

Original Research Article

Hedges in Medical Research Articles: A Corpus-based Comparative Study

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Article History

Received: 08.06.2021

Accepted: 05.07.2021

Published: 12.07.2021

Journal homepage:

<https://www.easpublisher.com>

Quick Response Code



Abstract: Hedges are rhetorical devices employed to mitigate one's assertiveness to gain ratification from others. They are used in research articles (RAs) to modulate authors' commitment to the propositions and convey compelling messages. Mainly following Yang's taxonomy (2013) on categories of hedges, we aim to explore the hedging expressions used in different sections across the RAs in the medical field. This study examines the use of hedges based on a corpus of RAs from reputable medical journals. Both similarities and variations are found in the overall distribution of hedges as well as different categories of hedges across various sections in RAs. The results are interpreted from two perspectives: different rhetorical purposes of various sections and different functions of various hedges.

Keywords Hedges; Research articles; Comparative study; Corpus.

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1. INTRODUCTION

One of the most distinguishable features of academic discourse is how the writer utilizes particular linguistic resources to avoid convictions, distance oneself from objective statements, and convey more cautious attitudes to the readers. When writers try to persuade readers to accept what has been conveyed in RAs, the propositions will be presented as opinions rather than facts (Hyland, 2000). Salager-Meyer (1995) also argued that "fundamental characteristics of science are uncertainty, doubt, and skepticism." The linguistic maneuvers employed to mitigate assertiveness in this situation are known as hedges.

There exists a lack of consensus in how to define hedges (Crompton, 1997). Based on Zadeh's (1965) research on fuzzy set theories, Lakoff (1973) put forward the definition of hedges. He defined hedges as "a set of words or phrases whose job is to make things fuzzy or less fuzzy," suggesting that writers' commitment to the proposition is less than fully conveyed. According to Brown and Levinson (1987), hedges are used to "modify the degree of membership of a predicate or a noun phrase in a set." Crompton (1997) questioned Lakoff's definition by introducing hedges as a kind of language that qualified a speaker's lack of commitment to his proposition. In addition, hedging devices have also been associated with various functions: implying precision, weakening the

assertiveness of a statement, etc. (Hyland, 1998). To sum up, despite the discrepancy in the literal description of the concept, those different definitions share some similarities with Lakoff's (1973) exploration. No matter what approaches researchers have adopted, they all regard modal verbs and lexical verbs as sub-types of hedges. However, a richer and more comprehensive understanding of the term hedging could be formed with a more fine-grained classification, which includes modifier words (e.g. "perhaps"), phrases (e.g. "certain amount"), or small sentences (e.g. "still needs to be studied") that affect the truth of a proposition to a certain degree, heightening its vagueness and tentativeness.

Hedges are pragmatically polyfunctional devices, which can "express politeness, indirectness, understatement, mitigation, commitment, and/or vagueness" (Salager-Meyer, 2011). Recent years have seen hedging devices as a focus of studies on various scientific discourses, whose most prominent aspect is to analyze the result and draw a conclusion. Naturally, RAs are widely recognized as a number of objective and informational "statements of fact which add up to the truth (Hyland, 1994). As a matter of fact, rather than a unidirectional channel for mere persuasion, RAs serve as a bridge open for interaction. RAs, along with other articles, are in need of the writer's anticipation and expectation of their readers, including their background

knowledge and their response (Windowson, 1984:220). Likewise, readers are trying to interpret writers' stances under the cautious wording and evaluate the significance of their research (Bazerman 1985), which requires writers to imply their attitude by the way they convey and reflect their commitments to the truth of the proposition. As Lyon (1977:797) put it, "Any utterance in which the speaker explicitly qualifies his commitment to the truth of the proposition expressed by the sentence he utters...is an epistemically modal or modalized sentence." In light of the fact that the epistemic system relates to the level of confidence in the writer's proposition, hedges play a significant role by enabling writers to demonstrate personal attitudes obtained from seemingly believable reasoning. Therefore, the use of hedging devices cuts down the writer's "degree of liability" (Huebler, 1983:18) and improves the reliability of the conclusion. To conclude, hedges in RAs are essential for reinforcing the writer's stance and supporting writer-reader relationships.

Theoretical research on hedges has been widely conducted for decades. Fraser (1975) explored the influence of modals and semi-modals on illocutionary acts indicated by performative verbs in sentences such as *I must ask you to leave*. The device to mitigate the speaker's commitment, in this case, was called "hedged performatives" by Fraser instead of hedges. Later research of Fraser (1980) appeared to agree with Lakoff's view on hedges, which were limited to expressions including *kind of* and *sort of*. Hedges were later recognized as modifiers to the true-value of the writer's proposition (Vande Kopple, 1985) and divided into two categories by Prince et al. (1982), namely, *approximators* and *shields*. Apart from theoretical studies on hedges, studies based on corpus have also taken place. By analyzing a corpus consisting of 15 articles drawn from 5 leading medical journals, Salager-Meyer (1994) grouped hedges in both research papers (RP) and case reports (CR) into 5 genres: approximators, shield, compound hedges, emotionally-charged expression, and authors' insufficiency and doubt. With the results of *Discussion* (RP)/*Comment* (CR) sections being the most heavily hedged sections, whereas *Methods* (RP) and *Case Report* (CR) the least-hedged rhetorical divisions, Salager-Meyer drew the conclusion that the choice of hedges was "dictated by the general structure of the discourse, by its communicative purpose, by the level of claim the writers wish to make, and by the authors' pretension to universality and generalization". Livytska (2019) calculated the frequency and type of hedges in RAs on Applied Linguistics with a corpus with 15 research articles. The results demonstrated that reader-oriented hedges are the most frequently encountered type of hedges in RAs of applied linguistics, indicating that the authors' need for approval from the readers and "politeness conventions of academic discourse". In spite of studies focusing on only one discipline or

language, cross-linguistic study on hedges has also been conducted on RAs. According to Hyland's taxonomy of hedges, Yang (2013) compared the use of hedges in three scientific writing corpora: the English RA corpus, the Chinese-authored English RA corpus, and the Chinese RA corpus. The results revealed a similar propensity for epistemic adverbs, adjectives, and nouns as well as lexical verbs in all three corpora. The subsequent choice for Chinese writers is phraseological expressions in Chinese RAs and modal verbs in English RAs, whereas English authors tend to use more *modal verbs*. This variation of choice is later attributed to linguistic and sociocultural differences.

Despite numerous studies concerning the use of hedges in academic RAs, a noticeable gap is seen in the corpus-based study on hedges used in medical RAs with standard IMRD formats, in which hedges allow authors to convey information with accuracy, prudence, and modesty. (Salager-Meyer, 2011) However, it is believed that the use of hedges has changed slightly over time. The samples of previous studies are also relatively small and can be updated with modern information collection techniques. For example, in Hyland's (1996) research, no more than 26 RAs were selected to establish a 75,000-word corpus. Moreover, Nwogu (1997) surveyed less than 20 RAs for detailed analysis.

By investigating the distribution and functions of different hedges across various rhetorical divisions of abundant scientific RAs selected from three reputable English medical journals in the recent three years, the present study seeks to extend and enrich previous researches. The questions of this research include: (1) What is the difference between the types of hedges in different sections of medical RAs? (2) What is the difference between the subcategories used in different sections of medical RAs?

2. MATERIAL AND METHODS

2.1 The Classification of Hedges

Following Yang's (2013) taxonomy of hedges, the hedges were divided primarily according to their surface characteristics. Furthermore, this study also takes another category called *approximators* into consideration. Hyland (1998:103) has defined these hedges as "the most numerically significant lexicogrammatical features used to hedge in science articles." Here in this study, all the hedges fall into one of the following five categories: *Modal verbs*; *Lexical verbs*; *Probability adverbs, adjectives, and nouns*; *Approximators*; and an additional category classified under "*other phrases*."

(1) *Modal verbs*

(Or Modal auxiliary verbs.) The devices frequently used to modify the "commitment to the truth-value of propositions" in scientific RAs. The

typical examples are: *Might (not)*, *May (not)*, *Could (not)*, *Would (not)*, *Can*, and *Cannot*.

- [1] If, in the absence of the cause of death: life expectancy *would* have increased during 2014-15, then that cause is responsible for all of the decline; (The BMJ-2018-method)
- [2] Before randomization, at least one such hospital in each program had to be identified by the program director as being a hospital in which the director *would* implement flexible schedules if the program was randomized to the flexible-policy group. (NEJM-2019-3-method)

(2) Lexical verbs

Verbs that express epistemic modality and allow authors to modulate the impact of his propositions (Granger & Paquot, 2009), such as *Seem*, *Expect*, *Suggest*, *Claim*, etc.

- [3] The 10-year threshold was chosen because studies with repeat measurements *suggest* physical activity in people with dementia begins to decline approximately a decade before diagnosis. (The BMJ -2019-4-method)
- [4] Finally, as a falsification test, we repeated the instrumental variable analysis for non-STEMI patients, a group for which increasing data *suggest* that routine ICU care does not improve outcomes. (The BMJ-2019-6-method)

(3) Probability adverbs, adjectives, and nouns:

Adverbs, Adjectives, or Nouns associated with possibility, such as *possible*, *possibly*, *possibility*, etc.

Probability adj.

- [5] Each also has been listed on the FDA mandated drug label as *possible* adverse reactions, can be reliably identified in claims data, and has supporting evidence of pathogenesis early after drug initiation was available. (The BMJ-2017-4-method)

Probability adv.

- [6] We excluded index samples that had been preceded by another within the prior two years, because they were *probably* not taken for primary screening. (The BMJ-2019-2-method)

Probability n.

- [7] We used confounding bias plots to assess relative bias in the instrumental variable *estimate* compared with standard multivariable regression. (The BMJ-2018-2-method)

(4) Approximators

Hedges connoting a sense of vagueness in the author's commitment to his proposition with "adaptors or rounders of quality, degree, frequency and time" (Wiboonwachara & Rungrojsuwan, 2020): about, around, quite, etc.

- [8] During the first decade of the 21st century stroke mortality rates in England halved, stroke event rates decreased by *about* 20%, and case fatality decreased by *about* 40%. (The BMJ-2019-5-discussion)
- [9] This trial was not powered to detect cardiovascular outcomes, but the differences between the interventions and control in systolic blood pressure would be expected to result in *around* a 20% reduction in stroke risk and 10% reduction in coronary heart disease risk. (The Lancet-2018-3-discussion).

(5) Other phrases

Phraseological expressions used to mitigate one's assertiveness such as "*In my view*", "*To my knowledge*", "*Still needs to be studied*", etc. Apparently, this category of hedges has been substantially overlooked in the RAs selected in the corpus. The statistics of different phrases investigated end up with a null value.

2.2 The Corpus

On the guidance of "representativity, reputation, and accessibility" (Nwogu, 1997), the study is carried out on a 479,130-word corpus consisting of 108 scientific research articles from three refereed medical journals--The Lancet, The New England Journal of Medicine (NEJM) and the British Medical Journal (BMJ). To strengthen the scientific rigor of this study, 12 RAs per year from 2018 to 2020 were selected on the basis of stratified sampling randomization and divided into the traditional IMRD (Introduction, Methodology, Results, and Discussion) format. Thus, the running tokens of the Introduction section comprise 41,896, and those of the Methodology section include 183,846, in comparison to Results with 110,986 and Discussion with 142,402.

2.3 Research Process

The analysis of the original texts in the Medical RA corpus was predominantly guided by quantitative and qualitative principles. First of all, with the help of text analysis software Antconc, the overall number and frequency of hedges were examined, as well as the distribution of different forms of hedges in various sections of RAs. In order to prove whether the difference is significant, the log-likelihood function was adopted to find whether there is any significance of the distribution of hedges among different sections. After that, the statistical results would be able to suggest the variation of types of hedging expressions used in

different sections of medical RAs, and the subcategories used in different sections.

3. RESULTS

The results presented in Table 1 below demonstrate the use of hedging devices across different sections of RAs. The variation not only appears in regards to the overall hedges used in different sections but also in the use of various forms and particular words in one single form.

As shown in Table 1, the overall numbers and frequency of hedges vary dramatically across different sections of RAs. The most frequently hedged section in

RAs is Discussion, with 23.40 hedges per 1000 words, almost two times richer than the hedges utilized in Methodology and Results, which yield 8.70 and 8.73 hedges per 1000 words each. Statistically, the difference between the Discussion section and the latter two sections including Methodology and Results is significant. The normalized frequency of hedges per 1000 words in Introduction, the second most heavily hedged section is 17.85, approximately twice the frequency of Methodology or Results. Likewise, the difference between the use of hedges in Introduction and Discussion shows a statistically significant difference as well. The table of the p-value between different sections is provided in Appendix I.

Table 1: The overall number and normalized frequency of hedges in different sections

Sections	Introduction		Methodology		Results		Discussion	
Words	41896		183846		110986		142402	
	Raw No.	Normalized Frequency	Raw No.	Normalized Frequency	Raw No.	Normalized Frequency	Raw No.	Normalized Frequency
Hedges	748	17.85	1600	8.70	969	8.73	3332	23.40

In addition to the variation of overall hedges across different sections, there remain differences in the distribution of various forms of hedges.

Table 2 summarizes the distribution of five kinds of hedges in different sections with their raw numbers and frequencies. As stated above, the five categories that hedges have been classified into are: *Modal verbs*; *Lexical verbs*; *Epistemic adjectives, nouns, and adverbs*; *Approximators*, and *other phrases*. Interestingly, having been examined thoroughly, the corpus includes no phraseological expressions on the list for this study. In the corpus, the proportions of different types of hedges in RAs from the largest to the smallest are: *Modal verbs* (33.73%); *Approximators* (21.94%); *Lexical verbs* (22.24%); *Probability adjectives, nouns, and adverbs* (22.08%); and *other phrases* (0). As a matter of fact, the results actively demonstrate that apart from the form with zero usage, the only noticeable difference lies between *Modal verbs* and the three other forms: *Approximators*; *Lexical verbs*; *Epistemic adjectives, nouns, and adverbs*.

In the corpus, various hedging devices are distributed unevenly in different sections. For example, the results reveal that the frequency of all forms of hedges in Discussion far exceeds Results as well as Methodology, which is reasonable considering that Discussion is the most heavily hedged section while

Methodology and Results are the two least frequently hedged sections. Between Results and Methodology, the only variation in the choice of hedges is seen in the occurrence of *Modal verbs*, which occur more frequently in Methodology than in Results (19.31, <0.0001). In further examinations, it is found that Results and Methodology also demonstrate a dramatic difference in the use of *Can* with it appearing 0.67 times per 1000 words in Methodology and falling by 0.53 in Results. Despite the fact that Discussion yields the highest densities of hedges, not all categories of hedges in Discussion are richer than in other sections. For example, the frequency of *Lexical verbs* in Introduction is similar to that of Discussion (7.82, 0.0051). Moreover, Introduction adopts *Approximators* far more frequently than Discussion (15.19, <0.0001). The frequency of individual *Approximators* demonstrates a considerable similarity similar in the rankings between Discussion and Introduction. However, the frequency of *Rather* is the major difference between Introduction and Discussion. Although the frequency of *Rather* ranks second in Discussion, it is seldom utilized in Introduction. The comparison between Introduction and Methodology is similar to that of Introduction and Results. Introduction shares a similar frequency of *Lexical verbs* and *Probability adverbs, adjectives & nouns* with both Methodology (3.68, 0.05520; 1.42, 0.2337) and Results (6.82, 0.00900; 0.02, 0.8871) whereas *Modal verbs* and *Approximators* occur far more frequently in Introduction than in Methodology (159.09, <0.0001; 184.59<0.0001) and Results (219.25, <0.0001; 98.71, <0.0001). A distributional breakdown of the comparative study on the use of different forms of hedges is presented by the tables in Appendix II.

Table 2: Distribution of various hedges in different sections

Sections	Introduction		Methodology		Results		Discussion		Total	Percentage
	Raw No.	per 1000 words	Raw No.	per 1000 words	Raw No.	per 1000 words	Raw No.	per 1000 words		
Modal v.	269	6.42	416	2.26	170	1.53	1388	9.75	2243	33.73%
Lexical v.	134	3.20	486	2.64	268	2.41	591	4.15	1479	22.24%
Probability adv., adj., & n.	98	2.34	375	2.04	264	2.38	731	5.13	1468	22.08%
Approximators	247	5.90	323	1.76	267	2.41	622	4.37	1459	21.94%
Other phrases	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00%

4. DISCUSSION

As mentioned previously, various hedging devices are employed to mitigate writers' assertiveness and heightening tentativeness. With the results of the data analysis, the research questions shall be answered. First of all, a considerate variability appears in the distribution of hedging devices employed in different sections in RAs. Moreover, different sections show both similarities and differences in the distribution of various categories of hedges categories individual hedges. The results can be elucidated by the following reasons.

4.1 Different rhetorical purposes of various sections

It is found in this research that overall, the *Discussion* section seems to be the most frequently hedged section, as confirmed by Hyland (1996). In the IMRD-structure corpus, *Discussion* yields 23.4 hedges per 1000 words, followed by *Introduction* with 17.85, *Results* and *Methodology* with 8.73 and 8.7 each. This variation of frequency directly demonstrates different rhetorical roles each section plays in RAs.

In *Discussion*, the author tends to put forward more general interpretations based on the research results. Naturally, hedges in this section would be the highest due to author's need to protect themselves from their counterparts and to convince the readers without imposing ideas on them. For example:

[10] Given the effectiveness of VOT for patients with complex social needs, the intervention *could* also be effective in treating other conditions that are prevalent in these populations; e.g., hepatitis C. (The Lancet-2019-3-discussion)

[11] Differences in health-related quality of life *would* arise from differences in drop usage, due to inconvenience or side-effects. (The Lancet-2019-4-discussion)

In these two sentences, both *would* and *could* serve the function of mitigating assertiveness when the authors offer interpretation to the research results.

The *Introduction* section serves the function of summarizing previous works in the field (Salager-Meyer, 1995). It is in this section that authors inevitably mention the prior researches including the criticisms to emphasize the purpose of their own study. To mitigate the Face Threatening Act (FTA) introduced by Brown and Levinson (1987) during this interaction with other researchers, the authors would use relatively more hedging devices in this section:

[12] Additionally, studies from the past few years *indicate* that although adverse events related to peanut OIT are prevalent in the first year of therapy, continued consumption of peanuts after OIT reduces recurrence of clinical reactivity. (The Lancet-2019-10-introduction)

[13] Findings from pilot studies of improved household storage in Sri Lanka and China and studies of community lockers in India *suggest* that the approach is appreciated by farming communities. (The Lancet-2017-10-introduction)

When mentioning previous studies, the authors use hedging devices like *indicate* and *suggest* to avoid threatening others' faces.

A common feature shared by *Results* and *Methodology* is the function of objective description, which is reflected in the obviously lower frequency in these two sections comparing with the discursive sections. The *Results* section is where the authors justify their methods and qualify the research data. Therefore, seldom do hedges appear in this section except for the need to signal the upcoming *Discussion*:

[14] These findings *suggest* some of the changes reported above were comparable to declines in mood seen during the start of internship but less than the declines seen in those who developed depression. (The BMJ -2019-12-result)

[15] In such patients, autoantibodies against many proteins can develop, and our data *indicate*

that GPIHBP1 is one of those proteins. (NEJM-2017-4-discussion)

In the *Results* section, it is likely that the authors need to briefly introduce the possible explanations to the research results, which is why suggest and indicate are adopted in these sentences.

However, *Methodology* aims to inform the readers of the techniques employed in the investigation. The description of the research process is entirely factual, which requires accuracy and precision rather than mitigation that would hamper the credibility of the authors. Hence least hedges are found in this section.

[16] Fourthly, we analyzed whether the relation between surgeons' age and operative mortality varied between male and female surgeons. (The BMJ-2018-4-method)

[17] Finally, we selected representative quotations to illustrate major themes. (The Lancet-2017-3-method)

No hedging devices are employed in these sentences which merely describe the research procedures. If inappropriate use of hedges takes place in this section, it could signal the author's lack of confidence and his reliability may be questioned by readers.

4.2 Different functions of various hedges

The findings reveal the predominant existence of *Modal verbs*, which account for 33.7% of the overall hedges. This finding is congruent with Hyland's study (1996). Also, *Modal verbs* are the hedging devices employed the most frequently in *Discussion*. One possible explanation for this result is that in most cases, *Modal verbs* can be viewed to serve epistemic functions by conveying tentativeness, for its existence allows a proposition to be non-categorical (Markkanen& Schroder) As Preisler (1986) remarked, "even when modal forms convey speaker-meanings, these are often given interpersonal significance by the particular context in which they appear, usually as part of a tentativeness strategy." For example:

[18] The web-based calculator *could* facilitate the adoption into clinical practice. (The BMJ-2018-1-discussion)

[19] Volume *might* be difficult to reliably reproduce with current high resolution cranial computed tomography. (The BMJ-2018-1-discussion)

[20] Thus, if a noninvasive approach to ablation of ventricular tachycardia is shown to be safe and effective, it *would* be a potentially important therapeutic advance. (NEJM-2017-12-discussion)

In the above three cases, the past form *Modal verbs* including *could*, *might*, and *would* are utilized epistemically in combination with lexical verbs to decrease the assertiveness in the sentences.

It should also be drawn to attention that the frequency of *Can* in *Methodology* is higher than that in *Results*, where *Would (not)* is more often used. It could be attributed to the hedging function of the word *Can* and *Would(not)*, while *Can* indicates possibility, which is appropriate for the descriptions of *Methodology* to avoid being categorical, the function of *Would(not)* lies primarily in predictions and anticipations. It is compatible with the role of *Results* where authors tend to have a brief explanation to echo the subsequent *Discussion*.

Though the highest densities of hedges are found in the *Discussion* section, *Approximators* in this section occur less frequently than in *Introduction*. As stated above, *Approximators* serve the function of modifying quality, degree, frequency, and time. Since *Introduction* is the section where authors review previous researches and cite related researches, it is likely that they would point out the gaps in these researches regarding quality, degree, frequency, or time. Meanwhile, in order to mitigate the threat to others' faces, *approximators* tend to appear in this section to hedge the utterance. For example:

[21] A Glasgow Blatchford score of 7 or more is best at predicting need for endoscopic treatment, and a PNED score of 4 or more and AIMS65 score of 2 or more are best at predicting mortality, although accuracy in predicting these endpoints is *relatively* low. (The BMJ-2017-1-method)

[22] To date, focus on care transitions, post-hospital outpatient care, and corresponding outcomes in the USA has *largely* been applied to vulnerable older adults discharged from inpatient stays. (The BMJ-2017-6-discussion)

[23] Sixth, our results focused *mainly* on aspirin-based antiplatelet treatment in secondary prevention because only a few of our patients were receiving long-term clopidogrel. (The Lancet-2017-8-discussion)

Obviously, in the first two sentences, the authors use *relatively* and *largely* to point out the shortcomings in the prediction of endpoints and the focus of the American medical system indirectly. In the third case, with the *Approximator mainly*, the author reveals the focus of his results without sounding categorical to seek protection from his counterparts.

Appendix

Table 3: P-value of the distribution of hedges across different sections

Sections	Introduction	Methodology	Results	Discussion
Introduction	-	0.0000	0.0000	0.0000
Methodology	-	-	0.9374	0.0000
Results	-	-	-	0.0000
Discussion	-	-	-	-

Appendix

Table 4: P-value of the use of different hedges between Introduction and Methodology

Sections	Introduction 41896	Methodology 183846	loglikelihood	p-value
Modal verbs	269	416	159.09	<0.0001
Lexical verbs	134	486	3.68	0.0552
Probability adverbs, adjectives & nouns	98	375	1.42	0.2337
Approximators	247	323	184.59	<0.0001
Other phrases	0	0		

Table 5: P-value of the use of different hedges between Introduction and Results

Sections	Introduction 41896	Results 110986	loglikelihood	p-value
Modal verbs	269	170	219.25	<0.0001
Lexical verbs	134	268	6.82	0.0090
Probability adverbs, adjectives & nouns	98	264	0.02	0.8871
Approximators	247	267	98.71	<0.0001
Other phrases	0	0		

Table 6: P-value of the use of different hedges between Introduction and Discussion

Sections	Introduction 41896	Discussion 142402	loglikelihood	p-value
Modal verbs	269	1388	43.04	<0.0001
Lexical verbs	134	591	7.82	0.0052
Probability adverbs, adjectives & nouns	98	731	64.96	<0.0001
Approximators	247	622	15.19	<0.0001
Other phrases	0	0		

Table 7: P-value of the use of different hedges between Methodology and Results

Sections	Methodology 183846	Results 110986	loglikelihood	p-value
Modal verbs	416	170	19.31	<0.0001
Lexical verbs	486	268	1.43	0.2322
Probability adverbs, adjectives & nouns	375	264	3.63	0.0569
Approximators	323	267	14.24	0.0002
Other phrases	0	0		

Table 8: P-value of the use of different hedges between Methodology and Discussion

Sections	Methodology 183846	Discussion 142402	loglikelihood	p-value
Modal verbs	416	1388	-830.20	<0.0001
Lexical verbs	486	591	-54.60	<0.0001
Probability adverbs, adjectives & nouns	375	731	-225.59	<0.0001

Approximators	323	622	-188.00	<0.0001
Other phrases	0	0		

Table 9: P-value of the use of different hedges between Results and Discussion

Sections	Results	Discussion	loglikelihood	p-value
	110986	142402		
Modal verbs	170	1388	-806.44	<0.0001
Lexical verbs	268	591	-57.29	<0.0001
Probability adverbs, adjectives & nouns	264	731	-127.05	<0.0001
Approximators	267	622	-71.08	<0.0001
Other phrases	0	0		

Table 10: Frequencies of 5 Modal verbs in Methodology and Results

Sections	Methodology		Results	
	183846		110986	
	Total	Normalized Frequency	Total	Normalized Frequency
Can	123	0.67	16	0.14
Would(not)	102	0.55	60	0.54
Could(not)	108	0.59	50	0.45
May(not)	42	0.23	28	0.25
Might(not)	37	0.20	15	0.14

Table 11: Top 10 Frequencies of 10 Approximators in Introduction and Discussion

Sections	Introduction		Discussion	
	41896		142402	
	Total	Normalized Frequency	Total	Normalized Frequency
About	45	1.07	114	0.80
Often	32	0.76	45	0.32
Approximately	24	0.57	43	0.30
Generally	18	0.43	36	0.25
Normally	18	0.43	3	0.02
General	17	0.41	57	0.40
Around	12	0.29	27	0.19
Rather	10	0.24	61	0.43
Typically	10	0.24	11	0.08
Largely	9	0.21	28	0.20

5. CONCLUSION

Overall, the results obtained demonstrate the variation in the distribution of hedging devices across different sections, among which *Discussion* is of the most frequent usage, almost four times the least hedged section. This principally results from the rhetorical purpose of the *Discussion* section, which is to convince the readers by interpreting specific research outcomes. In regards to the distribution of various hedging categories, *Modal verbs* play a prominent role by taking up almost 2/5 of the overall hedges, which is attributed to their epistemic features and function to conveying tentativeness. In addition to the above results, this paper also explored the use of different forms of hedges across different sections and offered explanations from the perspectives of rhetorical purposes and hedging functions.

The present study enriches the corpus-based study on comparative hedging usage concerning the

forms and RA structures. Hedges play a significant role in scientific RAs by gaining ratification from readers, hence acquiring a better knowledge of their usage contribute to the understanding of how to construct augments in RAs, which is beneficial for both native and ESL learners that are struggling with academic writings. However, this study mainly focuses on one discipline written in English within a relatively limited time span. It is hoped that in the future more holistic researches comparing hedges across different categories, rhetorical divisions, disciplines, and cultures will come into existence.

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Cite This Article: Yifan Wu (2021). Hedges in Medical Research Articles: A Corpus-based Comparative Study. *East African Scholars J Edu Humanit Lit*, 4(7), 275-283.