「論文」

A vocabulary study for enhancing learners' experiences: English-language medical research abstracts

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Abstract

This study investigated the vocabulary features of medical abstracts from the perspective of enhancing learners' vocabulary experiences in the disciplinary field. Our inquiry focused on the prevalence of the General Service List (GSL), the Academic Word List (AWL), the New General Service List (NGSL), and the New JACET List of 8000 Basic Words (hereafter referred to as "New JACET 8000"), as well as the most frequent lexical bundles within these texts. In a corpus of 456,641 tokens with 13,693 types, the repeated use of words and set phrases was found across multiple abstracts despite a high average type/token ratio in the individual texts. The coverages of the GSL and AWL, the NGSL, and the New JACET 8000 were about 80%. The ten highest frequency words accounted for 26% of the total word count with all ten words covered by the GSL; however, most of them were used in context-dependent sequences. The most frequently occurring lexical bundles were highly technical although individual words in the bundles were accessible. These findings may suggest the need for and provide insights into various strategies for raising learners' awareness of the specialized lexical landscape of texts in the disciplinary field.

1. Introduction

1.1 Vocabulary and academic comprehension

The foundation of academic understanding often lies in vocabulary mastery (Coxhead, 2016a; Nation & Macalister, 2021). In academic texts, students frequently encounter barriers due to unfamiliar words or uncertainty regarding their appropriate usage (Charles & Pecorari, 2016; Coxhead, 2017). This challenge is even more pronounced in specialized fields such as medicine (Dang, 2020; Tang & Liu, 2019).

Chung and Nation (2004) revealed that technical vocabulary constituted approximately 30% of an anatomy course text. In addition, students and professionals often have difficulty understanding and retaining the complex terms introduced in medical education and practice (Guest, 2013; Simpson, 2022). Another study suggests that advanced vocabulary learning is necessary for the accurate and appropriate use of terms, which is critical for patient care and interdisciplinary communication (Willey et al., 2019).

Medicine is a field with a high number of students in Japan. There are 81 medical schools or departments (MEXT, 2023a), with about 56,000 students (MEXT, 2023b), indicating one out of 67 could be a medical student based on the total university enrollment of about 630,000 (MEXT, 2023b). This growth was led by the government's 1973 policy addressing physician distribution across the country. Guidelines were issued to help these learners achieve "a level of proficiency" in English to meet the global standards (Hitosugi et al., 2016, p. 88). In these guidelines, "the minimum requirements" aim vocabulary levels to "be able to search for information consisting of English terms and expressions necessary for research in medicine and health care" and their reading skills to "read and understand the abstracts of target English-language research articles" (Japan Society for Medical English Education Guidelines Committee, 2015, pp. 4–5).

The need for teaching basic medical English vocabulary was emphasized by Tamamaki and Fujieda (1998), who revealed the correlation between students' familiarity with essential medical terms and their exposure to medical texts. Shimizu (2019) identified that Japanese medical students in whom the "average TOEIC score was 495 (Range: 270–650)" (p. 83) had difficulty in "understanding the main result of an abstract" (p. 85). These studies underline the complexity of contextual meanings of "lexical items such as *clinical* (compare *clinical trials* with *a clinical decision*)" (Coxhead, 2016b, p. 179). However, our understanding of the vocabulary of medical abstracts from the perspective of enhancing learners' vocabulary experiences is limited. This gap highlights the need for an analysis of the level of vocabulary used in medical research abstracts using word lists created for teaching.

1.2 Vocabulary lists

Teaching the most common words in particular contexts facilitates vocabulary learning (Nation, 2001). Various vocabulary lists have been created to date. Early efforts, such as Thorndike's word book (1921) and an update by Thorndike and Lorge (1944) were followed by lists such as the General Service List (GSL), a contribution "over three decades of work by an international group of leading researchers" (Gilner, 2011, p. 70). The GSL has been "developed from a corpus of 5 million words with the needs of ESL/EFL learners in mind" (Coxhead, 2000, p. 213), with two groups of "998 and 988 word families" (Quero & Coxhead, 2018, p. 54; hereafter, we refer to the two groups as the first one thousand and the first two thousand word families).

The GSL has been used frequently for the development of wordlists. Coxhead prepared the Academic Word List (AWL) of 570 word families (Coxhead, 2000), selected from "a 3,500,000 token corpus of academic English" spanning the Arts, Science, Law, and Commerce (Nation, 2001, p. 188) based on criteria such as the absence in the GSL and the presence in her corpus at least 100 times. The concept of "a word family" is defined as "a headword, its inflected forms, and its closely related derived forms" (Nation, 2001, p. 8). The rationale behind such a family-based organization is articulated by Coxhead (2000, p. 218), who, referencing Bauer and Nation (1993), posits that understanding "regularly inflected or derived members of a family does not require much more effort by learners if they know the base word and if they have control of basic word-building processes." Coxhead and Hirsh (2007) created "*the pilot science corpus*" (p. 70) of 1,761,380 tokens from textbooks and reading materials in the fourteen areas such as "biology" and "sport and health sciences." In their corpus, the coverage of "the first and second thousand of GSL" (Coxhead & Hirsh, 2007, p. 73) was about 70%. Fraser (2007) prepared the Pharmacology Word List (PWL) from a corpus of 51 international pharmacology journal article texts. In his corpus, the coverage of the GSL and AWL was 70.44% (Fraser, 2007). Wang et al. (2008) created "a Medical Academic Word List" (p. 445) using a corpus of over 1.09 million words from research articles of "almost all the fields of medical science" (p. 445) for designing curriculum in medical English education (Wang et al., 2008). Fraser (2007) also compiled a 58,413-token corpus of a pharmacology textbook, in which the coverage of the GSL and AWL was 68.77% (Fraser, 2007). Quero and Coxhead (2018) prepared two corpora including "a medical corpus" of two medical textbooks that cover "a comprehensive range of medical topics" (p. 58) and "a second medical corpus" of medical textbooks covering "a wide range of medical topics" (p. 59). In their corpora, the GSL coverage was about 60% with the AWL coverage being around 8%. Chen and

Ge (2007) created a corpus of "50 medical research articles with 190,425 running words" (Chen & Ge, 2007, p. 506) and examined the top 20 academic word items from "abstract," "introduction," "materials and methods," "results," and "discussion" sections. In their entire corpus, the coverage of the AWL was "10.073%" (Chen & Ge, 2007, p. 508), with the AWL words occurring evenly in the sections. The AWL was also used to develop a word list for medical professionals and students based on a corpus of 99 research articles (Tang & Liu, 2019).

The combination of the GSL and AWL has been considered "of relevance" (Gilner, 2011, p. 74); however, "the use of the 50-year-old GSL" (Green & Lambert, 2018, p. 107) has been criticized. "A word family approach" (Culligan, 2019, p. 37) has been regarded as "problematic" (Gardner & Davies, 2014, p. 307). The New General Service List (NGSL, Browne, 2013) was "conceived as a modern update of the General Service List (West, 1953)" (Mizumoto et al., 2021, p. 31). The NGSL is considered "optimal" for Japanese learners (Mizumoto et al., 2021, p. 32; Nakata, 2022, p. 23). According to Culligan's study (2019), Japanese undergraduates' perspectives on the GSL and NGSL suggest that the NGSL may offer a slightly easier learning curve and would be more suitable for learners.

In contrast, the New JACET 8000 (JACET Special Committee for Revision of the JACET Wordlist, 2016) is "an updated version of the JACET 8000 word list (JACET Committee for Revision of the JACET Wordlist, 2003). This wordlist was compiled by the Japan Association of College English Teachers (JACET)" (Mizumoto et al., 2021, p. 31). The updated version is regarded as "a list of the 8000 basic words which should be acquired by learners of English" (Terauchi, 2016, p. 13) and is, therefore, primarily for a Japanese audience; it includes lemmatized words with part-of-speech information.

1.3 Lexical bundles

Corpus studies have increasingly identified recurring "communicative events" (Swales, 1990, p. 9), focusing on prefabricated word sequences within their contexts. Lexical bundles, defined as "sequences of word forms" (Biber et al., 1999, p. 990), occur more commonly across language events than would be expected by chance. These "multi-word sequences" (Biber et al., 2004, p. 373; Mizumoto, 2015, p. 30) can be identified as "n-grams" (Mizumoto, 2015, p. 31; Stubbs & Barth, 2003, p. 61). It has been shown that 4-word bundles "hold 3-word bundles in their structure" (Cortes, 2004, p. 401; Hyland, 2008, p. 6) and are "far more common than 5-word strings" (Hyland, 2008, p. 8). Stubbs and Barth (2003) argue that "n-grams," referred to as "chains of word-forms" (p. 61), "are not necessarily linguistic units" (p. 62); however, frequently occurring 4-grams are shown to characterize text types in such a way that research articles have frequently occurring 4-grams such as "*on the other hand* and *at the beginning of*"(Cortes, 2013, p. 34). Examining n-grams is considered to "complement measures (such as type-token ratio) which can characterize text-types" (Stubbs & Barth, 2003, p. 79). The need for "teaching lexical bundles" in "English for Academic/Specific Purposes (EAP/ESP)" (Mizumoto, 2015, p. 33) settings has been underscored.

The approach has been applied to examine medical research articles. Jalali et al. (2015) identified that "in the present study" (p. 57) was the most frequent 4-gram in their 2.4-million-word research article texts from 33 "medical subject areas" (p. 54). Abdollahpour and Gholami (2018) identified "all four-word lexical bundles" (p. 90) within their corpus of "the abstract sections" (p. 82) from various medical journal articles, with subsequent "categorization into two major groups of general and technical" (p. 90). In their corpus, "this study was to" (p. 105) was "the most frequent general lexical bundle" (Abdollahpour & Gholami, 2018).

1.4 Medical research writing

Medical articles, especially in health research, must adhere to specific study design requirements, as reported by Millar et al. (2019). An international initiative that seeks to "ensure quality in the reporting" (Millar et al., 2019, p. 141) now provides "616 reporting guidelines" (EQUATOR Network, 2024) that stipulates "the required sections and information" (Millar et al., 2019, p. 150) necessary for each publication. Non-compliance with these guidelines "may result in a manuscript being deemed of inferior quality" (Millar, et al., 2019, p. 141) by the International Committee of Medical Journal Editors (ICMJE), working "to improve the quality of medical science and reporting" (ICMJE, 2024) and issuing "similar guidelines for medical research articles in general (the updated recommendations may be found at www.icmje.org)" (Millar et al., 2019, p. 141). Their recommendations are "widely accepted by biomedical journals" (Luo & Hyland, 2019, p. 39), and "play a central role" (Millar et al., 2012, p. 393) in research writing.

1.5 Aim of this study and research questions

This study aims to examine the vocabulary in our corpus of English-language abstracts of medical research articles. By examining our corpus texts with authentic vocabulary lists, we try to understand the vocabulary level of medical research abstracts. The present study poses the research questions (RQs) "What is the prevalence of words from the GSL, AWL, NGSL, and the New JACET 8000 within the corpus texts?" and "What are the most frequent lexical bundles in the corpus texts?"

2. The corpus and previous findings

2.1 The corpus

Our corpus comprises 1,481 abstracts of research articles from an international journal, *the New England Journal of Medicine* (*NEJM*), published in 2010 and 2015 through 2020. The gap in the years was due to a shortfall of human resources, which prevented the incorporation of abstracts from missing years. We used this journal's abstracts because the publications meet the criteria of "representativity, reputation, and accessibility" (Nwogu, 1997, p. 121), offer canonical insights for Japanese students in their training to "evaluate medical literatures" (Ogawa, 2014, p. 41) and also in learning how a vocabulary item "is actually used in writing for medical professionals" (Jego, 2012, p. 51). The journal offers official translations in Japanese (The New England Journal of Medicine, 2024a). The texts from the website were extracted, segmented into sentences, organized in spreadsheet columns, and saved as individual abstract files.

2.2 Previous findings from the corpus

Our previous study examined the 2018 part of this corpus. In the study, modal verbs appear mainly in the Introduction of the abstracts, followed by the Conclusion, Methods, and Results sections. The majority of the top 20 collocates for the "collocational framework" (Renouf & Sinclair, 1991, p. 128) "the . . . of" (Marco, 2000, p. 63) match those found in Marco's list such as "the risk of," "the effect of," and "the presence of." Punctuation marks like commas, semicolons, or colons have overlapping functions (Asano et al., 2021).

3. Methods

3.1 Wordlists

Our analysis focused on the vocabulary profiles of the texts in the entire corpus, concentrating on the coverage by general and academic word lists. For our analysis with the GSL (West, 1953) and the AWL (Coxhead, 2000), we relied on versions of these lists that were “created by Paul Nation and cleaned by Laurence Anthony” (Anthony, n.d.). We used the NGSL (Version 1.2; Browne, 2013) by accessing the website for the list. When using the New JACET 8000 in our analysis, we employed the concept of “flemma,” defined as “a base form as a headword and its inflected forms as one word,” a counting approach that “combines inflections of lemma groups but does not distinguish the POS” (Mizumoto et al., 2021, p. 33). We examined our corpus texts in their original forms for analyses involving other wordlists.

3.2 Tools

The texts were examined with CasualConc (Version 3.0.6; Imao, 2023), AntConc (Version 4.2.4; Anthony, 2023), and AntWordProfiler (Version 1.5.1; Anthony, 2021). The quantitation of vocabulary coverage deployed the stopword function of CasualConc. The target items were “removed in the pre-processing step” (Sarica & Luo, 2021, p. 1). The word frequency after removal was subtracted from the total word count of the texts to determine the word count. The results were processed using Microsoft Excel (version 2308) and Google Colaboratory’s Python environment. AntWordProfiler was used to determine the results and quantify types in each text. The data was lemmatized using spaCy (version 3.6.1) in the Python environment where necessary. AntConc was also used to obtain “n-grams (or “lexical bundles”)” to identify multi-word expressions that characterize the specific texts (Nesi, 2013, p. 418).

4. Results

4.1 Word profiles of the corpus texts

The corpus contained 456,641 words of 13,693 types (Table 1). The average word count per abstract exceeded 300 after 2016, with an increasing variation in length over time.

Table 1. Word count of the corpus texts per year

Year	2010	2015	2016	2017	2018	2019	2020	Total
Number of abstracts	208	223	208	208	208	209	217	1,481
Type	4,921	5,046	4,992	4,969	4,876	4,928	5,004	13,693
Total word count (Token)	58,747	65,377	65,290	65,726	65,684	67,736	68,081	456,641
Mean word count	282	293	314	316	316	324	314	308
Standard deviation	30	32	41	40	38	39	36	39

According to the journal guidelines (The New England Journal of Medicine, 2024b), a research article should not exceed 2,700 words, including the abstract, a maximum of five tables and figures, and up to 40 references. The guidelines do not set a word count limit for the abstracts, but an upward trend in the average word count was seen over the study period, accompanied by greater variation among the abstracts.

The type/token ratio (TTR) of individual abstract texts averaged around 45.0 (Figure 1). This ratio was high, considering that "general prose and essays in British and American English" texts in the Freiburg LOB (FLOB) and Freiburg-Brown (Frown) corpora have a TTR of "8.14" (Fujiwara, 2003, p. 93). These findings may be attributable to "the use of many different lexical items in a text" (Biber, 1988, p. 104). However, the entire corpus showed 13,693 types and 456,641 tokens (Table 1), with the top 100 words accounting for 53.1% of the total frequency (Table 2), suggesting

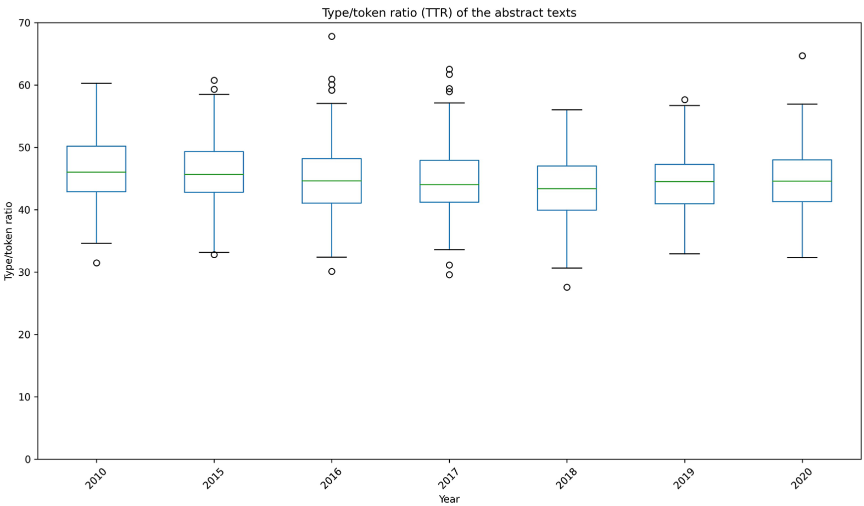

Figure 1. Distribution of type/token ratios (TTRs) for the individual abstract texts.

Table 2. Top 100 words in the corpus

Word	Raw freq.	Std (%)	Word	Raw freq.	Std (%)	Word	Raw freq.	Std (%)	Word	Raw freq.	Std (%)	Word	Raw freq.	Std (%)
1 the	24,564	5.4	21 placebo	2,306	0.5	41 on	1,364	0.3	61 higher	960	0.2	81 study	793	0.2
2 of	20,186	4.4	22 from	2,175	0.5	42 therapy	1,351	0.3	62 no	947	0.2	82 median	791	0.2
3 in	16,366	3.6	23 than	2,099	0.5	43 not	1,344	0.3	63 between	927	0.2	83 age	784	0.2
4 and	13,222	2.9	24 among	2,067	0.5	44 trial	1,341	0.3	64 compared	915	0.2	84 during	773	0.2
5 to	10,906	2.4	25 as	1,897	0.4	45 funded	1,327	0.3	65 those	902	0.2	84 significantly	773	0.2
6 with	9,084	2.0	26 per	1,860	0.4	46 death	1,300	0.3	66 this	891	0.2	86 control	768	0.2
7 a	8,249	1.8	27 that	1,766	0.4	47 assigned	1,288	0.3	67 days	886	0.2	87 difference	745	0.2
8 patients	6,963	1.5	28 ratio	1,627	0.4	48 dose	1,226	0.3	67 lower	886	0.2	88 clinical	723	0.2
9 was	5,992	1.3	29 an	1,609	0.4	49 survival	1,214	0.3	69 participants	885	0.2	89 cancer	721	0.2
10 group	5,453	1.2	30 primary	1,586	0.3	50 end	1,137	0.2	70 occurred	882	0.2	90 groups	720	0.2
11 were	4,903	1.1	31 risk	1,579	0.3	51 is	1,133	0.2	71 outcome	873	0.2	91 health	714	0.2
12 or	4,796	1.1	32 treatment	1,548	0.3	52 interval	1,118	0.2	72 total	872	0.2	92 rates	704	0.2
13 for	4,608	1.0	33 after	1,473	0.3	53 received	1,068	0.2	73 receive	866	0.2	93 free	694	0.2
14 at	3,205	0.7	34 mg	1,464	0.3	54 associated	1,067	0.2	74 more	853	0.2	94 up	692	0.2
15 by	2,696	0.6	35 number	1,442	0.3	55 adverse	1,066	0.2	75 randomly	848	0.2	95 overall	691	0.2
16 p	2,683	0.6	36 events	1,427	0.3	56 confidence	1,047	0.2	76 weeks	844	0.2	96 outcomes	681	0.1
17 ci	2,669	0.6	37 disease	1,423	0.3	57 gov	1,007	0.2	77 two	826	0.2	97 all	680	0.1
18 who	2,488	0.5	38 years	1,399	0.3	58 clinicaltrials	1,005	0.2	78 point	822	0.2	98 percentage	674	0.1
19 we	2,450	0.5	39 rate	1,398	0.3	59 hazard	1,002	0.2	79 points	799	0.2	99 care	673	0.1
20 had	2,365	0.5	40 months	1,389	0.3	60 vs	970	0.2	79 response	799	0.2	100 year	667	0.1

Raw freq: Raw frequency; Std (%): Frequency per one hundred words

that the texts contain many repetitive words and phrases.

The ten most frequent words accounted for 26% of the tokens. They were covered by the GSL but often used in context-dependent sequences. For example, the two most frequently used words, “the” and “of,” appeared in 455, 500, and 183 instances of four-grams “the . . . of the,” “in the . . . of,” and “the . . . of a,” respectively. There were 341, 108, and 61 instances of “the risk of,” “the effect of,” and “the presence of,” respectively; these are the top three “collocates” of the “the . . . of” framework in Marco’s study (2000, p. 68). These findings underscore the significant presence of this framework in our corpus. Words such as “per,” “ratio,” and “rate” frequently recurred, expressing “measure [and] quantification” (Marco, 2000, p. 69).

4.2 Lexical coverage of the wordlists

In the corpus text, the coverage of the first one thousand word families of the GSL was 59.4% on average, ranging from 39.1% to 80.4%. The coverage of the first two thousand word families was 64.7% and ranged from 43.9% to 84.9%. The coverage of the GSL and AWL was 75.2%, ranging from 54.7% to 95.0%. The NGSL showed a mean coverage of 75.1%, having a significantly greater coverage compared to the first and second two thousand word families of the GSL (t = 51.162, df = 2,960, $p < .01$). The cumulative coverage of the New JACET 8000 averaged 83.2%, ranging from 63.7% to 96.8% (Figure 2). The last 1,000 words in the word lists include specific terms such as “aspirin,” “variant,” “pneumonia,” “artery,” “coronary,” “infusion,” “renal,” “cardiovascular,” and “tuberculosis.” However, no marked difference was seen between the cumulative coverage of the 7,000 words and that of 8,000 words (Figure 2), suggesting that the last 1,000 words did not significantly contribute to the overall coverage.

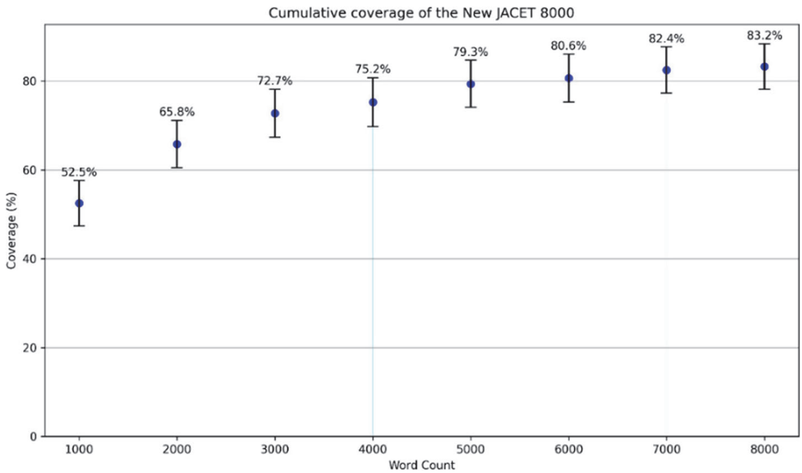

Figure 2. The mean and standard deviation of the cumulative coverage of the New JACET 8000.

4.3 Most frequent lexical bundles in the corpus

The ten most frequent 3-grams, 4-grams and 5-grams (Table 3) had a standard frequency of over 300 instances per million words. All ten most frequent 4-grams had a range of more than 10%. The instances of the bundles were noticeably frequent, taking into consideration the cut-off frequency of “20 per million words” (Cortes, 2004, p. 400; Hyland, 2008, p. 9; Hyland & Jiang, 2018, p. 385) used for quantifying bundles.

The most frequently occurring 3-gram “ci to p” was identified as “part of a 5-word string” (Hyland & Jiang, 2018, p. 386) “confidence interval ci to p” (Figure 3). The 4-gram “interval ci to p” “hold” (Cortes, 2004, p. 401) the three-word bundles “ci to p,” “confidence interval ci,” and “interval ci to” as shown in an example corpus text (Glauser et al., 2010, p. 790): “After 16 weeks of therapy, the freedom-from-failure

Table 3. The most frequently occurred lexical bundles

Rank	Three-gram	Raw	Std.	Range	Four-gram	Raw	Std.	Range	Five-gram	Raw	Std.	Range
1	ci to p	1,008	2,207	33.3	cinicaltrials gov number nct	932	2,041	62.8	confidence interval ci to p	398	872	26.9
2	patients in the	965	2,113	28.6	confidence interval ci to	767	1,680	51.8	the primary end point was	370	810	23.8
3	gov number nct	935	2,048	63.0	in the placebo group	636	1,393	18.8	at the dose of mg	224	491	11.4
4	clinicaltrials gov number	932	2,041	62.8	the primary end point	482	1,056	26.7	ratio confidence interval ci to	218	477	15.1
5	confidence interval ci	773	1,693	52.2	interval ci to p	398	872	26.9	hazard ratio ci to p	176	385	10.3
6	interval ci to	767	1,680	51.8	hazard ratio ci to	382	837	15.3	of the patients in the	152	333	7.8
7	the placebo group	753	1,649	20.0	primary end point was	379	830	24.3	in a ratio to receive	149	326	9.9
8	as compared with	720	1,577	33.0	group and in the	326	714	16.6	hazard ratio confidence interval ci	149	326	10.1
9	funded by the	718	1,572	48.2	the primary outcome was	317	694	20.4	in of patients in the	149	326	6.1
10	in the placebo	668	1,463	19.6	a total patients	316	692	20.3	primary end point was the	148	324	9.9

Raw: Raw frequency; Std.: Frequency per one million words; Range: Percentage

rates for ethosuximide and valproic acid were similar (53% and 58%, respectively; odds ratio with valproic acid vs. ethosuximide, 1.26; 95% confidence interval [CI], 0.80 to 1.98; P = 0.35) and were higher than the rate for lamotrigine (29%; odds ratio with ethosuximide vs. lamotrigine, 2.66; 95% CI, 1.65 to 4.28; odds ratio with valproic acid vs. lamotrigine, 3.34; 95% CI, 2.06 to 5.42; P < 0.001 for both comparisons)." The frequent use of "confidence interval" and "p" values suggests their role in describing study findings.

The most frequent 4-gram "clinical trials gov nct," which occurred in 62.8% of the texts, refers to a unique identifier assigned to clinical trials registered on a database of "clinical research studies" conducted around the world (ClinicalTrials.gov, 2023). This identifier, known as the "National Clinical Trial (NCT) number," is part of a global registry network that facilitates access to trial information and shows that the study satisfies the recommendation "as a condition of consideration for publication" (ICMJE, 2024, p. 13), highlighting the significance of referencing the regulatory aspects of research in this corpus text.

Of the 379 instances of the 4-gram "primary end point was," 370 (97.6%) occurred in the second most frequent 5-gram "the primary end point was." All these words are in the NGSL; "primary" is in the AWL and ranked at the 1098th in the New JACET 8000; "end" and "point" are both in the first thousand words of the GSL and rank in the 180s in the New JACET 8000. How-

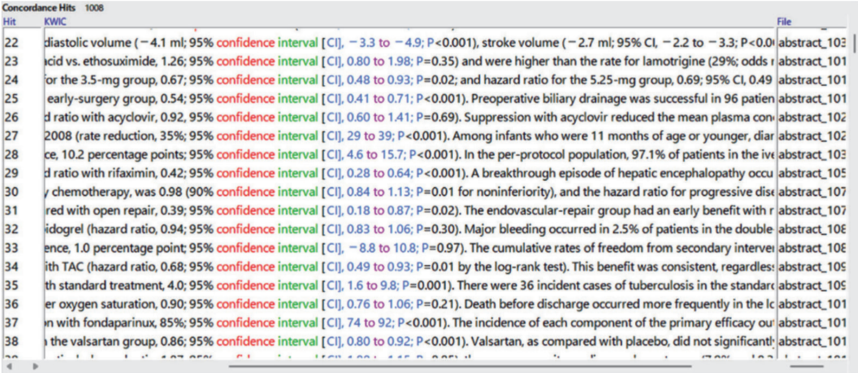

Figure 3. The concordance lines showing the 3-gram “ci to p”

ever, the combined sequence “primary end point” refers to “the study’s objective” (ICMJE, 2024, p. 17), indicating that the term is used to denote the “research outcome” (Nwogu, 1997, p. 132). Although each word may be accessible for learners, the sequence “primary end point” is highly technical. This gap between the general accessibility of individual words and the specialized use of the word sequence highlights the complexity of the texts.

5. Discussion

Our analysis revealed the vocabulary diversity and the repeated use of high frequency words, showing bundles to be highly technical. Individual texts had many word types, as shown by a mean TTR of about 45.0 (Figure 1). In contrast, the entire corpus contained 13,693 types and 456,641 tokens (Table 1), with the top 100 words accounting for 53.1% of the total frequency (Table 2). TTRs are affected by “the size of the corpus” (McEnery & Hardie, 2012, p. 50), but our corpus data showed the repetitive use of words and set phrases across multiple abstracts. This was consistent with the finding that the range, or “document frequency” (Tabata, 2012, p. 3) divided by the total number of texts, scored 50% or greater in several and exceeded 10% in many word sequences (Table 3), indicating conventional terminology usage across the corpus. The bundles were quite technical although each word was commonly found in the wordlists. These findings highlight the needs for furnishing students with lexical tools to navigate these texts effectively.

The first research question (RQ) explored the prevalence of words from specific lists within the corpus, finding mean coverages of 75.2%, 75.1%, and 83.2% for the GSL and AWL, NGSL, and New JACET 8000, respectively, highlighting the vocabulary complexity for learners. Nation and Macalister (2021) note understanding necessitates familiarity with at least "98 per cent" (p. 12) of text vocabulary.

Addressing the second RQ on frequent lexical bundles, we found the leading 3-gram "ci to p" within the 5-gram "confidence interval ci to p" appeared 872 times per million words across 26.9% of texts (Table 3), illustrating its use in stating study findings. Despite individual words in the bundle such as "primary end point was" being accessible, the sequence should be notably technical, underscoring textual complexity.

Our study needs to consider our target learners' vocabulary levels. Hamada et al. (2021) recorded an average vocabulary size of 4,575 words among over 1,000 "students from 16 Japanese universities (29 faculties)" (p. 29) using the New JACET 8000 list. Beglar (2010), using the vocabulary size test by Nation (2006), found vocabulary sizes ranging between 4,700 and 5,700 for Japanese university students of varying English proficiency levels. McLean et al. (2014) reported an average vocabulary size of "3,939 word families" (p. 35) with the "Vocabulary Size Test" (p. 34) by Nation and Beglar (2007). Although we must interpret these results individually and cautiously, the findings imply that the learners may not fully grasp all vocabulary present in the word lists examined in our study.

The major approach, among vocabulary learning strategies, is introduced by Nation and Macalister (2021). They advocate for "intensive reading" (p. 42), where teachers can help "learners use context clues to guess the meaning of the word" (p. 43).

To improve medical students' English proficiency, Fraser et al. (2015) developed "word lists" (p. 16) from medical texts, including doctor-patient conversation and "an anatomy textbook *Gray's Anatomy for Students*" (p. 17). Fraser et al. (2015) hypothesized that students' familiarity with the content "would help them greatly when they encountered difficult words or sentences" (p. 18). They integrated corpus studies with their classroom activities, facilitating students' association with the subject-matter contexts (Fraser et al., 2015). The creation of word lists, informed by interviews with medical professors and "feedback from doctors" (Fraser et al., 2015, p. 18), received "positive feedback" (p. 19) from students.

An alternative learning strategy involves leveraging learners' first language (L1) to establish the "meaning-form link" (Schmitt, 2008, p. 353) despite discouragement from the Ministry of Education, Culture, Sports, Science and Technology's policy (MEXT, 2014). A survey shows learners' preference for "the idea of F[oreign] L[anguage] learning as bilingual education" (Turnbull, 2018, p. 119), suggesting that "translanguaging" (García, 2009, p. 45; Turnbull, 2018, p. 101), could be a mainstream option. García (2009, p. 45) posits that the term "translanguaging" as bilinguals' use of their languages to become aware of their multilingual worlds, a concept originated from Cen Williams (Baker, 2001).

New studies highlight the benefits of translanguaging in higher education. Shoecraft et al. (2024) reported on their action research in a first-year anatomy course at an Australian university, where more than 30% of students were learning English as an additional language (EAL). The translation of mini-lecture video transcripts into the students' first languages proved beneficial as scaffolding. Scanning in the first language before reading or viewing in English saved time in understanding the content and helped to build students' confidence. Zheng and Drybrough (2023) investigated the translanguaging practices of five Chinese postgraduate students during the outlining, note-taking, and drafting stages of their master's dissertation writing process at a British university. The study reveals six translanguaging practices, such as "to illustrate the relationship between different pieces of information" (Zheng & Drybrough, 2023, p. 9), supported students' self-regulation and efficiency in controlling the extensive writing process to achieve their writing goals. In a mixed-methods study, Galante (2020) investigated the effects of translanguaging on academic vocabulary development compared to a traditional monolingual approach. The results of vocabulary tests, classroom observations, and learner diaries at the end of the 12-week EAP program revealed that the translanguaging group had a significantly higher academic vocabulary than the monolingual group. Active engagement in cross-linguistic meaning making was observed in the translanguaging group.

In classrooms sharing "similar L1-related difficulties" (Flowerdew, 2012, p. 215), "a bilingual corpus" (Aijmer, 2002, p. 1) containing "source texts and their translations" (Baker, 1993, p. 248) aids in exploring concordance lines "as students can see the different contexts in which a word is used" (Flowerdew, 2012, p. 215). Chujo et al. (2006) used an online bilingual concordancer equipped with "Japanese-English parallel corpora" (p. 153) of news articles in Japanese university beginning-level English classes for activities like identifying patterns and tendencies. Using a concordancer helped learners find language patterns "themselves (with guidance from handouts)" (Chujo et al., 2006, p. 169).

Our project developed the Medical English Education Support System (MEESUS) featuring bilingual concordancing from our corpus texts and the official Japanese translations (Nakano et al., 2021). The journal's regional site (Nankodo, 2024) offers Japanese translations of abstracts of various "original articles" (The New England Journal of Medicine, 2024b). In one study, about 100 first-year medical students in a private university were asked to become familiar with the system, examine language items the participants picked up from the tool, and write their findings on a worksheet in a required course (Asano et al., 2022a). These students averaged 475.04 in TOEFL ITP score with a standard deviation (SD) of 43.17, suggesting that most students were at or below the CEFR B1 level (Oshimi, 2022). They were subsequently involved in "the peer-worksheet viewing activity" (Asano et al., 2022a, p. 22), and many commented their surprise in learning the contextual meaning of items such as "mean" for "heikin," "case" for "shorei," and "develop" for "shojiru [to occur]." One participant reported, "I was surprised to learn that "subject" has the meaning of "hikensha." I will keep this in mind as I will be using it a lot in the future" (Asano et al., 2022a, p. 24). In another study, fourth-year medical students (average TOEFL ITP score 455.9; SD 45.7) were introduced to "guidelines" (Millar et al., 2019, p. 150), read a model abstract to review how the information was given in a required course at the same university (Asano et al., 2022b). They were tasked to choose an abstract, extract information such as "trial design," and write a summary. Those who used the bilingual display of the tool scored higher than non-users in all task items. Although the "learner-directed corpus projects" have invited arguments such as "whether such an approach is feasible is questionable" (Ballance & Coxhead, 2022, p. 412), these attempts might foster learners' "awareness" and "tolerance" foreseeable in their "real world" community (Cook, 2010, p. 117–118).

This study had some limitations: it analyzed only abstracts from the past seven years. With ongoing data addition, a full-scale of analysis may be optimal in the future. This study used the New JACET 8000, which contains lemmatized words with part-of-speech information. However, the corpus texts were lemmatized in the analysis without considering the part-of-speech information.

The corpus texts exhibited specialized vocabulary and lexical bundles suggestive of disciplinary conventions. Nation and Macalister (2021, p. 137) propose that an English course incorporating digital tools could be "a means of improving and developing information gathering skills in both L1 and L2." Nation (2001) argues the difficulty of technical vocabulary for a disciplinary novice learner guessing from the context as "the reader does not already have a good background in that technical area" and thus "looking the word up in a dictionary does not bring much satisfaction" (p. 204). In a meta-analysis, the use of parallel corpora was found to be effective for learners whose first language is Japanese (Boulton & Cobb, 2017). Although a broader discussion is needed, the findings of this study may suggest the need for and provide insights into different strategies for helping students to "succeed in the learning contexts" (Tribble, 2017, p. 40) and raising learners' awareness of specialized language used in medical abstracts.

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