Middle East J Rehabil Health Stud. 2021 April; 8(2):e110556. doi: 10.5812/mejrh.110556.

Published online 2021 April 20. **Research Article**

Investigating Speech Tempo, Speaking Rate, and the Related Factors in the Iranian Elderly Women Talking with Tehrani and Semnani Accents

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Received 2020 October 24; **Revised** 2021 March 28; **Accepted** 2021 April 03.

Abstract

Background: Some variables, such as age, gender, regional and dialectical differences influence speech tempo. Men and younger individuals speak faster than women and the elderly. Therefore, these variations should be considered when assessing speaking rate.

Objectives: Since different accents influence speaking rates and there is no previous study investigated speech tempo with respect to regional and accent differences in Iran, and given that the elderly are more prone to problems influencing speaking rate, the present study was done to compare speech tempo and speaking rate in two different accents, namely Tehrani and Semnani, and to investigate some related factors.

Methods: This cross-sectional study was performed on 200 elderly women selected via convenience sampling method. Speech tempo, speaking rate, verbal fluency, and cognition scores were compared using an independent-samples *t*-test. Pearson's correlation coefficient test was used to assess correlations between speaking rate and level of education, Montreal cognitive assessment (MoCA), and verbal fluency scores.

Results: No significant difference was found in speech tempo between the studied accents ($P = 0.13$). Speaking rate was significantly slower in the Tehrani accent than the Semnani one ($P = 0.04$). The Tehrani elderly obtained significantly less scores in verbal fluency and MoCA (($P \leq 0.001$) and ($P = 0.04$), respectively. In both groups, speaking rate had a significant correlation with verbal fluency and MoCA scores but not with level of education.

Conclusions: Although, our results showed no difference in speech tempo between the studied accents, the Tehrani elderly unexpectedly spoke more slowly meaning that they paused more while speaking. There was a relationship between faster speaking, better verbal fluency, and cognitive performance.

Keywords: Speech, Elderly, Dialect, Iran, Cognition

1. Background

Speech tempo or articulation rate has been sometimes replaced with speaking/speech rate in the literature. Although, both of these concepts are referred to the number of segments produced per unit of time, speech tempo measures speed of articulatory movements and is calculated after excluding non-fluencies, such as silent pauses and fillers like "mmm" (1). Hesitations, pauses, and affective expressions influence speaking rate but not speech tempo. One would speak fast when he/she is excited or talk slowly while being fatigued (2) and long pauses are related to cognitive processes and word retrieval while short ones are due to breathing and articulation (3).

Studies have shown that the elderly talk more slowly than young or middle-aged individuals (4, 5). This decline in speaking rate is related to their function of cognition and articulation (6, 7). Neurological and mood disorders in the elderly also influence speaking rate. For example, rate problems have been reported in the patients with ataxic or hyperkinetic dysarthria (8) and Alzheimer's disease leading to problems in word finding and reducing narrative skills (9). Depression also causes a slower speaking rate and more frequent pauses (10).

On the other hand, speech tempo is related to some within-speaker variables, such as emotional state, complexity of utterance, formality, talking over a long distance, and also some between-speaker variables including age,

gender, level of education, job, socio-economic status, geographical differences, and dialects (1, 11, 12). Therefore, natural reduction in speech tempo in the elderly may be the result of needing more processing time, slow neuromuscular function, psycho-social differences, and a significant reduction in control of fine oral-motor movements (13). It can also be due to different styles of speaking in the elderly, such as speaking more formally (14). Many studies have compared speech tempo between languages and have reported different rates based on length of words and phrases, but it seems that such differences exist between different accents of the same language as well (15). The effect of regional differences on speech tempo could be the result of cultural differences, but this effect has not been well understood yet (2).

Jacewicz et al., reported that vowel duration varied across three different American regional dialects, and slower speaking rate in females could be justified by prolongation of vowels in these dialects (16). Variation in speech tempo has been also studied among other languages' dialects, such as the Dutch language (15, 17). Iran is a vast country with various languages and accents. Limited studies have investigated speaking rate/speech tempo in children and adults (18-21), but no study has assessed speech tempo with respect to geographical and accent differences. This variable can influence norms and speech therapists' judgment while assessing speech tempo under pathologic conditions. Many believe that the inhabitants of Semnan, a city in center of Iran, have a slower speech tempo while talking in Farsi than the individuals living in Tehran, capital of Iran. Although, we found no information about acoustic phonetics of the Semnani accent, people would say this accent has a slower speech tempo than Tehrani one when they are asked, maybe as a result of more stress on expressing words and sometimes vowel prolongations in the Semnani accent. But, this is just a perceptual claim about the rate, which needs to be assessed objectively.

2. Objectives

Accordingly, this research is designed to study the effect of accents on speech tempo and speaking rate in healthy Persian elderly women talking with Semnani and Tehrani accents and to investigate the relationship between speaking rate and some between-speaker variables. This study also presents preliminary norms for speech tempo in the elderly with Semnani and Tehrani accents.

3. Methods

3.1. Participants

This cross-sectional study was done on 200 elderly women aged over 60 years old and selected through convenience sampling method. The participants were selected from individuals present in public places including mosques, libraries, and parks, and 200 eligible participants from Semnan and east of Tehran were included in the study. Inclusion criteria included being female, native speaker, having over 60 years of age, being right-handed, not being handicapped, having independence in performing daily activities and personal affairs, being literate, having normal cognition, not having a voice, fluency, and speech sound disorder, having no history of psychological or neurological problems, not having severe respiratory or heart disease, not being diabetic, and not being addicted to drugs or alcohol. These criteria were checked based on interviews and self-reports. Exclusion criteria were being reluctant to continue the study and failing in the Montreal cognitive assessment (MoCA). Groups of participants were matched, in terms of age and level of education, and there was no significant difference between age of the participants from Tehran and Semnan with mean ages of 63.74 ± 3.22 and 62.96 ± 3.24 years old, respectively ($P = 0.09$).

3.2. Procedure

The first evaluation was done using the MoCA. If participants were in normal range of cognition in MoCA, then verbal fluency test was performed and finally, a 3-min sample of their spontaneous speech was recorded for further analysis and studying speech tempo and speaking rate. The sample of continuous speech was recorded using a Sony ICD-PX440 voice recorder, held 20 cm away from the participant's mouth. Then, the speech samples were entered into Cool Edit Pro software (2.1) to analyze the first 300 syllables. These 300 syllables did not include the time when the participant wanted to change the title or ask something or answer by a short phrase. For assessing speech tempo, the analyzed sample of speech was used again after removing filled and silent pauses. Pauses less than 250 ms at syntactic boundaries, which are due to breathing, were excluded based on the Goldman-Eisler method (22).

An informed written consent was obtained from all the participants. The study was conducted in 2018, after obtaining ethical approval from the Semnan University of Medical Sciences.

3.3. Instruments

Cognitive status of the participants was assessed by MoCA. This test is used to determine mild cognitive impairment. Its validity has been determined previously by Emsaki et al. (2011) with Cronbach's alpha coefficient of 0.77. A score of 24 has been also specified as the cut-off point for this test (23).

Verbal fluency test was the other evaluation. This test has two parts: (1) phonological fluency, and (2) semantic fluency. Two tasks of fruit and animal naming are used

to evaluate semantic fluency function. In addition, for assessing phonological fluency function, the participants are asked to state words starting with the three phonemes of "F, A, S" separately in one minute. The verbal fluency test used in this study was developed by Ebrahimipour (2014), validity and reliability of which have been also confirmed (24). As mentioned in the test manual, the total score is obtained by adding semantic fluency scores to phonological fluency scores.

3.4. Data Analysis

SPSS software (ver.16) was used for data analysis (SPSS Inc., Chicago, IL, USA). Levene's test and independent-samples *t*-test were used for comparing the data between the two groups. Pearson's correlation coefficient test was used to study the correlation between results of speaking rate and cognitive and verbal fluency in the participants. For comparing demographic data in the participants, the Mann-Whitney U test was employed.

4. Results

Demographic data of the participants are presented in Table 1. The results of independent-samples *t*-test revealed that mean rate of speaking was significantly lower in the elderly women with Tehrani accent than their counterparts with Semnani accent ($P = 0.04$). Conversely, speech tempo was not significantly different ($P = 0.13$) between both groups although, the Tehrani accent was slightly faster. Scores of the MoCA and verbal fluency tests were also significantly higher in the Semnani elderly women [with ($P = 0.04$) and ($P \leq 0.001$), respectively]. The related data are presented in Table 2.

As shown in Table 3, there was a significant positive weak correlation between speaking rate and cognition score in the elderly women with Tehrani ($P = 0.01$, $r = 0.23$) and Semnani accents ($P = 0.03$, $r = 0.21$). There was a significant positive moderate correlation between rate of speaking and verbal fluency test score in the elderly women with Tehrani ($P \leq 0.001$, $r = 0.6$) and Semnani accents ($P \leq 0.001$, $r = 0.49$), but there was no significant correlation between speaking rate and level of education ($P > 0.05$).

5. Discussion

Different accents have different prosodies and also an association has been found between prosody and speech tempo (25, 26). For instance, stress as a prosody component can be used at level of syllables, words, or phrases (27) making different variations in pronunciations. In the present study, speech tempo or articulation rate was relatively slower in the Semnani accent than the Tehrani accent, but the difference was not significant. Clopper et al., in a study on two English-American accents in the central and southern regions of America found no significant difference in speaking rate of young participants, despite the belief that speaking rate of people in the southern regions is slower (28). But, Jacewicz et al., in their study on young and older adults found significant differences in speech tempo between the northern and southern dialects in America (1), which can be justified by segmental differences and variations in prosody patterns, such as distributions of pauses and pitch accents between theses dialects. Verhoeven et al. reported a significant difference in speech tempo in spontaneous speech of two different accents of Dutch spoken in Belgium and Netherlands in young adults and the elderly (15). Robb et al. demonstrated that young New Zealand English speakers had higher speech tempo than the American English speakers and suggested that rate difference between these two accents was attributed to different patterns of vowel production and possible differences in rhythm timing (29).

In the present study, speaking rate was significantly faster in the elderly from Semnan. Since, speaking rate is the sum of speech tempo and time of pauses and as speech tempo was not significantly different between the two groups and even faster in the Tehrani accent, the unexpected slower speaking rate in the Tehrani participants was attributed to their more frequent pauses. Full and silent pauses usually indicate the moment when a person searches for the next word or phrase and has a word finding problem (30). In a previous investigation conducted to study the effect of gender, task, and age on rate of speaking in the elderly talking with Tehrani accent, the reported speaking rate was faster than this study (21). Higher rate observed in that study could be related to small sample size and not eliminating the effect of gender because studies have shown that men speak faster than women (2, 17). Cynthia et al., in their study on two different English accents found no significant difference in speaking rate and mean time of pauses between the two dialects in young participants; however, regional dialect had a significant effect on distribution of pauses and pitch of accents (28). In a study about the New Zealand and American accents, Robb et al. showed that the overall speech and articulation rates were significantly faster in the group with New Zealand accent (29).

In this study, the significant difference found in speaking rate of the participants with accents from two different regions can be explained by significant difference in verbal fluency and cognitive performance of the two groups. Speaking rate had a significant positive relationship with verbal fluency and MoCA scores, i.e., it was faster when verbal fluency and MoCA scores were higher. Verbal fluency is a test used to assess the ability of word retrieval and is sensitive to functional problems of the brain in frontal and temporal lobes (31). Although, all the par-

Table 1. Comparison of Participants' Demographic Data Talking in Tehrani and Semnani Accents [a]

Variables	Economic Status [b]	Education [c]	Working Experience [d]	Stress Level [e]
Tehrani elderly	105.82 (3)	106.49 (2)	103.22 (3)	102.35 (3)
Semnani elderly	95.18 (3)	94.51 (1)	97.78 (3)	98.65 (3)
Z	1.47	1.61	1.24	0.48
P [f]	0.14	0.10	0.21	0.62

[a] Values are expressed as mean rank (mean) unless otherwise indicated.
[b] 1 = excellent; 2 = very good; 3 = good; 4 = bad; 5 = very bad.
[c] 1 = elementary; 2 = guidance school; 3 = high school; 4 = diploma; 5 = graduated.
[d] 1 = full time; 2 = part time; 3 = no job.
[e] 1 = very high; 2 = high; 3 = average; 4 = low; 5 = very low.
[f] Mann-Whitney U test.

Table 2. Comparing Speaking Rate, Speech Tempo, Verbal-Fluency and Cognition in Elderly Women with Tehrani and Semnani Accents [a]

Variables	Speaking Rate [b]	Speech Tempo [b]	Verbal-Fluency	Montreal Cognitive Assessment
Tehrani elderly (N = 100)	3.1 ± 0.34	4.25 ± 0.29	23.62 ± 8.02	25.04 ± 1.39
Semnani elderly (N = 100)	3.19 ± 0.29	4.19 ± 0.3	27.72 ± 7.34	25.48 ± 1.60
t	2.06	1.48	3.77	2.05
P [c]	0.04	0.13	≤ 0.001	0.04

[a] Values are expressed as mean ± SD unless otherwise indicated.
[b] Syllable per second.
[c] Independent *t*-test

Table 3. Correlation Between Speaking Rate and Verbal-Fluency Scores, Cognition and Education

Speaking Rate in Elderly	Verbal-Fluency	Montreal Cognitive Assessment	Education
Semnani (N = 100)			
r	0.49	0.23	0.18
P [a]	≤ 0.001	0.01	0.07
Tehrani (N = 100)			
r	0.6	0.21	0.17
P [a]	≤ 0.001	0.03	0.09

[a] Pearson's correlation coefficient test.

ticipants were within normal range of cognition, mean score of MoCA, and verbal fluency tests was significantly higher in the Semnani elderly women than that of the elderly inhabitants of Tehran. The significant difference found in cognition scores between the two groups could be related to the effect of air pollution and regional differences, as studies have shown that noise and traffic-related air pollution adversely influences cognitive and verbal fluency skills (32, 33). Comparing the fine particle matter (PM2.5) index in Semnan and Tehran cities, (obtained from http://aqms.doe.ir) showed significantly higher air pollution levels in Tehran city over the past year (Z = 9.46 and P ≤ 0.001).

There was no significant relationship between speaking rate and level of education in each group in this study, which was similar to the results reported in the study by Jacewicz and Fox (2). This discrepancy is probably related to the fact that the evaluated task in this study was spontaneous speech, allowing the use of simple words and structures due to being a routine activity. According to Kemper et al., older people use shorter and simpler sentences than younger individuals (34).

One of the limitations in this study was including only female participants and not considering different age ranges of the elderly. Thus, for the future studies, it is recommended to investigate speaking rate and speech tempo in different Iranian accents and to use acoustic analysis in order to study segmental and suprasegmental features.

5.1. Conclusions

Results of the present study showed no significant difference in speech tempo between the elderly women

speaking with Tehrani and Semnani accents, but speaking rate was significantly slower in the Tehrani participants due to producing more non-fluencies. A faster speaking rate was related to better verbal fluency and cognitive performance and Semnani speakers had better cognitive performance and verbal fluency in this study.

Acknowledgments

This study was conducted by Semnan University of Medical Sciences supports. We appreciate Miss Salehinejad and Shahraeini for their help and all elderly who participated in this study.

Footnotes

Authors' Contribution: Study conception, Maryam Mokhlesin and Fatemeh Kasbi; Data collection, Mehran Choobineh, Alireza Ghasemi and Zahra Ahmadizadeh; Data analysis, Maryam Mokhlesin, Zahra Ahmadizadeh; Drafting of the article, Maryam Mokhlesin,Fatemeh Kasbi and Zahra Ahmadizadeh.

Conflict of Interests: There is no conflict of interests.

Ethical Approval: The study was conducted in 2018, after obtaining ethical approval from the Semnan University of Medical Sciences (IR.SEMUMS.REC.1397.016).

Funding/Support: This study is supported by Student Research Committee of Semnan University of Medical Sciences.

Informed Consent: An informed written consent was obtained from all the participants.

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