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An Acoustic Analysis of Vowel Sounds in Kachchi Sindhi

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Abstract

Kachchi is one of the six dialects of Sindhi spoken widely in India and the Sindh region of Pakistan. It is also spoken in the Kutch region of Gujarat, India. Kachchi is significantly distinct from other dialects because of geographical, and cultural differences. It is written in Perso-Arabic script in Pakistan and Gujarati script in India. Kachchi is the least studied language, particularly in the field of linguistics (acoustics), and therefore it is the prime focus of the study. The study aims to analyze the acoustic realizations of ten Kachchi vowel sounds. The study is based on ten Kachchi words from ten native Kachchi speakers, residing in Sindh, Pakistan. A total of (10×10×3=300) voice samples were analyzed, and each recording had all ten Kachchi words recorded by native Kachchi speakers. Each word had three utterances. The data consist of ten Kachchi-Sindhi vowels /iː/, /ɑ/, /ɔ/, /u/, /e/, /ɛ/, /o/, /ɪ/, /ə/, and /ʊ/, were recorded by ten native Kachchi speakers (5 males and 5 females). For the collection of data, convenience sampling was collected. Four parameters were considered for the acoustic analysis of Kachchi-Sindhi vowels i.e. vowel quality (F1-F2), fundamental frequency (F0), duration, and stop the closure. Vowel quality, durational values of vowels and stop closures are acoustically described in the study. The acoustic examination revealed that the F0 value was relatively higher between female than male speakers. The vowel quality (F1-F2) was analyzed and the vowel space of Kachchi-Sindhi vowel sounds was plotted. The results further revealed that females' vowel quality (F1-F2) was also higher than males. Between the two stop consonants, voiced alveolar /d/ had the longest durational value than voiceless velar /k/.

Keywords: Kachchi, dialect, Sindhi, fundamental frequency, vowel quality, duration

Introduction

Studying different languages acoustically has a vast significance in the field of phonetics in particular and linguistics in general. A great number of languages have been studied acoustically and their main focus was revolved around the vocalic sound system of the language. The recent studies show the acoustic study of the vowel of Persian (Ansarin, 2004), Turkish (Lanfranc and Mark, 2012), Chinese (Howie and Howie, 1976), Urdu (Rehman, 2019),

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etc., have been done, however, the literature review shows no study has been done on the acoustic properties of Kachchi vowels.

Kachchi belongs to the Indo-Aryan family of language. Khubchandani (1981) states that Sindhi dialect Kachchi is mainly spoken in the Kutch region of Gujarat, India and it is one of the significant dialects of Sindhi. About 866,000 people in Kutch speak Kachchi as their first language. Kachchi is also spoken in Sindh, Pakistan, but only by a considerable number of people. Kachchi is also spoken in Trinidad and Tobago. Kachchi can be spelt as Cutchi, Kutchi, or Kutchhi. Kachchi has borrowed its vocabulary from Gujarati, Sindhi, and Rajasthani. In India, Kachchi is written in Gujarati script while in Pakistani it follows Perso-Arabic script and is a phonetic language.

The target of the present study is to analyze Kachchi vowels acoustically, a dialect of Sindhi, vowels produced by native Kachchi speakers. The current paper examines five parameters of human speech i.e. F0, F1, F2, F3, and the duration of Kachchi vowel driven by the data. It also examines the stop closures. The present experiment is based on ten voice samples of native Kachchi speakers. The basic goal of the study is to document the acoustic realizations of Kachchi vowels, which have been articulated by native Kachchi speakers. The study focuses on ten Kachchi monophthongs i.e. /i:/, /ɑ/, /ɔ/, /u/, /e/, /ɛ/, /o/, /ɪ/, /ə/, and /ʊ/. It also analyses the stop closure of voiceless velar consonant /k/ and voiced alveolar /d/. The paper analyzes (10×10×3=300) voice samples. Ten Kachchi words were taken to examine the Kachchi vowels' acoustic realizations. Ten native Kachchi speakers (5 males and 5 females) from Karachi, Sindh recorded all the ten words within one recording through mobile *iPhone X's* recorder without any background noise. Five parameters were considered for the analysis of Kachchi vowel's production given as F1, F2, F3, and duration. F1 measures the height of the tongue, F2 measures the back-ness of the vowel, F3 value provides a relatively good indication of the overall vocal tract length for the speakers, F0 measures pitch and the duration is length of the vowel. The recorded voice samples were transferred to the Praat Speech Processing tool for analysis.

Significance of the Study

Kachchi is one of the dialects of Sindhi, however, it is not a much-studied dialect, especially in the field of acoustic phonetics. The vowel systems of many languages have been studied however, the acoustic Kachchi vowel system has not been studied yet in accordance

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with the author's information. Keerio et al. (2014) studied the isolated vowels of Sindhi and five of its dialects except Kachchi, consequently, the present study holds a great significance. The foundational work will determine and assist the further research related to Kachchi Sindhi in future.

Objectives of the Study

- To analyze the acoustic properties of Kachchi/Sindhi vowel sounds.
- To form vowel space of Kachchi/Sindhi vowel sounds uttered by native Kachchi speakers.
- To determine gender differences in vowel quality (F1-F2), F0 (fundamental frequency), and duration of Kachchi/Sindhi vowel sounds.

Prior Works

Kachchi is one of the dialects of Sindhi spoken in the western state of Gujarat, India i.e. Rann of Kutch (Cole, 2006) while some argue that it is the dialect of Gujrati, however, it is lexically similar to both languages. Kachchi is one of the six major dialects of Sindhi (Khubchandani, 1981). The Lawatiya community in Oman considers that the Lawatiya language is based on Kachchi (Salman and Kharusi, 2011). Salman and Kharusi (2011) found that there is a greater lexical similarity between Lawatiya and Kachchi, they further add that Sindhi, Kachchi, and Lawatiya are spoken in Oman as three distinct varieties. Furthermore, describing the vowels is more difficult than the consonants due to the variation of utterance from person to person (Mahar and Memon, 2009). Ansarin (2004) finds that three vowels /i, ɑ, u/ are major means of communication in the majority of the world's languages. Nihalani, (1995) and Allana, (2009) discuss that there are ten vowel sounds in Sindhi. The current study elaborates that Kachchi (one of the dialects of Sindhi) also has ten pure vowel sounds.

The paper aims to analyze five parameters of Kachchi vowels i.e. F1, F2, F3, F0 and durational values. The first two formants require two main articulators i.e. tongue and lip (Ladefoged, 1993; Pfitzinger, 2003). The F1 is related to tongue height while F2 is related to tongue back-ness and lip rounding (Raphael, 2006). The first two formants are necessarily required for speech analysis while the other formants i.e. F3, F4, and F5 are required for speech recognition and synthesis (Parson, 1987) and therefore the current study has not focused on F3 in the result section. In adult male speakers, formants are described concerning their ranges, for instance, F1 ranges between 200-800 Hz, F2 ranges between 600-2800 Hz, and F3 ranges

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between 1300-3400 Hz (Parson, 1987). The vocal tract of females is smaller in size as compared to males due to which their formant frequencies are higher than males (Abbasi, Pathan, & Channa, 2018; Abbasi & Channa 2020). Parson (1987) states that males' vocal tract is about 17cm long. He further says that the variation of frequencies from person to person is due to the size of the vocal tract. According to many phoneticians, the first two formants (F1 and F2) are measured to acoustically quantify vowel quality. The present study aims to measure the first two formants of Kachchi vowels to determine the distinction of formant frequencies among male and female Kachchi speakers.

Furthermore, fundamental frequency (F0) is significant for distinguishing primarily stressed vowels from other vowels (Gordon, 2004). The fundamental frequency (F0) is the number of cycles completed by the vocal folds within one second (Ogden, 2009). According to Abbasi, et. al (2018), the average value of F0 for men is 120 Hz and for women 220 Hz, and for children of around age ten years, it is 336 Hz. They further add that different size of the vocal tract leads to variation in resonance frequency. Moreover, to establish an accurate vowel plot, Ladefoged (2001) recommended calculating the average values of formants.

Therefore, the study measures the average for each formant for appropriate plotting of vowels. Additionally, Keerio (2014) analyzed ten Sindhi vowel sounds acoustically and the study focused on all the dialects of Sindhi with the exception of Kachchi. The study measured six parameters of Sindhi vowel sounds i.e. F0, F1, F2, F3, F4, and duration and classified /ɪ/, /ʊ/, and /ə/ of Sindhi vowel system as short vowels and /i/, /u/, /a/, /æ/, /ɔ/, /o/, and /e/ as long vowels as shown in Table. 1.

Table. 1. Duration of Sindhi vowel (Keerio et al., 2014)

IPA Symbol	/i/	/ɪ/	/e/	/ɛ/	/ə/	/ɑ/	/ɔ/	/o/	/ʊ/	/u/
Sindhi Symbol	اِي	اِ	اي	ايَ	اَ	آ	اوَ	او	ا	او
Duration in ms	344	169	370	358	194	334	304	390	181	367

Furthermore, Hindi, Urdu, Punjabi, Kachchi, Sindhi, Dogri, Gojri, and Lahndi are the Indo-Aryan languages which have more long vowels than short vowels (Pandey, 2010). Moreover, Kachchi is distinct from other dialects of Sindhi because of geographical and cultural differences. Sindhi and its dialects are distinct from other Indo-Aryan languages because of the

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presence of implosives. Sindhi has four implosives i.e. bilabial, retroflex, palatal, and velar implosives (/ɓ/, /ɗ/, /ɠ/, and /ʄ/) while its dialect Kachchi has only two implosives i.e. bilabial /ɓ/ and alveolar /ɗ/ (Pandey, 2010). However, Cole (2006) discussed that Kachchi has all four implosives as Sindhi i.e., /ɓ/, /ɗ/, /ɠ/, and /ʄ/ as cited by Heritage Voices: Language - Kachchi.

Research Queries

- How do the first two formant frequencies differ between male and female in Kachchi/Sindhi vowel sounds?
- How do vowel durational values differ in Kachchi/Sindhi vowel sounds between opposite genders when uttered by Kachchi speakers?

Hypothesis

- If Kachchi/Sindhi vowels are uttered by opposite genders, the values of the first two formant frequencies will be distinguishable between them.
- If Kachchi/Sindhi vowel sounds are uttered by opposite genders, then their durational values will differ.

Methods and Procedures

Speakers

The participants were selected for this study, they belonged to Karachi, Sindh. All the participants were native Kachchi speakers. Two of the participants belonged to the Kachch region of Gujarat, India. The ages of the participants ranged from 25 to 80. A total of ten native Kachchi speakers recorded their voice samples. There were five male and five female speakers. The recordings were done without any background noise.

Recordings

Ten voice samples were recorded by ten Kachchi speakers via mobile *iPhone X's* recorder and were analyzed on *Praat Speech Processing Tool.* Five parameters of each vowel sound were measured i.e. F0, F1, F2, F3, and duration. After the recording of 300 voice samples was performed, the samples were then converted to MP3 audio from an MP3 audio converter on Google to analyze them on Praat. The recorded voice samples were put into Praat then the 'View and Edit' option was clicked to get the spectrograph of the token sound sample. Then the token Kachchi vowel sound was selected to be analyzed. Then the F1 formant was measured by using the F1 key on the keyboard for accurate measurement. Similarly, F2 and F3 were measured by using F2 and F3 keys. The duration of the vowel was measured manually by

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selecting the target vowel sound. The duration that appeared on the software was in seconds but then it was converted into milliseconds as per its standard of measurement.

Data Collection Procedure

The experiment is based on 300 voice samples of ten Kachchi vowels i.e. /iː/, /ɑ/, /ɔ/, /u/, /e/, /ɛ/, /o/, /ɪ/, /ə/, and /ʊ/. Ten words were selected for sampling. All the selected words were disyllabic. The speakers were seated in a room with no background noise to get the best sound results. The speakers were asked to say each word thrice in isolation. All the words, uttered by one speaker, were recorded in one recording. After recording one word thrice the recorder was paused and then a new word was recorded. The words selected for the experiment are shown in Table. 2.

Table 2. Kachchi words used in the study

Kachchi Vowel	Kachchi Word	English Glossary
/iː/	/kʰiːrə/	Milk
/ɑ/	/vɑrə/	Hair
/ɔ/	/ɓɔʈi/	Piece of meat
/u/	/kurɔ/	Liar
/e/	/kerə/	Who
/ɛ/	/mɛlo/	Dirty
/o/	/doɣo/	Yogurt
/ɪ/	/vɪnə/	Go
/ə/	/kədə/	Height
/ʊ/	/pʰʊlə/	Flower

Results

The results of the examined Kachchi vowel sounds show the durational values and vowel quality (F1 and F2) of Kachchi vocalic sounds. Furthermore, the durational value of two stop consonants was also analyzed. The examined vowels were at the initial syllable position. The short and long vowels were also examined statistically.

Vowel Duration

The durational values of vowels allow us to classify them either as short or long vowels. Phonologically, Kachchi vowels are classified into three groups, pairing long (tense) and short (lax) vowels i.e. (i) /iː/ and /ɪ/ (ii) /uː/ and /ʊ/ and (iii) /ɑ/ and /ə/. The durational values for all

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ten vowels were measured using *Praat Speech Processing Tool*. The token vowel sound was selected from start to end on the spectrogram and the duration was measured visually, displayed by Praat at the bottom of the spectrogram. The durational values were generated by Praat in seconds which were then converted to milliseconds to achieve precise values. Since each word was uttered thrice, the duration was also measured three times and then the average was taken to achieve appropriate measurement. The mean durational values of all the vowels are shown in Table. 3.

Table 3. Mean durational values of Kachchi vowels

Kachchi vowel	/i:/	/ɑ/	/ɔ/	/u/	/e/	/ɛ/	/o/	/ɪ/	/ə/	/ʊ/
Duration (ms)	224	219	113	140	215	134	147	67	62	56

The statistical results of the experiment reveal that the mean durational value of females for short vowels is 60 milliseconds while for males it is 64 milliseconds, whereas for long vowels the mean value for females is 190 milliseconds and for males, it is 198 milliseconds. The variability was observed in values for each individual for both tense and lax vowels. The mean value for short vowels is 62 milliseconds while for long vowels it is 194 milliseconds. The mean durational value for short vowels is illustrated in Figure. 1. Figure. 2 illustrates the mean durational value for long vowels.

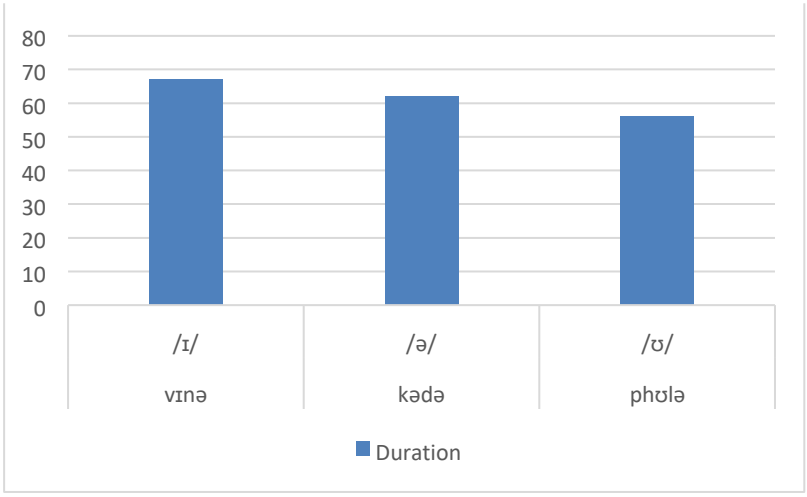

Figure. 1. Mean durational value of short vowels

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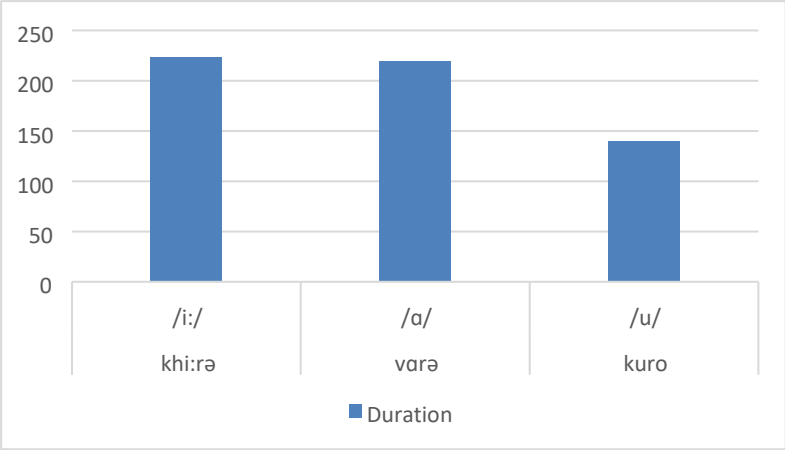

Figure. 2. Mean durational values of long vowels

The analyzed data was observed which revealed that the duration values for vowels were longer in male than female in all the vowels except for two vowels i.e. /u/ and /ɛ/ as shown in Figure. 3.

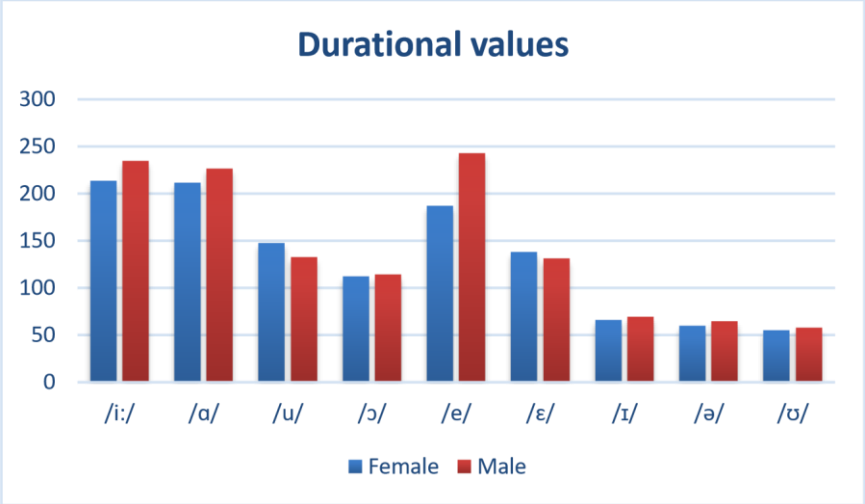

Figure. 3. Vowel duration for male and female

Fundamental Frequency (F0)

Fundamental frequency (F0) of a sound is related to the pitch. The data collected reveal the differences in F0 values between both male and female. The range of F0 of all the vowels was similar among the same gender. The mean value of F0 for all the Kachchi vowels in illustrated in Figure. 4.

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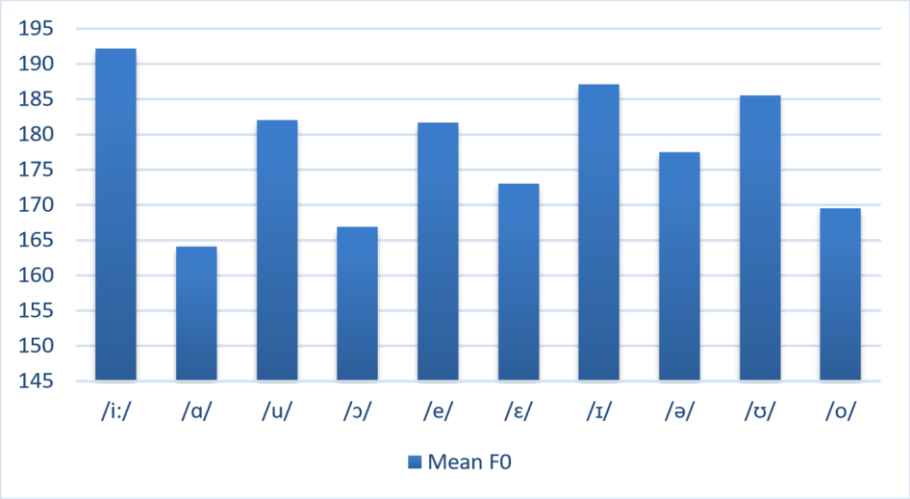

Figure. 4. Mean value of F0 across speakers

The value of F0 was relatively higher among female speakers than males. Figure. 5 illustrates the mean F0 value for female and Figure. 6 represents the mean F0 value among male speakers.

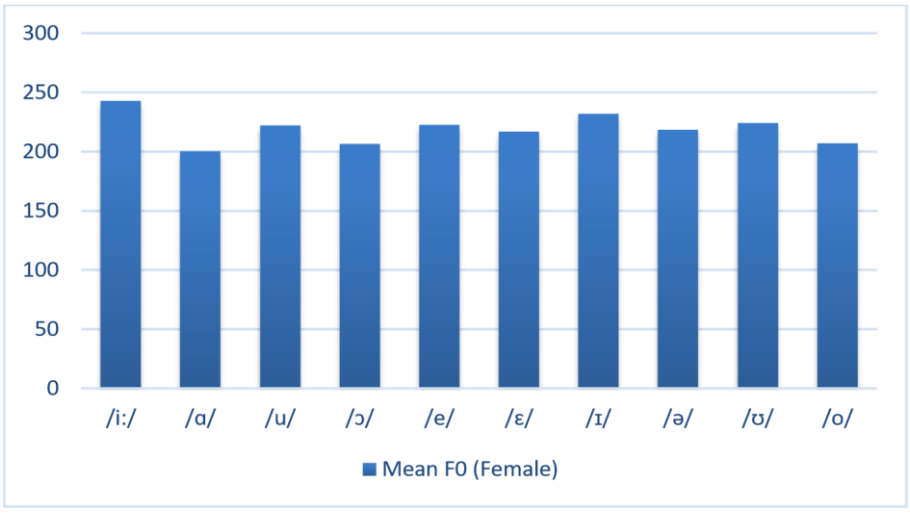

Figure. 5. Mean F0 value among female speakers

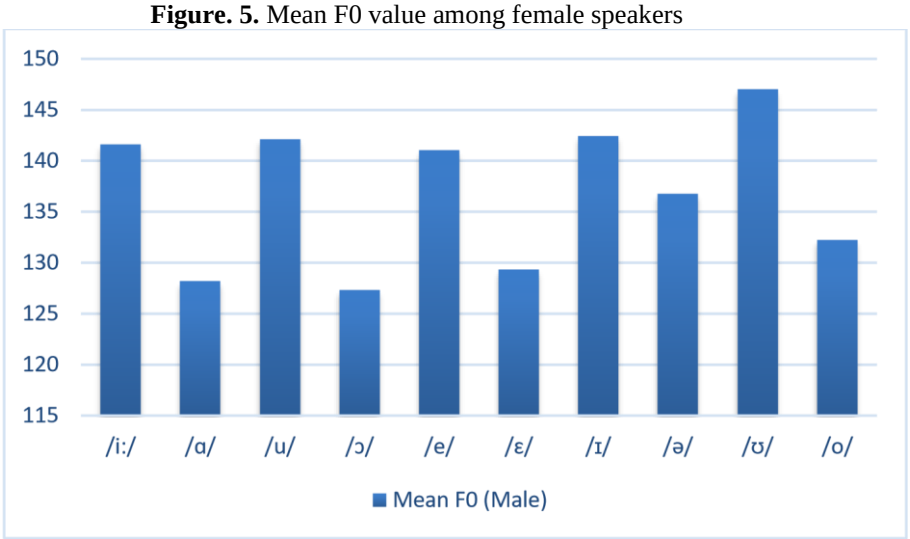

Figure. 6. Mean F0 value among male speakers

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The results reveal that male speakers' average F0 value for all the Kachchi vowels ranged between 120 to 150 Hz while the among female speakers the value ranged between 190 to 250 Hz. The average F0 value of female speakers for long vowels is 222 Hz while for short vowels the average value is 225 Hz. The male speaker's mean F0 for long vowels is 137 Hz and for long vowels, the mean value is 142 Hz. The results are further shown that the mean value of F0 of long and short vowels differs by 3 Hz among female speakers and by 5 Hz among male speakers. To summarize, the F0 value is higher among female than male speakers. Furthermore, the value of F0 is higher for short vowels than for long vowels.

Vowel Quality (F1 and F2)

All voiced sounds of a language have formants but they are relatively strong in vocalic sounds (Moore, 2003). The first formant is concerned with the height of the tongue and lip rounding such that the higher the F1 value the lower the tongue will be and vice versa. The second formant is concerned with the back-ness of the tongue such that the higher the F2 value the more forward the tongue will be and vice versa while lips are either spread or in a neutral position. The acoustic-phonetic vowel plot of the first two formants of Kachchi vowels is not present in the literature. The present study has acoustically analyzed the Kachchi vowels and has plotted the vowels as illustrated in Figure. 7.

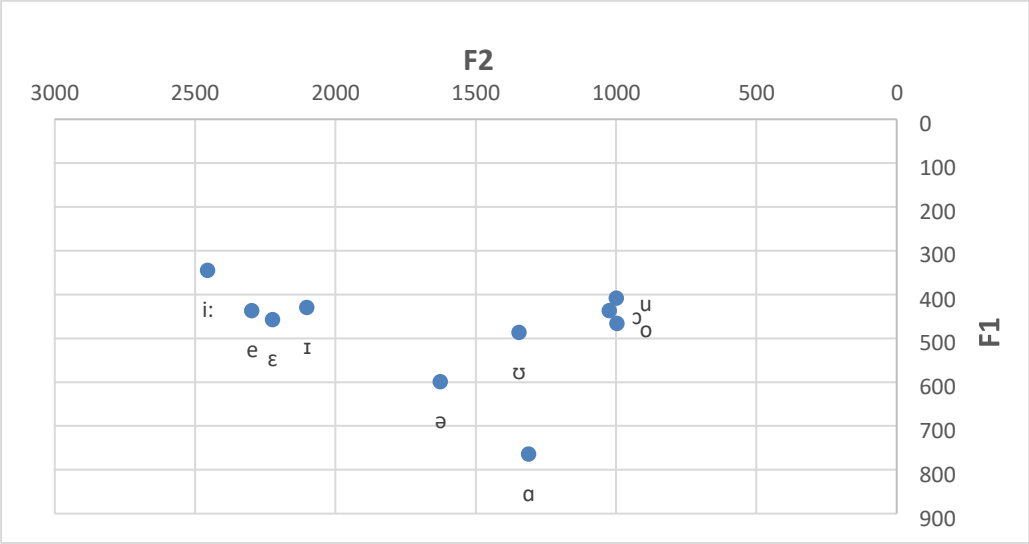

Figure. 7. Vowel space of Kachchi vowels

Figure. 7 illustrates the vowel plot of Kachchi vowels uttered by the ten adult native Kachchi speakers. The four corner vowels of Kachchi can be seen in Figure. 7 initiating from

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/i:/ (high, front vowel) to /ɛ/ (low, front vowel), then from /ɛ/ to /ɑ/ (low, back vowel), then from /ɑ/ to /u/ (high, back vowel), and then lastly from /ɑ/ to /i:/ and the remaining vowels lie between these four corner vowels. The clear vowel quality is observed in the mid-central vowel /ə/, high back vowel /ʊ/, and low back vowel /ɑ/.

Furthermore, the distinction in vowel quality is also observed among different genders. The average values of F1 and F2 are relatively high for females as compared to male speakers. Figure. 8 shows average F1 and F2 values for all the vowels uttered by female speakers. The average values of F1 and F2 for all the Kachchi vowels uttered by male speakers as illustrated in Figure. 9.

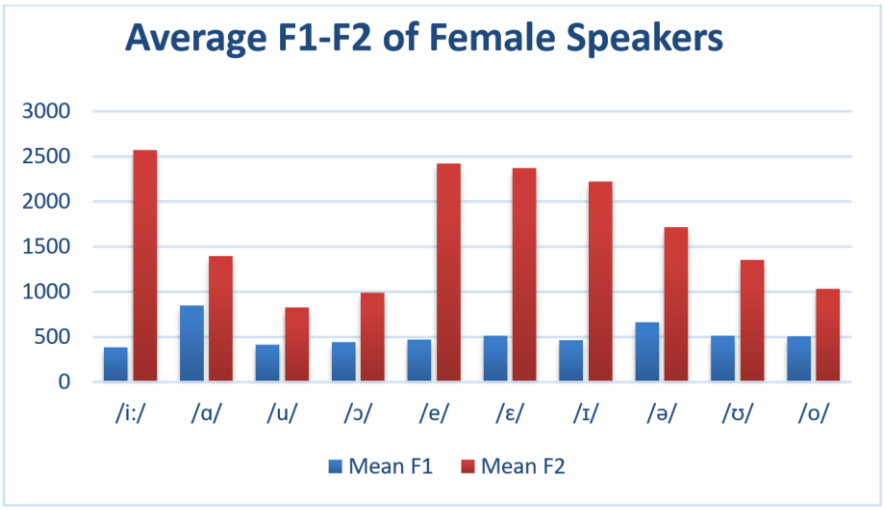

Figure. 8. Average values of F1 and F2 of Kachchi vowels

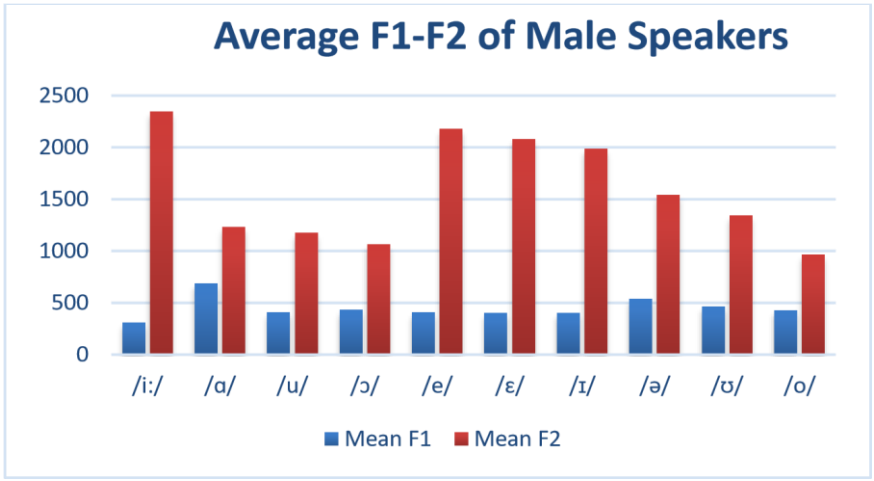

Figure. 9. Average values of F1 and F2 of Kachchi vowels

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The mean values of F1 and F2 of ten Kachchi vowels are illustrated in Table. 4.

Table.4. Mean values of F1 and F2 of ten Kachchi vowels

Kachchi word	Kachchi vowel	F1 (Hz)	F2(Hz)
kʰiːrə	/iː/	344.412	2454.88
vɑrə	/ɑ/	763.943	1311.539
kurɔ	/u/	407.895	998.639
ɓɔʈi	/ɔ/	436.359	1024.307
kerə	/e/	436.639	2297.595
mɛlo	/ɛ/	456.996	2223.834
vɪnə	/ɪ/	429.319	2101.338
kədə	/ə/	598.578	1625.621
pʰʊlə	/ʊ/	486.124	1345.53
doɣo	/o/	466.203	996.454

Stop Closure

There were two stop consonants in the study, occurring in the first syllable of the word i.e. alveolar and glottal stop. The stop closure was measured in milliseconds from the beginning of the release of the burst to the beginning of the preceding vowel. The mean value of stop closure of /k/ was 36 milliseconds and of /d/ was 93 milliseconds. The difference in duration between male and female speakers was also observed. The durational value of stop consonants of male speakers was longer than the female speakers. Figure. 10 illustrates mean of stop closures /k/ and /d/ across all speakers.

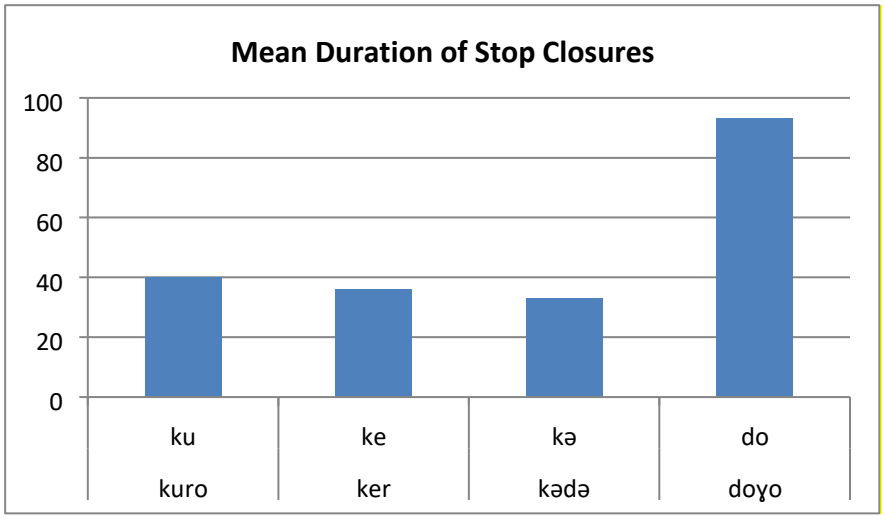

Figure. 10. Mean of stop closures across all speakers

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Discussion

The results show that the difference in durational values between male and female is evident but this distinction is greater in long vowels than the short vowels. The durational value of vowels is longer among male speakers than females, which indicates that Kachchi female speakers have faster utterances than male speakers which resulted in a longer durational value among male speakers. The interesting factor here is that most of the previous studies have found a lower durational value of vowels among male speakers. Byrd (1994) discovered that males' utterance duration is 6.2% lower than females. Ericsdotter and Ericsson (2001) found that in Swedish, males have a longer durational value of vowels than females in unstressed words. Furthermore, the study also found that female had higher F0 value of vowels than male. Males have thicker and longer vocal folds (Kahane, 1978) which lead to a lower F0 value (Pépiot, 2014). Females require a higher F0 value to achieve the same pitch results as males (Pépiot, 2014). The study also found four corner vowels of Kachchi i.e. /i:/, /ɛ/, /ɑ/, and /u/. The findings show that females had a higher resonant frequency of vowels than males. The durational value of vowels after velar /k/ was lower as compared to the vowel after alveolar /d/ on account of voiceless and voiced consonants.

Conclusion

The present study examined the acoustic realizations of ten Kachchi vowels. The study analyzed fundamental frequency (F0), average duration, and the first three formant frequencies of Kachchi vowels. The average durational values classified the Kachchi vowels as short and long vowels. The findings of the study reveal that the durational values of vowels were greater in male than female, concluding that Kachchi male speakers have a lower utterance rate than female. Secondly, the first-ever Kachchi vowel space plot has been designed through the F1-F2 values. This foundational study will assist in further research on Kachchi.

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Appendix-A

Word	Vowel	Speaker	F1 (Hz)	F2 (Hz)	F3 (Hz)	F0 (Hz)	Duration (ms)
kʰi:rə	/i:/	Female 1	347.487	2634.97	2957.77	278.436	153.242
		Female 2	351.221	2175.77	2872.24	218.507	203.441
		Female 3	422.931	2692.43	3072.27	269.259	252.229
		Female 4	385.008	2690.25	3194.48	241.043	170.647
		Female 5	395.37	2626.64	3289.71	206.503	285.65
		Male 1	290.726	2553.35	3191.8	109.253	281.389
		Male 2	282.424	2293.84	2793.76	131.451	215.239
		Male 3	325.385	2331.99	3084.56	155.873	210.154

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		Male 4	313.415	2283.81	2943.67	149.804	247.399
		Male 5	330.155	2265.74	2718.68	161.556	218.714
		Average	344.412	2454.88	3011.9	192.169	223.81
vɑrə	/ɑ/	Female 1	851.653	1376.29	2816.33	225.25	218.102
		Female 2	801.419	1509.91	2663.79	207.683	150.569
		Female 3	734.41	1422.17	2614.22	182.511	252.009
		Female 4	923.085	1358.84	2562.17	198.09	141.172
		Female 5	910.054	1309.05	2756.68	186.17	294.406
		Male 1	728.338	1362.79	2695.83	105.549	238.372
		Male 2	670.546	1169.63	2578.47	113.731	143.27
		Male 3	623.934	1117.8	2353.92	131.279	199.2
		Male 4	685.803	1274.34	2400.53	138.836	323.383
		Male 5	710.189	1214.58	2360.38	151.349	228.744
		Average	763.943	1311.54	2580.23	164.045	218.923
ɓəʈi	/ə/	Female 1	500.211	1044.96	2597.62	237.895	113.328
		Female 2	454.481	999.34	2994.01	231.716	95.859
		Female 3	396.52	943.818	2855.03	180.978	131.555
		Female 4	408.636	1006.97	3081.65	200.482	107.973
		Female 5	452.564	941.154	3031.11	180.879	111.36
		Male 1	443.349	1127.68	2691.43	103.863	122.259
		Male 2	398.771	1425.44	2826.78	115.644	117.326
		Male 3	414.221	926.787	2556.05	141.398	91.439
		Male 4	456.462	922.11	2844.5	132.443	129.641
		Male 5	438.374	904.824	2365.81	143.116	108.779
		Average	436.359	1024.31	2784.4	166.841	112.952
kurə	/u/	Female 1	460.52	794.841	2733.67	266.802	143.304
		Female 2	385.307	923.435	2837.62	183.5	165.971
		Female 3	387.499	738.262	2758.57	213.044	193.17
		Female 4	390.293	817.246	2897.46	223.977	119.763
		Female 5	435.806	849.21	3334.33	222.472	115.191
		Male 1	320.11	841.97	2524.73	102.484	175.302

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		Male 2	638.899	2549.61	3194.76	126.653	116.887
		Male 3	363.487	716.197	2550.73	168.824	93.898
		Male 4	356.864	842.458	2699.02	145.415	151.608
		Male 5	340.166	913.155	2320.99	167.188	124.208
		Average	407.895	998.638	2785.19	182.036	139.93
kerə	/e/	Female 1	528.009	2452.79	2871.84	244.391	184.111
		Female 2	461.856	1903.96	2712.33	196.462	202.95
		Female 3	430.194	2667.24	3107.25	214.645	171.522
		Female 4	445.441	2345.48	2898.23	223.332	224.013
		Female 5	475.206	2729.41	2983.44	232.6	152.675
		Male 1	391.924	2300.39	2903.58	98.021	209.263
		Male 2	363.86	2165.09	2633.84	134.607	223.557
		Male 3	429.026	2080.63	2585.94	160.196	195.228
		Male 4	413.719	2236.25	2494.92	148.248	342.108
		Male 5	427.156	2094.7	2577.29	163.88	244.559
		Average	436.639	2297.59	2776.87	181.638	214.999
mɛlo	/ɛ/	Female 1	501.769	2292.95	2673.4	219.256	127.221
		Female 2	601.363	1996.24	2791.98	235.47	147.019
		Female 3	444.054	2466.18	2994.33	213.617	161.53
		Female 4	499.868	2340.16	2916.5	213.273	114.799
		Female 5	519.353	2747.19	3239.48	201.906	139.816
		Male 1	386.488	2302.77	3012.66	104.198	171.421
		Male 2	336.717	1982.65	2438.81	121.007	136.115
		Male 3	408.606	2010.42	2519.38	142.994	103.257
		Male 4	423.172	2090.54	2644	128.136	127.48
		Male 5	448.573	2009.24	2590.52	150.1	116.108
		Average	456.996	2223.83	2782.11	172.996	134.477
doɣɔ	/o/	Female 1	513.574	1020.19	2837.24	230.831	110.034

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		Female 2	559.081	1169.09	3081.17	167.017	132.88
		Female 3	573.087	1011.16	2977.41	204.555	143.767
		Female 4	430.321	1017.27	2779.06	211.194	134.035
		Female 5	453.126	925.736	3158.35	220.19	113.192
		Male 1	428.489	1030.67	2734.04	100.071	222.2
		Male 2	393.03	842.513	2799.7	121.713	137.087
		Male 3	429.265	947.934	2459.71	147.277	144.165
		Male 4	432.5	981.98	2794.4	138.509	173.48
		Male 5	449.552	1018	2407.93	153.491	154.682
		Average	466.203	996.454	2802.9	169.485	146.552
vɪnə	ɪ/	Female 1	488.275	2126.19	2684.87	252.839	53.289
		Female 2	404.71	1811.29	2632.8	228.839	58.61
		Female 3	417.335	2638.33	3156.9	209.265	55.962
		Female 4	462.486	2186.77	2995.98	233.548	79.428
		Female 5	528.738	2320.48	3101.12	234.023	80.945
		Male 1	373.295	2182.69	2872.29	114.894	47.667
		Male 2	353.825	1896.84	2458.55	125.621	59.94
		Male 3	413.765	1981.21	2486.39	159.949	62.447
		Male 4	411.911	1929.9	2410.53	139.918	81.423
		Male 5	438.851	1939.69	2543.98	171.634	92.578
		Average	429.319	2101.34	2734.34	187.053	67.229
kədə	ə/	Female 1	711.261	1798.5	2863.36	257.412	56.232
		Female 2	623.006	1518.14	2768.97	156.134	43.667
		Female 3	644.415	1728.99	2776.34	209.311	68.27
		Female 4	633.952	1804.79	2766.56	227.151	66.563
		Female 5	687.12	1697.53	3156.54	240.559	63.255
		Male 1	560.959	1637.5	2675.45	91.226	45.333
		Male 2	486.368	1536.46	2565.99	124.629	56.005
		Male 3	459.529	1460.93	2485.55	155.485	67.991

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		Male 4	527.401	1532.74	2441.57	151.905	81.755
		Male 5	651.767	1540.64	2342.1	160.527	71.511
		Average	598.578	1625.62	2684.24	177.434	62.058
		Female 1	526.266	1342.94	2722.34	262.003	43.6667
		Female 2	472.638	1216.58	2895.84	202.381	59.861
		Female 3	540.326	1286.56	2756.47	152.272	51.009
		Female 4	485.191	1485.86	2890.96	243.737	54.333
		Female 5	519.825	1418.66	3113.55	259.677	64.327
pʰʊlə	ʊ/	Male 1	463.89	1198.1	2517.97	102.108	47.667
		Male 2	586.953	1879.75	2802.28	126.614	39.667
		Male 3	386.16	1304.86	2494.36	172.919	46.667
		Male 4	457.569	1292.74	2602.56	151.857	77.102
		Male 5	422.418	1029.26	2275.96	181.397	75.807
		Average	486.124	1345.53	2707.23	185.496	56.011