dysphagia exhibited an overall PPV of 68.7%, with the CCv3.0 and CCv4.0 groups displaying PPVs of 67.7% and 69.4%, respectively. NCCP had a PPV of 58.8%, with the CCv3.0 and CCv4.0 groups demonstrating PPVs of 63.6% and 50%, respectively. Typical GERD symptoms had an overall PPV of 57.3%, with the CCv3.0 and CCv4.0 groups showing PPVs of 60.3% and 53.8%, respectively.

Atypical GERD symptoms had an overall NPV of 38.9%, with the CCv3.0 and CCv4.0 groups showing NPV's rates of 44.6% and 32.9%, respectively. Dysphagia exhibited an

Table 2: Manometry diagnosis with respect to major symptoms studied

Indication of HRM, no. (%)	Total	EGJ outflow disorders (*n*=42 [23.1%])		Peristaltic disorders (*n*=69 [37.9%])		Normal study
		Achalasia	EGJOO	Absent contractility	IEM	
	n=182	*n*=19 (45.2)	*n*=23 (54.8)	*n*=11 (15.9)	*n*=58 (84.1)	*n*=71 (39)
Atypical GERD symptoms[a]	38 (20.9)	2 (10.5)	2 (8.7)	3 (27.3)	16 (27.6)	15 (21.1)
Dysphagia	67 (36.8)	15 (78.9)	11 (47.8)	4 (36.4)	16 (27.6)	21 (29.6)
Noncardiac chest pain	17 (9.3)	2 (10.5)	1 (4.3)	–	7 (12.1)	7 (9.9)
Typical GERD symptoms	143 (78.6)	9 (47.4)	17 (73.9)	9 (81.8)	47 (81)	61 (85.9)

EGJOO: esophagogastric junction outflow obstruction; GERD: gastroesophageal reflux disease; HRM: high-resolution manometry; IEM; ineffective esophageal motility. a—Atypical GERD symptoms include any of the following: change voice, cough, globus sensation, or throat clearing. b—Typical GERD symptoms include heartburn, regurgitation, or both of them

Table 3: Sensitivity, specificity, positive, and negative predictive values of symptomatic variables for major esophageal motility disorders

Symptoms (95% CI)	Sensitivity			*P*	Specificity			*P*	Positive predictive value			*P*	Negative predictive value			*P*
	Overall	Chicago 3.0	Chicago 4.0		Overall	Chicago 3.0	Chicago 4.0		Overall	Chicago 3.0	Chicago 4.0		Overall	Chicago 3.0	Chicago 4.0	
Atypical GERD symptoms[a]	20.7 (13.6–29.5)	29.3 (18.1–42.7)	11.3 (4.27–23)	0.03	78.9 (67.6–87.7)	84.6 (69.5–94.1)	71.9 (53.3–86.3)	0.2	60.5 (43.4–76)	73.9 (51.6–89.8)	40 (16.3–67.7)	0.04	38.9 (30.9–47.4)	44.6 (33–56.6)	32.9 (22.1–45.1)	0.1
Dysphagia	41.1 (32.2–51.2)	36.2 (24–49.9)	47.2 (33.3–61.4)	0.2	70.4 (58.4–80.7)	74.4 (57.9–87)	65.6 (46.8–81.4)	0.4	68.7 (56.2–79.4)	67.7 (48.6–83.3)	69.4 (51.9–83.7)	1	43.5 (34.3–53)	43.9 (31.7–56.7)	42.9 (28.8–57.8)	1
Noncardiac chest pain	9 (4.4–15.9)	12.1 (4.99–23.3)	5.66 (1.18–15.7)	0.3	90.1 (80.7–95.5)	89.7 (75.8 –97.1)	90.6 (75–98)	1	58.8 (32.9–81.6)	63.6 (30.8–89.1)	50 (11.8–88.2)	0.6	38.8 (31.3–46.7)	40.7 (30.2–51.8)	36.7 (26.1–48.3)	0.6
Typical GERD symptoms[b]	73.9 (64.7–81.8)	81 (68.6–90.1)	66 (51.7–78.5)	0.08	14.1 (6.97–24.4)	20.5 (9.3–36.5)	6.25 (0.76–20.8)	0.1	57.3 (48.8–65.6)	60.3 (48.5–71.2)	53.8 (41–66.3)	0.4	25.6 (13–42.1)	42.1 (20.3–66.5)	10 (1.23–31.7)	0.03

GERD: gastroesophageal reflux disease. a—Atypical GERD symptoms include any of the following: change voice, cough, globus sensation, or throat clearing. b—Typical GERD symptoms include heartburn, regurgitation, or both of them

overall NPV of 43.5%, with the CCv3.0 and CCv4.0 groups showing NPV's rates of 43.9% and 42.9%, respectively. NCCP had an NPV of 38.8%, with the CCv3.0 and CCv4.0 groups demonstrating NPVs of 40.7% and 36.7%, respectively. Typical GERD symptoms had an overall NPV of 25.6%, with the CCv3.0 and CCv4.0 groups scores showing NPVs of 42.1% and 10%, respectively.

DISCUSSION

The objective of this study was to assess the correlation between symptoms and CCv3.0 and CCv4.0 using HRM in a single-center setting in Saudi Arabia and to evaluate the diagnostic performance of both classifications and identify any potential improvements offered by CCv4.0.

One of the key findings of this study was the variability in the performance of symptomatic variables across the two classifications. The overall sensitivity was low (20.7%) for atypical GERD symptoms, suggesting that these symptoms may not be reliable indicators of EMDs. However, the sensitivity increased to 29.3% with CCv3.0, indicating slightly improved diagnostic performance. Conversely, the sensitivity decreased to 11.3% with CCv4.0. This discrepancy suggests that CCv4.0 may be less sensitive for detecting EMDs in patients with atypical GERD symptoms.

Dysphagia, a common symptom associated with EMDs, demonstrated moderate overall sensitivity (41.1%). However, the sensitivity was slightly higher with CCv4.0 (47.2%) compared with CCv3.0 (36.2%), suggesting that CCv4.0 may provide better diagnostic accuracy for dysphagia. NCCP, another symptom associated with EMDs, exhibited a low overall sensitivity (9%). The sensitivity remained consistently low when considering both CCv3.0 and CCv4.0, implying that NCCP alone may not be a reliable indicator of EMDs, regardless of the classification system used.

In contrast, typical GERD symptoms showed the highest overall sensitivity (73.9%), indicating that these symptoms are more strongly associated with EMDs. Sensitivity was relatively consistent between the two classifications, with CCv3.0 performing slightly better (81%) than CCv4.0 (66%). Specificity analysis revealed that atypical GERD symptoms had a higher overall specificity (78.9%) with CCv3.0 (84.6%), suggesting that these symptoms may be more specific indicators of EMDs. However, the specificity decreased to 71.9% with CCv4.0, indicating that this classification may result in more false positives for atypical GERD symptoms.

Similarly, dysphagia exhibited moderate overall specificity (70.4%) when both classifications were considered. NCCP had the highest overall specificity (90.1%), indicating that this symptom is more specific to EMDs. Specificity remained consistently high across both classifications.

Regarding the PPV, atypical GERD symptoms had a moderate overall PPV (60.5%), suggesting that these symptoms can be indicative of EMDs in a significant proportion of cases. Dysphagia demonstrated a similar PPV (68.7%), indicating a relatively high likelihood of EMDs when this symptom is present. NCCP exhibited a lower PPV (58.8%), suggesting that this symptom alone may not reliably predict the presence of EMDs. Typical GERD symptoms showed a moderate overall PPV (57.3%), indicating that these symptoms may be indicative of EMDs.

Regarding NPV, atypical GERD symptoms had a moderate overall NPV (38.9%), suggesting that the absence of these symptoms does not necessarily rule out EMDs. Dysphagia showed a similar NPV (43.5%), implying that the absence of this symptom does not reliably exclude EMDs. NCCP exhibited a moderate NPV (38.8%), indicating that the absence of this symptom alone may not reliably exclude EMDs. Typical GERD symptoms had the lowest overall NPV (25.6%), suggesting that the absence of these symptoms does not effectively rule out EMDs.

The findings of this study are consistent with those of previous studies conducted in different settings, including India, Egypt, and Thailand, which also investigated the correlation between symptoms and HRM findings.

In a study conducted in India,[14] the correlation between symptoms and manometric findings was explored in patients with dysphagia, NCCP, gastroesophageal reflux, and esophageal belchers. The results revealed that dysphagia has a high likelihood ratio and PPV for major motility disorders. These findings align with our study's findings, which also identified dysphagia as a symptom with moderate sensitivity and specificity. Therefore, dysphagia appears to be a significant symptom associated with EMDs, as supported by multiple studies.

A study conducted in Egypt[15] aimed to classify EMDs using HRM based on CCv3.0. The results showed that achalasia was the most common EMD in patients with non-obstructive dysphagia. This finding corresponds with that of our study, in which dysphagia was associated with major motility disorders, particularly achalasia. An Egyptian study emphasized the high regurgitation experienced by patients with achalasia, which aligns with our study's observation that dysphagia is a reliable symptom for detecting major motility disorders.

Similarly, a study conducted in Thailand[16] evaluated the diagnostic yield of high-resolution manometry in patients from Thailand. The results indicated that dysphagia was the symptom most often correlated with major EMDs, which was consistent with our findings. However, the study highlighted that HRM was less beneficial in patients presenting with symptoms other than dysphagia, such as nausea or vomiting, or belching. This reinforces the importance of dysphagia as a prominent symptom in diagnosing EMDs.

A study was conducted comparing the frequency of motility disorders diagnosed using different versions (CCv3.0 and CCv4.0).[17] This study found that motility disorder diagnoses remained essentially unchanged between the two versions. However, a decrease in the frequency of IEM was observed with CCv4.0 compared with CCv3.0. This finding is consistent with that of our study, which also utilized CCv3.0 and CCv4.0 to assess diagnostic performance. The study also noted that IEM diagnosed using CCv4.0 appeared to be more likely associated with GERD, as evidenced by higher GERD-Q scores. This supports our observation of relatively higher sensitivity and specificity for dysphagia, which may be indicative of EMDs associated with GERD.

This study had several notable strengths. First, it focused on a specific population in a single-center setting in Saudi Arabia, providing insights into CCv3.0 and CCv4.0 diagnostic performance in this particular context. This localized approach enhances the relevance and applicability of the findings to clinical practice in Saudi Arabia. Second, this study used HRM, which is a widely accepted and advanced diagnostic tool for evaluating EMDs. HRM adds credibility and accuracy in assessing symptom correlations using classification systems. Additionally, this study employed a comprehensive analysis of the sensitivity, specificity, PPV, and NPV to evaluate the diagnostic performance of symptomatic variables, thereby providing a thorough understanding of the association between symptoms and EMDs.

Despite its strengths, this study has some limitations that should be acknowledged. First, the study was conducted at a single center, which may limit the generalizability of the findings to other settings or populations. Therefore, caution should be exercised when applying these results to different patient groups or regions. Second, this study relied on self-reported symptoms, which can be subjective

and prone to recall bias. Objective measures or additional assessment tools could have strengthened the validity of the symptom correlation analysis. Moreover, the study did not investigate other potential confounding factors, such as comorbidities or medication use, which could influence symptom presentation and diagnosis. Future studies should incorporate a broader range of variables to better understand the complexity of symptomatology in EMDs.

Several recommendations can be made based on the findings of this study. First, further research is required to validate these results in more extensive multicenter studies involving diverse patient populations. This would enhance the generalizability and robustness of the diagnostic performance of CCv3.0 and CCv4.0. Additionally, future studies should consider exploring the impact of potential confounding factors such as comorbidities and medication use on symptom correlation with EMDs. Understanding the influence of these factors will aid in improving the accuracy of diagnosis and treatment decisions. Furthermore, incorporating objective measures or complementary diagnostic tools along with self-reported symptoms could enhance the reliability and validity of symptom correlation analyses.

In conclusion, this study evaluated symptom correlation with the CC of versions 3.0 and 4.0 using HRM in a single-center setting in Saudi Arabia. These findings underscore the variability in the diagnostic performance of symptomatic variables for major EMDs. Although CCv4.0 showed potential improvements in sensitivity for dysphagia, it exhibited lower sensitivity for atypical GERD symptoms. This study highlights the importance of considering multiple factors, including HRM findings and patient-reported symptoms, in the diagnosis and management of EMDs. Further research is warranted to validate these findings in more extensive multicenter studies and to explore additional factors that may enhance diagnostic accuracy. These insights contribute to the growing body of knowledge on the diagnostic performance of CCv3.0 and CCv4.0 and provide guidance for clinicians in Saudi Arabia.

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Conflicts of interest

There are no conflicts of interest.

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