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Comparison of the Rate of Verbal Oral Movements in Healthy Younger and Older Native Speakers of Persians

Shiva Ebrahimian Dehaghani[1,2], PhD; Atefeh Hoseinzadeh Mofrad[3], BS; Jalal Bakhtiyari[4*], PhD

[1]Department of Speech Therapy, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[2]Rehabilitation Sciences Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Department of Speech and Language Pathologist, School of Rehabilitation Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[4]PhD in Speech and Language Therapy, Department of Speech Therapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran

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ABSTRACT

Background: Normal aging is associated with many changes in speech-producing elements that can influence the articulators' ability to produce sounds quickly and precisely. To diagnose any motor problems in the oral area, obtaining numerical oral motor performance rates in normal individuals is necessary. According to previous studies, quantitative measures of Oral diadochokinesis (DDK) vary across different cultures, languages, and ages. However, little research was conducted in native Persian speakers to evaluate normal DDK in different age groups. Therefore, this study aimed to determine and compare DDK indicators in healthy young and older native Persian speakers.

Methods: In this cross-sectional study, the participants were 105 healthy young and older individuals (56 women and 49 men) with age range from18-40, 60-80, and >80 years. Each subject was asked to repetitively express the syllables 15 times, and the sequence /pataka/ 10 times. Mann–Whitney and independent-sample t-tests were applied to show the differences, respectively between and within age groups.

Results: The significant difference was revealed between young and older groups in performance in all tasks (P=0.00). In younger participants, increasing age correlated significantly with increasing time needed to produce /ta/ (P=0.04) and /ka/ (P=0.01) syllables. Moreover, the rate variation decreased as the point of articulation moved backward in the vocal tract for /ta/ and /ka/ production in both the older (P=0.6) and younger group (P=0.4).

Conclusion: This study's results can also help clinicians document the differences in the articulation rate between older and younger people and diagnose abnormal oral motor rates.

Introduction

Healthy aging is related to slowed speed for gross and fine motor movements [1]. By aging, muscle mass and strength decrease, and movements gradually become less coordinated [1]. Oral diadochokinesis (DDK) reflects the degree of coordination in motor function, and measures of DDK performance can thus illustrate these age-related alterations, including a slowdown in performance [1]. Moreover, alterations in speech expression can be a primary symptom for the early stages of motor speech disorders and nervous system diseases [2]. Consequently, reliable assessments of speech expression are of great clinical significance. Measures of DDK are broadly applied in evaluating the motor speech disorders which can detect abnormalities by recording speech performance changes and categorizing syndromes [3].

*Corresponding author: Jalal Bakhtiyari, PhD in Speech & Language Therapy, Department of Speech Therapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran.
Tel: +98 9123717072
Email: bakhtiyari.slp@gmail.com

To achieve exact clinical data, it is essential to have information on normative performance [1].

In older persons, neurological disorders such as Parkinson's disease, amyotrophic lateral sclerosis, or stroke, and disorders which can appear in younger persons such as multiple sclerosis and traumatic brain injury, may be accompanied by lack of coordination in their speech structures [4-9]. Moreover, because of age-related decreases in oral sensation, we would anticipate a deterioration in the consistency of speech motor movements in older adults compared to younger adults, when the former is required to accelerate their syllable repetition rates in metronome-paced tasks [10]. In this connection, Van Brenk et al. suggested that age-related differences in speed-accuracy interchange can be ruled out [10]. Differences in kinematic features point towards the likelihood that older adults aim to simplify a closed-loop control system to maintain movement stability at slower speech rates [10]. Padovani et al. concluded that the DDK tests could discriminate between young and elderly adults. In both groups, the DDK rates decreased as the statements became more complex [2, 10, 11]. Earlier research has reported changes in articulation and speech rates in healthy individuals across their life span, with the reductions in DDK rates of syllable repetition as adult age [2, 10, 11]. Therefore, it is necessary to obtain numerical oral-motor measures in normal individuals to evaluate and manage motor problems in the oral area.

Based on previous studies, quantitative measures of DDK vary across different cultures, languages, and ages [1, 2, 12, 13]. However, to date little research has focused on the Persian language in normal persons to determine normative DDK rates in different age groups [14]. As noted, valid mean DDK measures for different age ranges are needed to equip clinicians with appropriate tools that allow them to assess motor speech disorders by observing DDK variations during therapy sessions. Therefore, this study aimed to determine and compare DDK indicators in healthy young and older individuals who were native speakers of Persian.

Methods

Samples

The participants in this cross-sectional study were 105 healthy young and older individuals (56 women and 49 men) in Shiraz city. The inclusion criterion for our study was age within the following ranges: 18-40, 60-80, and >80 years. Individuals were excluded if they had diabetes, chronic sinusitis, taste or swallowing disorders, neurological problems, cognitive impairments, or alertness problems, if they were using medications which affect saliva production, if they reported alcohol consumption more than 2 days per week, if they had a history of smoking in the 2 years prior to the study, or if there were potential problems with the assessment of oral performance. Oral performance was assessed by a speech and language pathologist who was an expert in the evaluation and was trained in how to perform assessments. We obtained informed consent from our participants before the study. This study was funded by Shiraz University of Medical Sciences. Ethical approval was issued under ID number IR.SUMS.IREC.1396.s540.

Methods

To perform the test, each participant was instructed to repetitively produce the syllables /pa/, /ta/, and /ka/ 15 times and the sequence /pataka/ 10 times, as quickly as they could with safe pitch and loudness. The examiner recorded the time needed for each task. Then they were trained to produce the syllables /pa/, /ta/, /ka/, and the sequence /pataka/ as quickly as they could in 5 seconds, and the examiner recorded the number of syllables expressed in each task.

Speech samples were recorded with a Sony ICD–AX412F digital voice recorder emplaced on a stand at a 45-degree angle 15 cm from the participant's mouth in a silent room. The examiner listened to all records and recorded the times and numbers of each syllables for further analysis.

Statistical Analysis

The normality of data was tested with the Shapiro–Wilk test. Descriptive statistics were used to provide a concise summary of data. Mann–Whitney and independent-sample t- tests were applied, respectively to determine the differences among age groups and within each age group.

The data were analyzed with the Statistical Package for Social Sciences (SPSS, Inc., Chicago IL, USA, version 16). The level of significance was set at <0.05.

Results

The participants in the present study were 45 older people with a mean age of 65.89 years (SD 6.37) and 60 young people with a mean age of 27.62 years (SD 5.77). Mean education was 15.37 years (SD 1.83) in the young group and 11.26 years (SD 4.68) in the older group. Normative data from our DDK assessments of oral motor function are presented for 5-year age subgroups in older (Table 1) and young participants (Table 2).

The results showed a significant correlation in young people between increasing age and the time needed (speed) for DDK /ta/ (P=0.04) and /ka/ (P=0.01) production. There was no significant correlation between increasing age and speed of DDK production for the syllables /pa/ (P=0.5) or /pataka/ (P=0.2).

In the older group, comparisons between 60-69 and 79-70 year old subgroups disclosed no significant relationship between increasing age and time (speed) required for DDK production in the /pa/ (P=0.8/), /ta/ (P=0.6), /ka/ (P=0.5) and /pataka/ (P=0.8) tasks. Comparisons between the 60-69 and 80 years or older subgroups showed a significant relationship between increasing age and the time required for the /pataka/ task (P=0/02): by increasing age, DDK rate decreased for /pataka/ production. There was no significant relationship between increased age and DDK rate for the other syllables [/pa/ (P=0.5), /ta/ (P=0.9), /ka/ (P=0.1)].

Comparisons between the two oldest subgroups (70-79 and 80 years or older) showed a significant relationship

Table 1: Diadochokinesis rates in the older age group. (Mean±SD)

	/pa/ Repetitions in 5 s	/ta/ Repetitions in 5 s	/ka/ Repetitions in 5 s	/pataka/ Repetitions in 5 s	Time for 15 repetitions / pa/	Time for 15 repetitions/ta/	Time for 15 repetitions/ka/	Time for 10 repetitions / pataka/
60-65	22.5±3.8	22.5±4.9	21.9±5	10.1±2.4	3.7±0.6	3.7±0.7	3.8±0.9	5.4±1.6
66-70	21.5±6.5	20.3±5.8	20.2±5.8	11±3.8	4.1±0.7	4.4±1.1	4.6±1.2	5.5±1.4
71-75	22.5±2.5	23±2.9	24±3.5	10.3±1.2	3.2±0.4	3.4±0.3	3.1±0.5	5.1±1.1
76-80	23±5	22±4.3	22.3±3	10±2.6	3.6±1.0	3.9±1.2	3.7±1.4	4.8±2.3
81-85	22	18	23	6	3.8	5.0	3.6	11.9

Table 2: Diadochokinesis rates in the younger group. (Mean±SD)

	/pa/ Repetitions in 5 s	/ta/ Repetitions in 5 s	/ka/ Repetitions in 5 s	/pataka/ Repetitions in 5 s	Time for 15 repetitions /pa/	Time for 15 repetitions /ta/	Time for 15 repetitions / ka/	Time for 10 repetitions / pataka/
21-25	38.5±9.5	38.5±10.6	34.1±9.7	13.6±2.3	2.4±0.4	2.4±0.4	2.5±0.3	4.3±0.7
26-30	36.4±8	34.5±8.1	30.6±8	12.2±1.3	2.7±0.5	2.5±0.4	2.5±0.3	3.9±0.6
31-36	35±8.1	34.8±7	31.8±7.1	12.6±2	2.8±0.2	2.8±0.5	2.7±0.4	4.5±0.6
36-40	29.78±10.2	30.5±11.8	28.5±10.1	10.8±2	3.3±0.9	3.2±0.8	3.3±0.8	5.1±1.6

between increasing age and the time required to produce the /pataka/ syllable (P=0.01): by increasing age, the DDK rate decreased. However, there was no significant relationship between increased age and DDK rate for any of the other syllables [/pa/ (P=0.5), /ta/ (P=0.7), /ka/ (P=0.1)].

The two age groups significantly differed in the DDK rate, with young people vocalizing more rapidly than older people in all tasks.

In both young and older groups the rate of vocalization decreased when the point of articulation was further back in the vocal tract, e.g. DDK rate for /ta/ and /ka/ production in the older (P=0.6) and young group (P=0.4).

There was no significant relationship between gender and DDK rate in the older group [/pa/ (P=0.5), /ta/ (P=0.8), /ka/ (P=0.4), /pataka/ (P=0.2)] or the young group [(/pa/ (P=0.3), /ta/ (P=0.8), /ka/ (P=0.1), /pataka/ (P=0.1)].

Discussion

In neurological disorders which affect speech, the evaluation of oral movements is essential, together with verified normative values of oral movements in young and old people for every language and culture. The present study was designed to provide quantitative information about the DKK status in young and older native speakers of Persian, and compare the DDK findings in these two age groups. The results showed significant differences in task performance between age groups, with young people vocalizing faster than older people in all tasks. Our comparison of the first two older age subgroups (60-69 and 70-79 years) detected no significant relationship between increasing age and the time (speed) required for DDK tasks. However, comparisons between 60-69 and 80 years or older subgroups, and between 70-79 and 80 years or older subgroups, showed a significant relationship between increasing age and the time required to produce the /pataka/ task: with increasing age, DDK rate decreased. In contrast, there was no significant relationship between increasing age and DDK rate for the other syllables tested here. These findings contradict the results of Pierce et al., who found that the main effect for age was not statistically significant for any task [15]. The present findings also contrast with the results of Kikutani et al., who compared DDK rates across older age groups (65-69, 70-74, 75-79, 80+ years). Although they reported significant differences in alternating motion rate (AMR(with age (P<0.05), the relationship was not direct given that it was observed only for /ta/ (P=0.016) and /ka/ (P=0.004) in people with full, normal dentition [16]. Furthermore, these results suggest that age differences of 10 years in older people are not associated with changes in the DKK ability to repeat single syllables, but may be reflected as differences in the rate of producing three syllables – i.e., a more complex movement. Findings such as these are evidence of the different nature of individual and complex movements [17].

Another main result of the present study was that in both young and older groups, the vocalization rate decreased when the point of articulation was further back in the vocal tract, as in /ta/ and /ka/ production. Earlier research suggested that the vocalization rate decreases in both young and older people as the point of articulation recedes. A study by Kianfar and colleagues on the rate of alternative and sequential movements to produce syllables in Persian speakers aged 60-80 years showed that as the syllables were produced further back in the mouth, the repetition rate decreased [18]. Devadiga and Bhat also observed that as syllable production moved from anterior to posterior, the average DDK rate decreased [19]. These findings can be ascribed to the greater effort needed to produce the sounds and the larger number of muscles involved as the articulatory position shifts from anterior to posterior. For example, the effort needed to produce labial phonemes may be less, followed by tongue-tip phonemes, whereas syllable production with the back of the tongue requires more effort. Devadiga and Bhat, citing a 1998 study by Prathanee, noted that for bilabial articulation, only the orbicular muscles are involved, whereas, for other phonemes requiring the tongue tip and back of the tongue, several other muscles are needed. Thus, it appears to be evidence that the rate of vocalization decreases when the point of production is further back in the vocal tract [19].

The present results showed no significant relationship

between gender and DDK rate in either the young or older groups. This result contrasts with the findings by Pierce et al., who reported that the main effect of gender was statistically significant in each AMR task, i.e., males had higher rates than females, although the association between gender and sequential motion rate was not significant [15]. The present findings also contradict the results of Kreul, who found younger men to be quicker than younger women, and older women to be quicker than older men [20]. In addition, our findings also contrast with the results of Ptacek et al., who found young adult women to be faster at multisyllable tasks than young adult men, and young adult men to be faster at single-syllable tasks than young adult women [21]. Ptacek et al. also found that in all tasks older men were faster than women [21]. The present results are also consistent with the findings of Mousavi et al., who suggested that DDK performance was more affected by age than gender, and the latter was thus not a significant factor [14].

According to this study's results, young people vocalized at a faster rate than older people in all of tasks. A 2005 study of Persian speakers by Shahbodaghi and colleagues also determined that mean syllable repetition time decreased with increasing age [22]. The verbal DDK rates published by Shahbodaghi et al. were slightly slower for older participants than for younger ones, demonstrating a tendency toward reduced oral DDK speeds with increasing age [22]. Our findings are also consistent with the results of Ben-David and Icht, who reported that older adults had slower rates than younger adults [1], and with Devadiga and Bhat, who found a significant main effect of age in their comparison of younger and older people [19]. The present findings support the results of Mousavi et al., who demonstrated a significant negative, albeit weak, correlation between age and 5-second syllable repetition rates. In other words, the number of syllables produced decreased with increasing age in their participants. Moreover, and colleagues found a significant positive, but weak, correlation between age and the time required to repeat all syllables tested (except for /pata/), as well as the time needed to repeat specific syllables [14].

Aging often decreases the rate of speech, as a result of age-related changes in respiratory, laryngeal, and oral structures that alter motor functions of the tongue, lips, cheeks, and mandible. "In addition to these quantitative changes, qualitative alterations can also affect five attributes of speech associated with older age: voice tremor, air loss, laryngeal tension, imprecise consonants, and slow articulation rate" [1]. Maybe generally all of the characteristics is associated with speech production also affecting the performance of oral DDK tasks, specifically [1]. Indeed, the rate of oral DDK in older adults is known to be slower than in younger individuals [1]. It is thus plausible that young people vocalize faster than older people during oral tasks. The main limitation of this study was the small sample size of older people who were healthy and normal in all aspects and had no specific diseases.

Conclusion

The present findings show that by increasing age, the speed of oral motor production decreases. Information about diadochokinetic performance can help predict side effects and diagnose motor disorders in healthy older people.

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Conflict of Interest: None declared.

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