The study on verbal fluency in older adults in Nonthaburi Province

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ABSTRACT

Background: Verbal fluency assesses cognitive function in dementia and word retrieval in aphasia. However, the lack of data on verbal fluency among healthy older Thai individuals hinders comparisons with patient results. This is particularly concerning because older individuals are at higher risk for stroke and dementia. As Thailand has transitioned into an aging society, addressing this gap in data is essential.

Objective: This study aims to examine verbal fluency in Thai individuals aged 60 and above, focusing on factors such as age, gender, and education level affecting word count. The goal is to update Thai data, provide more assessment options, and enhance understanding of related factors. This will improve the accuracy of result interpretation and inform treatment planning.

Materials and methods: The study involved 147 healthy Thai individuals aged 60-89 living in Nonthaburi, Thailand. Participants must pass the Thai Mental State Examination (TMSE), visual screening by naming a picture and reading text, hearing screening through finger rubbing, oral reading (Noo Jaew Passage), and oral motor examinations to include only healthy participants without speech impairment. The speech-language pathologist, as an examiner, asks participants to generate words within a minute for each category (randomly assigned: animal, object, and food). Each intelligible and correct word in their category was scored. Researchers transcribed the recordings and counted the words produced.

Results: The average age of the total participants was 70.59 (SD=7.25) years, with 110 women (75%). The average words are: 19.35 (SD=5.25) animals, 20.18 (SD=6.70) objects, and 15.02 (SD=4.56) foods. Participants aged 60-69 exhibited the highest verbal fluency for animal, object, and food categories at 20.63 (SD=5.02), 21.86 (SD=6.19), and 16.35 (SD=4.71), respectively.

Conclusion: The study investigates verbal fluency in older Thai individuals in Nonthaburi, focusing on animal, object, and food categories. Results show that fluency declines with age. While higher education enhanced performance in the animal and object categories, it did not affect the food category. Gender significantly impacted the food category, with females performing better, possibly due to cultural roles. The data can be helpful in clinical assessments and future research on cognitive aging in Thai populations.

Introduction

Thailand has become an "Aging Society," with over 10% of its population aged 60 years and older. Of the 66 million people, 13 million (19%) are in this age group.[1] In Nonthaburi, 20% of the population is 60 and above. Older individuals are at higher risk for stroke and dementia.[2] The prevalence of stroke in Thai adults aged 45 and above is 1.88%, with a mean onset age of 65.[3] The prevalence of dementia in Thailand varied from 2.35%

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among adults aged 45 and above to 3.4-9.88% in those aged 60 and above.[4-6] Women had a greater dementia rate than men, and it increased with age, doubling about every five years until 85 years of age.[7]

Verbal fluency tests effectively assess cognitive impairments related to both stroke and dementia. These tests evaluate word retrieval ability in the context of aphasia and cognitive function within one minute and categorize them into semantic fluency (listing words within a category) and phonemic fluency (naming words starting with a given letter).[8] Examples of tests include verbal fluency; Western Aphasia Battery (WAB),[9] Boston Diagnostic Aphasia Examination (BDAE),[10] and Montreal Cognitive Assessment (MoCA).[11]

Phonemic fluency requires literacy skills, while semantic fluency is generally more effortless but can be influenced by educational levels.[12] Previous studies on Thai adults' verbal fluency in the animal category lack comparisons between early and late older populations.[12,13] Rather than relying solely on the animal category, broadening categories will improve assessment options. This study compares verbal fluency data among Nonthaburi older people aged 60-69, 70-79, and 80-89, focusing on animal, object, and food categories. Researchers selected these categories to provide more options for repeated assessments and prevent memorization. The study updates Thai verbal fluency data for Nonthaburi, identifies factors affecting word counts, such as age, gender, and education, and guides the selection of assessment categories. These insights will help explain results and plan appropriate training.

Materials and methods

The study population included healthy, older Thai individuals living in Nonthaburi, Thailand. The sample size calculation was performed using the finite sample proportion in the n4Studies application,[14] utilizing the 2019 data from the Department of Older Persons, which indicated 239,410 older individuals in Nonthaburi.[15] The sample was stratified into age cohorts 60-69, 70-79, and 80-89, mirroring the demographic distribution.[16] The study included 147 people, with 84 participants aged 60-69, 45 participants aged 70-79, and 18 participants aged 80-89. The participants were chosen via purposive sampling, selecting healthy clients or caregivers receiving services at Sirindhorn National Medical Rehabilitation Institute and members from the Center for Older People's Quality of Life in Nonthaburi. The study was conducted through in-person contacts at these places, with participant recruitment starting in October 2020 and ending in July 2021. The Sirindhorn National Medical Rehabilitation Institute Human Ethics Committee, Nonthaburi Province, Thailand, accepted this study (63017).

Inclusion criteria: healthy Thai individuals aged 60-89 years, primarily using the Central Thai dialect, with no history of cerebral or neurological diseases, no severe visual or auditory impairments, and the ability to perform daily tasks independently. Exclusion criteria: TMSE score ≤23,[17] inability to read or repeat the passage intelligibly, and failure in the oral motor examination.

Participants had to pass dementia screening using the Thai Mental State Examination (TMSE).[17] Vision and hearing were initially screened by questioning participants about any existing vision or hearing problems. Participants were observed to ensure they could see images and read the text correctly for visual screening during the TMSE and Noo Jaew Passage assessments,[18] and hearing was evaluated using a finger-rubbing test.[19] Oral reading of the Noo Jaew Passage assessed intelligibility, and illiterate participants repeated the text after an examiner. Oral motor examinations evaluated the functioning of the speech organs. These screenings included only healthy participants with clear and intelligible speech. All participants provided written informed consent. Researchers and speech-language pathologists (SLPs) conducted the screenings and assessments.

Participants had one 1 minute per category (animal, object, and food) to generate as many words as possible without cues. Categories were randomly allocated, and no examples were given to prevent bias. The researchers instructed participants that "food" is anything edible, typically complete dishes. Each intelligible and correct word in its category received one score. Repeated words, incorrect target language, intrusions (words outside the category), and non-specific words (e.g., "cooked food," "fried food," or "fish" without specifying boiled/fried/grilled) are not credited. Variations (starting or ending with the same word) are credited up to two scores. For example, if "noodles" and "fish noodles" are mentioned, only "fish noodles" will be credited. Similarly, "fried chicken," "fried fish," and "fried meat" will receive only two scores. Synonyms like "dog" and "canine" (or "สุนัข" and "หมา" in Thai) or "TV" and "television" (or "ทีวี" and "โทรทัศน์" in Thai) will be credited once.

Researchers transcribed the recordings and counted the words produced. Percentage, mean, SD, and 95% confidence interval were used to examine demographic data. One-way ANOVA compared means across the three age groups; independent t-tests compared means between genders; and multiple regression analysis examined how age, TMSE score, gender, and education affected word count in each category. SPSS 29.0 was used for all analyses.

Results

The study included 147 healthy older people in Nonthaburi, 110 women and 37 men, 70 from the Center for Older People's Quality of Life, and 77 from Sirindhorn National Medical Rehabilitation Institute. The mean TMSE score for the entire sample was 28.27 (SD=1.52). One-way ANOVA revealed significant differences in TMSE scores among the three age groups (*p*=0.017[a]), as presented in Table 1. An independent t-test indicated that the 60-69 age group exhibited significantly higher TMSE scores than the 80-89 age group (*p*=0.024[b]).

Table 1. Demographic data and average words within 1 minute of each age group.

	60-69 (N=84)	70-79 (N=45)	80-89 (N=18)	Total (N=147)	*p* value[a]
Age (years)	65.07±2.67 (64.49, 65.65)	75.49±1.51 (75.03, 75.94)	84.11±1.93 (83.22, 85.00)	70.59±7.25 (69.42, 71.77)	<0.001**
Female (%)	67 (80%)	33 (73%)	56 (50%)	110 (75%)	0.096
TMSE	28.54±1.41 (28.23, 28.84)	28.07±1.50 (27.62, 28.52)	27.50±1.79 (26.67, 28.33)	28.27±1.52 (28.02, 28.51)	0.017*
Education (years)	13.52±4.45 (12.56, 14.49)	13.56±4.43 (12.22, 14.89)	12.33±5.72 (9.69, 14.98)	13.39±4.60 (12.64, 14.13)	0.586
Animal	20.63±5.02 (19.54, 21.72)	18.09±5.08 (16.56, 19.62)	16.56±5.15 (14.18, 18.93)	19.35±5.25 (18.50, 20.20)	0.001**
Object	21.86±6.19 (20.51, 23.20)	19.42±6.85 (17.37, 21.48)	14.28±4.91 (12.01, 16.55)	20.18±6.70 (19.10, 21.27)	<0.001**
Food	16.35±4.71 (15.32, 17.37)	13.71±3.21 (12.75, 14.68)	12.11±4.60 (9.99, 14.24)	15.02±4.56 (14.28, 15.76)	<0.001**

Note: values are reported as mean±SD (95% CI lower, 95% CI upper), [a]tested via One-way ANOVA, *p<0.05, **p<0.01, considered statistically significant.

The average years of education for the total sample was 13.39 (SD=4.60), with no significant differences observed among the three age groups (*p*=0.586[a]). The educational distribution of the participants is as follows: one participant is illiterate with non-formal education; 17 participants have completed 4-6 years of primary education; 38 participants have completed 7-12 years of secondary education; and 91 participants have received 13-21 years of tertiary education. Within the tertiary education group, 12 hold diplomas, 50 hold bachelor's degrees, 27 hold master's degrees, and 2 hold doctorate degrees.

Verbal fluency averaged 19.35 (SD=5.25) words for animals, 20.18 (SD=6.70) for objects, and 15.02 (SD=4.56) for food. There were significant differences across all three categories among age groups (*p*<0.001[a]). In Table 2, an independent t-test showed that the 60-69 age group produced more animal and food words than the 70-79 and 80-89 age groups, whereas the 80-89 age group created fewer object words.

Table 2. Comparative analysis of age, TMSE, education, and verbal fluency between different age groups.

	60-69 vs 70-79[b]	60-69 vs 80-89[b]	70-79 vs 80-89[b]
Age (years)	-10.41 (-11.44, -9.39) *p*<0.001**	-19.04 (-20.48, -17.6) *p*<0.001**	-8.63 (-10.17, -7.08) *p*<0.001**
TMSE	0.47 (-0.2, 1.13) *p*=0.269	1.04 (0.1, 1.97) *p*=0.024*	0.57 (-0.44, 1.57) *p*=0.521
Education (years)	-0.03 (-2.09, 2.03) *p*=1.000	1.19 (-1.71, 4.09) *p*=0.965	1.22 (-1.89, 4.34) *p*=1.000
Animal	2.54 (0.28, 4.8) *p*=0.022*	4.08 (0.9, 7.26) *p*=0.007**	1.53 (-1.88, 4.95) *p*=0.836
Object	2.43 (-0.37, 5.24) *p*=0.112	7.58 (3.64, 11.52) *p*<0.001**	5.14 (0.91, 9.38) *p*=0.011*
Food	2.63 (0.71, 4.56) *p*=0.003**	4.23 (1.53, 6.94) *p*<0.001**	1.6 (-1.3, 4.5) *p*=0.551

Note: values are reported as mean difference (95% CI lower, 95% CI upper),[b]tested via independent T-test, *p< 0.05, **p<0.01, considered statistically significant

A multiple linear regression analysis examining the factors influencing verbal fluency determined that increased age was associated with fewer words across all three categories. Conversely, higher TMSE scores were correlated with an increased number of words in each category. Additionally, more years of education were linked to an increased number of words in the animal and object categories; however, education level did not significantly affect the number of words in the food category (coefficient=0.11, *p*=0.158), as detailed in Table 3.

Table 3. Regression coefficients and significance levels of each verbal fluency.

	Animal	Object	Food
Age	-0.17 (p=0.003**)	-0.25 (p<0.001**)	-0.18 (p<0.001**)
TMSE	0.69 (p=0.020*)	1.17 (p=0.001**)	0.73 (p=0.004**)
Education	0.23 (p=0.017*)	0.47 (p<0.001**)	0.11 (p=0.158)
Gender	1.13 (p=0.224)	1.67 (p=0.113)	1.89 (p=0.016*)

Note: values are reported as regression coefficients with p values,p<0.05, **p<0.01, considered statistically significant.*

Gender did not significantly impact the number of words in the animal and object categories but did influence the food category (coefficient=1.89, p=0.016). When comparing genders, only the average age and the number of words in the food category demonstrated statistically significant differences (p=0.043 and p=0.008, respectively), as illustrated in Table 4.

Table 4. Comparison of characteristics by gender.

	Female (N=110)	Male (N=37)	p value[b]
Age	69.89±6.76 (68.63, 71.16)	72.67±8.31 (70.00, 75.35)	0.043*
TMSE	28.27±1.52 (27.99, 28.56)	28.24±1.53 (27.75, 28.74)	0.919
Education	13.08±4.78 (12.19, 13.97)	14.30±3.93 (13.03, 15.56)	0.165
Animal	19.69±5.39 (18.68, 20.70)	18.35±4.75 (16.82, 19.88)	0.181
Object	20.65±6.95 (19.35, 21.94)	18.81±5.75 (16.96, 20.66)	0.150
Food	15.59±4.60 (14.73, 16.45)	13.32±4.03 (12.03, 14.62)	0.008**

*Note: [b]tested via independent T-test, *p<0.05, **p<0.01, considered statistically significant.*

Discussion

This study is the first to investigate verbal fluency in older Thai individuals with the highest average educational attainment of 13.39 (SD=4.60) years, focusing on vocabulary in the Thai language's animal, object, and food categories. A literature review revealed no prior studies on word counts in the categories of objects or food, although related studies in categories such as furniture, clothing, vegetable, and fruit exist.[32,33] However, these are not directly comparable due to the broader definitions of object and food. Therefore, the comparison here is limited to the animal category, as shown in Table 5.

Table 5. Comparison of study data across different languages.

Study	Language	N	Age	Education	Animal
Teerapong[9]	Thai	30	52.5±6.8	10.6±5.7	17.7±3.4
Muangpaisan et al.[13]		30	63.7±7.3	6.7±3.2	17.3±6.4
Charernboon[12]		61	64.7±6.7	10.4±5.0	19.4±5.0
This study		147	70.6±7.3	13.4±4.6	19.4±5.3
Tombaugh et al.[20]	English	259	60-79	9-21	17.1±4.3
Brickman et al.[21]		55	61-82	13.0±3.2	17.4
Knight et al.[22]		272	73.7±5.8	0-16	18.8±4.7
Kempler et al.[23]	Vietnamese	60	71.6±5.8	8.6±4.2	17.3±5.2
Chan & Poon[24]	Chinese	156	71.4±5.4	7.5±6.1	14.5±4.2
Ostrosky-Solis et al.[25]	Spanish	181	60-90	7-12	17.9±4.7
Mathuranath et al.[26]	Malayalam	153	66.9±5.6	7.2±6.1	7.8±3.6
Kavé[27]	Hebrew	166	51-85	8-24	19.0±5.0
Pekkala et al.[28]	Finnish	30	66.7±5.5	9.7±3.3	18.9±4.7
Ryu et al.[29]	Korean	3025	71.7±6.7	7.4±5.2	12.9±4.2
Cavaco et al.[30]	Portuguese	487	60-89	0-20	14.8±5.1
Vogel et al.[31]	Danish	100	70.9±6.4	11.9±2.6	21.3±4.8

Note: values are reported as mean±SD.

Verbal fluency scores vary across languages and are influenced by age, education, and cultural context.[32, 33] In Thai studies, Teerapong reported 17.7 (SD=3.4) words,[9] Muangpaisan *et al.* found 17.3 (SD=6.4) words,[13] and Charernboon reported 19.4 (SD=5.0) words.[12] This study, with participants averaging 70.6 (SD=7.3) years of age and 13.4 (SD=4.6) years of education, found an average of 19.4 (SD=5.3) words, consistent with Charernboon's findings. This study's average TMSE score was 28.3 (SD=1.5), similar to the previous study by Muangpaisan *et al.*, which reported a score of 28.1 (SD=1.8).[13]

Comparing these results with studies in other languages reveals diverse outcomes. English studies by Tombaugh et al. reported 17.1 (SD=4.3) words,[20] Brickman *et al.* found 17.4 words,[21] and Knight et al. reported 18.8 (SD=4.7) words.[22] Chinese studies by Chan and Poon reported 14.5 (SD=4.2) words,[24] and Spanish studies by Ostrosky-Solis *et al.* found 17.9 (SD=4.7) words.[25] Danish studies by Vogel *et al.* reported the highest average of 21.3 (SD=4.8) words.[31] The study conducted by Mathuranath *et al.* in the Malayalam language reported the lowest average of 7.8 (SD=3.6) words.[26]

These differences emphasize that verbal fluency scores are language-specific and cannot be directly compared across languages. This highlights the need for culturally and linguistically appropriate normative data to assess verbal fluency accurately.[32,33] Factors such as word length and cultural differences in language use affect performance.[32] For example, Kempler *et al.* found that Spanish speakers had lower verbal fluency scores than Vietnamese speakers, attributing this to the longer word length in Spanish.[23] Pekkala et al. noted that although Finnish words are generally longer than English words, there was no significant difference in verbal fluency scores between Finnish and English speakers.[28] In Thai, the nature of the language adds another layer of complexity. For example, the use of word-guides presents unique challenges and opportunities in verbal fluency tasks: words starting with "ปลา" (pla/fish): "ปลาทอด" (pla-tod/fried fish), "ปลานึ่ง" (pla-nueng/steamed fish), "ปลาต้ม" (pla-tom/boiled fish); words starting with "นก" (nok/bird): "นกยูง" (nok-yung/peacock), "นกพิราบ" (nok-pirab/pigeon), "นกอินทรี" (nok-insee/eagle)**;** Words ending with "ย่าง" (yang/grill): "ไก่ย่าง" (gai-yang/grilled chicken), "หมูย่าง" (moo-yang/grilled pork), "เนื้อย่าง" (nuea-yang/grilled beef). In this study, researchers defined precise criteria for variations of a term that share the same first or last word. These variations were considered valid only if they did not exceed two variations. Other common rhyme word groups include "หมู หมา กา ไก่" (moo-ma-ga-gai/pig-dog-crow-chicken) and "ช้าง ม้า วัว ควาย" (chang-ma-wua-khwai/elephant-horse-cow-buffalo). If no variations or intrusions exist, each word is counted as one point.

Impact of Education and Age

In agreement with most normative studies, performance on the semantic fluency test declined with age[34-36] and increased with education.[20,34,35] Education affects verbal fluency (animal) in Chinese, English, Greek, Hebrew, Malayalam, Portuguese, and Spanish.[20,23-27, 30,33,36] When using these normative data clinically, educational data should be considered. These findings confirm literacy's role in semantic fluency.[37] However, the association pattern is specific to the "animal" category. Literacy may affect other categories more or less, depending on their ecological or cultural relevance.[37] Our study found no significant correlation between education level and the food category.

Gender Differences

The gender effect is inconsistent across studies. No gender effect in the animal category was found in Dutch, English, Hebrew, and Malayalam.[20,26,27,33,38] Most studies in the literature are consistent with these negative findings.[20,34,35] However, a gender impact was observed in Chinese and Greek.[24,33,36,] presumably because women are less educated.[24] Some studies report significant gender effects in other categories similar to our findings.[36,38,39] For example, while men may perform better in naming tools, women name fruits better.[39] Our study found significant gender-related differences only in the food category, not animal or object categories. This may be because Thai women typically prepare food.[40] Cultural factors, including gender-specific responsibilities and educational opportunities, affect language fluency.

Conclusion

This study is one of the first to investigate verbal fluency in literate older Thai individuals in Nonthaburi and focuses on vocabulary in animal, object, and food categories. The results provide critical normative data for semantic fluency in the Thai language, highlighting the influence of age, education, and gender on verbal fluency performance.

Verbal fluency declined with age across all categories. The 60-69 age group exhibited significantly higher verbal fluency scores than the 70-79 and 80-89 age groups. Higher levels of education were associated with better performance in the animal and object categories. However, education did not significantly impact performance in the food category. Gender had a significant impact only on the food category, where females performed better, likely due to cultural roles in food preparation. These findings in the animal category align with previous research across various languages, emphasizing the importance of considering demographic factors when evaluating cognitive health in the elderly.

The normative data provided by this study can serve as a valuable reference for clinical assessments and future research on cognitive aging in Thai populations, particularly those with complete secondary education. However, the study sample included fewer participants aged 80 and above. Most participants were from Nonthaburi province, similar to Bangkok but may only partially represent Thailand's older population. This shortcoming may limit the findings' applicability to other sociocultural locations. Age, education, and culture should be considered when assessing verbal fluency.

References

[1] Senanarong V, Harnphadungkit K, Poungvarin N, Vannasaeng S, Chongwisal S, Chakorn T, *et al*. The Dementia and Disability Project in Thai Elderly: rational design methodology and early results. BMC Neurol. 2013; 13: 3. doi: 10.1186/1471-2377-13-3.

[2] Foundation of Thai Gerontology Research and Development Institute (TGRI). Situation of the Thai Older Persons 2021. Nakhon Pathom: Institute for Population and Social Research, Mahidol University; 2021.

[3] Suwanwela NC. Stroke epidemiology in Thailand. J Stroke. 2014; 16(1): 1-7. doi: 10.5853/jos.2014.16.1.1.

[4] Wangtongkum S, Sucharitkul P, Silprasert N, Inthrachak R. Prevalence of dementia among population age over 45 years in Chiang Mai, Thailand. J Med Assoc Thai. 2008; 91(11): 1685-90. PMID: 19127790.

[5] Senanarong V, Poungvarin N, Sukhatunga K, Prayoonwiwat N, Chaisewikul R, Petchurai R, *et al*. Cognitive status in the community dwelling Thai elderly. J Med Assoc Thai. 2001; 84(3): 408-16. PMID: 11460944.

[6] Jitapunkul S, Kunanusont C, Phoolcharoen W, Suriyawongpaisal P. Prevalence estimation of dementia among Thai elderly: a national survey. J Med Assoc Thai. 2001; 84(4): 461-7. PMID: 11460954.

[7] Nichols E, Steinmetz JD, Vollset SE, Fukutaki K, Chalek J, Abd-Allah F, et al. Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. Lancet Public Health. 2022; 7(2): e105-e125.doi: 10.1016/S2468-2667(21)00249-8.

[8] Whiteside DM, Kealey T, Semla M, Luu H, Rice L, Basso MR, et al. Verbal Fluency: Language or Executive Function Measure? Appl Neuropsychol Adult. 2016; 23(1): 29-34. doi: 10.1080/23279095.2015.1004574.

[9] Teerapong W. The comparison of language abilities of Thai aphasic patients and Thai normal subjects by using Thai Adaptation of Western Aphasia Battery [Thesis]. Nakhon Pathom: Mahidol University; 2000.

[10] Gandour J, Dardarananda R, Buckingham H, Viriyavejakul A. A Thai adaptation of the Boston Diagnostic Aphasia Examination. Crossroads. 1986; 2(3): 1-39.

[11] Julayanont P, Tangwongchai S, Hemrungrojn S, Tunvirachaisakul C, Phanthumchinda K, Hongsawat J, *et al*. The Montreal cognitive assessment—basic: A screening tool for mild cognitive impairment in illiterate and low-educated elderly adults. J Am Geriatr Soc. 2015; 63(12): 2550-4. doi: 10.1111/jgs.13820.

[12] Charernboon T. Verbal fluency in the Thai elderly with mild cognitive impairment and elderly with dementia. J Ment Health Thai. 2018; 26(2): 91-102.

[13] Muangpaisan W, Assantachai P, Sitthichai K, Richardson K, Brayne C. The distribution of Thai Mental State Examination Scores among non-demented elderly in suburban Bangkok metropolitan and associated factors. J Med Assoc Thai. 2015; 98(9): 916-24. PMID: 26591404.

[14] Ngamjarus C. n4Studies: Sample Size Calculation for an Epidemiological Study on a Smart Device. Siriraj Med J. 2016; 68(3): 160-70.

[15] Statistics of Elderly Person in Thailand 2019 [Internet]. 2019. Available from: www.dop.go.th/download/knowledge/th1580099938-275_1.pdf.

[16] Department of Older Persons. Situation of The Thai Elderly 2019. Nakhon Pathom: Institute for Population and Social Research, Mahidol University, and Foundation of Thai Gerontology Research and Development Institute (TGRI); 2019.

[17] Train the Brain Forum Committee. Thai mental state examination (TMSE). Siriraj Hosp Gaz. 1993; 45: 661-74.

[18] Sindermsuk D. The survey of speech defects among prathom 4 students in Mitsampan School Group [Thesis]. Nakhon Pathom: Mahidol University; 1986.

[19] Torres-Russotto D, Landau WM, Harding GW, Bohne BA, Sun K, Sinatra PM. Calibrated finger rub auditory screening test (CALFRAST). Neurology. 2009; 72(18): 1595-600. doi: 10.1212/WNL.0b013e3181a41280.

[20] Tombaugh TN, Kozak J, Rees L. Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming. Arch Clin Neuropsychol. 1999; 14(2): 167-77. doi: 10.1093/arclin/14.2.167.

[21] Brickman AM, Paul RH, Cohen RA, Williams LM, MacGregor KL, Jefferson AL, *et al*. Category and letter verbal fluency across the adult lifespan: relationship to EEG theta power. Arch Clin Neuropsychol. 2005; 20(5): 561-73. doi: 10.1016/j.acn.2004.12.006.

[22] Knight RG, McMahon J, Green TJ, Skeaff CM. Regression equations for predicting scores of persons over 65 on the rey auditory verbal learning test, the mini-mental state examination, the trail making test, and semantic fluency measures. Br J Clin Psychol. 2006; 45(Pt 3): 393-402. doi: 10.1348/014466505x68032.

[23] Kempler D, Teng EL, Dick M, Taussig IM, Davis DS. The effects of age, education, and ethnicity on verbal fluency. J Int Neuropsychol Soc. 1998; 4(6): 531-8. doi: 10.1017/s1355617798466013.

[24] Chan AS, Poon MW. Performance of 7-to 95-year-old individuals in a Chinese version of the category

fluency test. J Int Neuropsychol Soc. 1999; 5(6): 525-33. doi: 10.1017/s135561779956606x.

[25] Ostrosky-Solis F, Gutierrez AL, Flores MR, Ardila A. Same or different? Semantic verbal fluency across Spanish-speakers from different countries. Arch Clin Neuropsychol. 2007; 22(3): 367-77. doi: 10.1016/j.acn.2007.01.011.

[26] Mathuranath PS, George A, Cherian PJ, Alexander A, Sarma SG, Sarma PS. Effects of age, education and gender on verbal fluency. J Clin Exp Neuropsychol. 2003; 25(8): 1057-64. doi: 10.1076/jcen.25.8.1057.16736.

[27] Kavé G. Phonemic fluency, semantic fluency, and difference scores: normative data for adult Hebrew speakers. J Clin Exp Neuropsychol. 2005; 27(6): 690-9. doi: 10.1080/13803390490918499.

[28] Pekkala S, Goral M, Hyun J, Obler LK, Erkinjuntti T, Albert ML. Semantic verbal fluency in two contrasting languages. Clin Linguist Phon. 2009; 23(6): 431-45. doi: 10.1080/02699200902839800.

[29] Ryu SH, Kim KW, Kim S, Park JH, Kim TH, Jeong HG, Kim JL, Moon SW, Bae JN, Yoon JC, Choo IH, Lee DW, Chang SM, Jhoo JH, Kim SK, Cho MJ. Normative study of the category fluency test (CFT) from nationwide data on community-dwelling elderly in Korea. Arch Gerontol Geriatr. 2012; 54(2): 305-9. doi: 10.1016/j.archger.2011.05.010.

[30] Cavaco S, Gonçalves A, Pinto C, Almeida E, Gomes F, Moreira I, Fernandes J, Teixeira-Pinto A. Semantic fluency and phonemic fluency: regression-based norms for the Portuguese population. Arch Clin Neuropsychol. 2013; 28(3): 262-71. doi: 10.1093/arclin/act001.

[31] Vogel A, Stokholm J, Jørgensen K. Normative data for eight verbal fluency measures in older Danish adults. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn. 2020; 27(1): 114-124. doi: 10.1080/13825585.2019.1593935.

[32] Villalobos D, Torres-Simón L, Pacios J, Paúl N, Del Río D. A Systematic Review of Normative Data for Verbal Fluency Test in Different Languages. Neuropsychol Rev. 2023; 33(4): 733-64. doi: 10.1007/s11065-022-09549-0.

[33] Ardila A. A cross-linguistic comparison of category verbal fluency test (ANIMALS): a systematic review. Arch Clin Neuropsychol. 2020; 35(2): 213-25. doi: 10.1093/arclin/acz060.

[34] Benito-Cuadrado MM, Esteba-Castillo S, Böhm P, Cejudo-Bolívar J, Peña-Casanova J. Semantic Verbal Fluency of Animals: A Normative and Predictive Study in a Spanish Population. J Clin Exp Neuropsychol. 2002; 24(8): 1117-22. doi: 10.1076/jcen.24.8.1117.8376.

[35] Gladsjo JA, Schuman CC, Evans JD, Peavy GM, Miller SW, Heaton RK. Norms for Letter and Category Fluency: Demographic Corrections for Age, Education, and Ethnicity. Assessment. 1999; 6(2): 147-78. doi: 10.1177/107319119900600204.

[36] Kosmidis MH, Vlahou CH, Panagiotaki P, Kiosseoglou G. The verbal fluency task in the Greek population: Normative data, and clustering and switching strategies. J Int Neuropsychol Soc. 2004; 10(2): 164-72. doi: 10.1017/S1355617704102014.

[37] da Silva CG, Petersson KM, Faísca L, Ingvar M, Reis A. The Effects of Literacy and Education on the Quantitative and Qualitative Aspects of Semantic Verbal Fluency. J Clin Exp Neuropsychol. 2004; 26(2): 266-77. doi: 10.1076/jcen.26.2.266.28089.

[38] Van Der Elst WIM, Van Boxtel MPJ, Van Breukelen GJP, Jolles J. Normative data for the Animal, Profession, and Letter M Naming verbal fluency tests for Dutch speaking participants and the effects of age, education, and sex. J Int Neuropsychol Soc. 2006; 12(1): 80-9. doi: 10.1017/S1355617706060115.

[39] Capitani E, Laiacona M, Barbarotto R. Gender Affects Word Retrieval of Certain Categories in Semantic Fluency Tasks. Cortex. 1999;35(2):273-8. doi: 10.1016/s0010-9452(08)70800-1.

[40] Chandrangam K. The relationship between gender and women's self-value in Bangkok metropolis [Thesis]. Bangkok: Chulalongkorn University; 2005.