NSS Neutrosophic Sets and Systems
{Special Issue: Impact of Neutrosophy in solving the Latin American's social problems}, Vol. 37, 2020
University of New Mexico

Selection of Non-Pharmacological Treatments for mild Cognitive Impairment in older Adults with Neutrosophic-AHP

Guillermo De Jesús Bastida Tello[1], Raúl Comas Rodríguez[2] and José Luis García Delgado[3]

[1] Universidad Regional Autónoma de los Andes (UNIANDES), Km 5 ½ Vía a Baños, Ambato, CP. 180166. Ecuador; Email: guillermobastidastello@hotmail.com
[2] Universidad Regional Autónoma de los Andes (UNIANDES), Km 5 ½ Vía a Baños, Ambato, CP. 180166. Ecuador; Email: raulcomasrodriguez@gmail.com
[3] Universidad Regional Autónoma de los Andes (UNIANDES), Km 5 ½ Vía a Baños, Ambato, CP. 180166. Ecuador; Email: joselgd14@gmail.com

Abstract: The aging of population includes a social group that has increased in recent years. Properly attending to the conditions of the elderly represents a problem to be addressed by Public Health institutions. A pathology that occurs very frequently is the cognitive impairment. Selecting the correct treatment for this type of condition is subject to the set of criteria that characterize the patient. Problems of this nature have been addressed by science from the implementation of artificial intelligence. The present research aims to develop a method for the selection of non-pharmacological treatments for mild cognitive impairment in older adults. The method operates using the neutrosophic AHP to model indeterminacy. The result is a case study with the implementation of the proposed method as an example of applicability.

Keywords: Population aging; AHP; Neutrosophic Numbers; mild cognitive impairment.

1. Introduction

Cognitive impairment is a disease that affects older adults and significantly deteriorates their mental health. Currently, people in the elderly category are exposed to stressful situations in which cognitive impairment is unavoidable. This leads people to have all kinds of mental health problems that can eventually turn into chronic mental disorders if they are not properly identified and treated.

Older adults with mental health problems usually have a tendency not to admit their health problems due to fear of the stigma associated with these types of illnesses and the risk of being declared disabled. In the case of adults with mild cognitive impairment, they are usually in a state of denial, a situation that can cause more serious complications and even turn into a chronic mental illness, so it is necessary to treat them right from the appearance of the first symptoms.

If an adult's mental status can be easily assessed and examined, chances are that their mental problems can be detected at a very early stage and can be controlled and cured in a timely manner, as long as they receive appropriate treatments and medications [1]. In order to know the epidemiological clinical behavior of mild cognitive impairment in the elderly, a study was carried out in Ecuador, which determined that there is a prevalence of 38.6%; it was also identified that women have higher rates than men, 18.5% versus 14.3% respectively [2].

In [3], a study associated with this issue was also carried out. It determined that the prevalence in general is 13.6% in those over 50 years of age and the female gender also predominates. Age over 65 years, low level of education and the number of children are the most important socio-demographic variables that play an important role for a person to develop mild cognitive impairment [3].

The scenarios described above become the main motivation to carry out this research; the main objective is to develop a method for the selection of non-pharmacological treatments for mild cognitive impairment in older adults based on neutrosophic AHP[4]. In the preliminaries of this document, we present some findings on mild cognitive impairment in older adults identified from the review of the scientific literature. In the materials section, we propose a method for the selection of non-pharmacological treatments for mild cognitive impairment, based on the mental health status of the people and that supports its functioning on the basis of neutrosophic AHP. In the Results, a case study is used to determine the applicability of the proposed method.

2. Preliminaries

This section carries out a study of the main theories associated with the modeled problem. The current state of the elderly is characterized as the central theme of the research proposal. We also cover the main elements that describe cognitive delay in the elderly. Finally, we introduce the possible non-pharmacological therapies to be selected according to the characteristics of the patient.

2.1. Older adult

According to the Inter-American Convention on the Protection of the Human Rights of Older Persons, someone is considered to be older from the age of 60 onwards, subject to the internal laws of the States, although it may not establish an age over 65 years to be legally considered an older person [5]. Based on this guideline, in Ecuador the Constitution of the Republic of Ecuador of 2008, in its second chapter, article 14 stipulates: The right of the population to live in a healthy and ecologically balanced environment is recognized, which guarantees sustainability and good living [6].

During the Inter-American Convention on the Protection of the Human Rights of Older Persons, with a plenary session in the city of Washington, on March 21, 2019 the activity carried out by Ecuador was praised, as a country that has established norms and laws in favor of the older adults. It also recognizes that it has legislated reforms to dignify the condition of the elderly and whose greatest effect was achieved on April 29, 2019, with the entry into effect of the Organic Law of Older Adults, which seeks to eradicate abandonment or negligence suffered by this human group [7].

Older adults are considered a vulnerable group at the national and international level [8]. The course of the years, physical and mental wear and tear and environmental, demographic, social and economic factors are some of the elements that affect the appearance of mild cognitive impairment in the elderly.

2.2. Cognitive impairment

In order to assess the health status of adults aged 60 and over, the Survey on Health, Well-being and Aging (SHWA) is carried out in coordination with the Ministry of Economic and Social Inclusion and monitored by the National Institute of Statistics and Censuses (NISC) [9]. With this survey, they determined the demographic characteristics, health status and state of mind of the people of 60 years and over of the Ecuadorian population, in order to implement policies, strategies and public programs that improve the social and health conditions of older adults.

An important aspect of aging is cognitive impairment, which reflects a decrease in the performance of one or more of the mental or intellectual abilities: memory, orientation, abstract thinking, language, judgment, reasoning and calculation, constructive, learning and visual spatial ability. Several studies show the weight of age, educational level, socio-economic condition, the presence of affective symptoms play a very important role in the prevalence of cognitive impairment.

While many cognitive functions remain the same as in their youth, older adults experience a decline in some cognitive spheres, such as learning new information and executing fast motor functions. In addition to the decline in cognitive function typical of aging, there are pathologies such as Alzheimer's disease that disproportionately affect older adults. They can also partially or globally alter cognitive functions, both acutely and chronically [10].

The term "cognitive impairment" is a concept that, although it does not specify the intellectual function or functions affected or the underlying cause, should be considered as a situation that reveals the existence of a problem whose diagnosis must be established promptly in order to adopt the appropriate therapeutic measures.

2.3. Non-pharmacological therapies

Non-pharmacological therapies comprise a group of non-chemical interventions that stimulate the performance of cognitive processes, improve affectivity and enhance the independence of daily life. All these actions are reflected in the improvement of the patient's quality of life; some are described below [11]:

Music therapy: Playing a song to a patient with mild cognitive impairment or some form of dementia, especially those suffering from Alzheimer's, helps them awaken emotions and memories of the past, enhancing security and personal identity [12].

Sensory stimulation: The person is exposed to a space with different stimuli either actively or passively in order to cause them a feeling of relaxation and peace. This can be achieved by giving the patient something pleasant to smell or caressing him/her among other stimulations [13].

Activities of daily life: These are the basic tasks that human beings perform in their routine which generate independence; these can be basic: such as bathing, dressing, eating, or walking. The instrumental types that are related to managing money, taking care of another person, preparing food and finally the advanced types that adhere to the social, work and lifestyle of the person.

Cognitive Stimulation: The person is asked to name an object in their own words when visualizing a mimic, a gesture or by simple touch; another example would be assigning them papers as coupons with a monetary value "x" and proceeding to play the buyer and seller business, this activity allows the patient to identify and understand the value of each number [14].

3. Materials and Methods

This section describes the structure and operation of the proposed method. It operates through neutrosophic AHP. The method starts with the identification of the objective to be achieved, see [15, 16]. Then the evaluation criteria are selected on the objective. These criteria can be decomposed into sub-evaluation criteria and so on. Finally, the alternatives to be evaluated are determined. This is represented in a tree as shown in Figure 1, where the first node in the upper level represents the evaluation objective, in a lower level are placed the criteria, even lower are the sub criteria and so on. While the lowest level represents the alternatives.

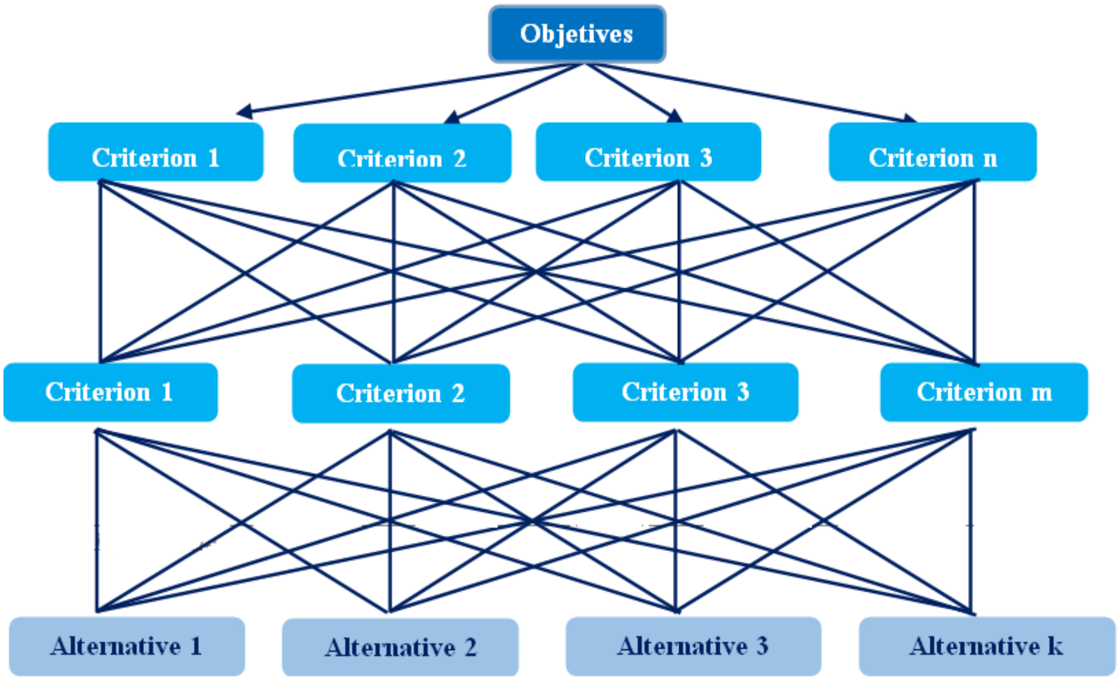

Figure 1. Tree that is the starting point to apply the AHP technique. (Source: [15])

The AHP technique is based on a scale for measuring the relative importance of the elements of the same level within the tree in Figure 1. In this article it is calculated by applying a scale equivalent to a *Triangular Single Value Neutrosophic Number* (TSVNN), as shown in Table 1 [17].

Saaty scale	Definition	Triangular Neutrosophic Scale
1	Equally influential	$\tilde{1} = \langle(1,1,1); 0,5; 0,5; 050\rangle$
3	Slightly influential	$\tilde{3} = \langle(2,3,4); 0,3; 0,75; 0,70\rangle$
5	Strongly influential	$\tilde{5} = \langle(4,5,6); 0,80; 0,15; 0,20\rangle$
7	Very strongly influential	$\tilde{7} = \langle(6,7,8); 0,9; 0,10; 0,10\rangle$
9	Absolutely influential	$\tilde{9} = \langle(9,9,9); 1,0; 0,0; 0,0\rangle$
2, 4, 6, 8	Sporadic values between two scales close to each other	$\tilde{2} = \langle(1,2,3); 0,40; 0,65; 0,60\rangle$ $\tilde{4} = \langle(3,4,5); 0,60; 0,35; 0,40\rangle$ $\tilde{6} = \langle(5,6,7); 0,70; 0,25; 0,30\rangle$ $\tilde{8} = \langle(7,8,9); 0,85; 0,10; 0,15\rangle$

Table 1. Saaty Scale taken to a TSVNN Scale (Source: [16])

Definition 1. Let X be a universe of discourse. A *Neutrosophic Set* (NS) is characterized by three membership functions, $u_A(x), r_A(x), v_A(x) : X \rightarrow\ ]^-0, 1^+[$, which satisfy the condition -0 ≤ inf $u_A(x)$ +

$\inf\ r_A(x) + \inf\ v_A(x) \le \sup\ u_A(x) + \sup\ r_A(x) + \sup\ v_A(x) \le 3+$ for all $x \in X$. $u_A(x), r_A(x)$ and $v_A(x)$ denote the membership functions to true, indeterminate and false of x in A, respectively, and their images are standard or non-standard subsets of $]^{-}0, 1^{+}[$ (see [18, 19]).

Definition 2. Let X be a universe of discourse. A *Single Value Neutrosophic Set* (SVNS) A over X is an object of the form: $A = \{\langle x, u_A(x), r_A(x), v_A(x)\rangle : x \in X\}$ (1)

Where $u_A, r_A, v_A : X \rightarrow [0,1]$, satisfy the condition $0 \le u_A(x) + r_A(x) + v_A(x) \le 3$ for all $x \in X$. $u_A(x), r_A(x)$ and $v_A(x)$ denote the membership functions of true, indeterminate and false of x in A, respectively. For convenience, a *Single Value Neutrosophic Number* (SVNN) will be expressed as A = (a, b, c), where a, b, c ∈ [0,1] and satisfies $0 \le a + b + c \le 3$ (see [18],[9]).

Definition 3. A *Triangular Single Value Neutrosophic Number* (TSVNN), which is denoted by: $\tilde{a} = \langle (a_1, a_2. a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, is a CN over $\mathbb{R}$, whose truth membership functions, indeterminacy, and falsehood are defined below (see [18],[20]):

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}\left(\frac{x-a_1}{a_2-a_1}\right)}, & a_1 \le x \le a_2 \\ \alpha_{\tilde{a}}, & x = a_2 \\ \alpha_{\tilde{a}\left(\frac{a_3-x}{a_3-a_2}\right)}, & a_2 < x \le a_3 \\ 0, & \text{otherwise} \end{cases} \quad (2)$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{\left(a_2 - x + \beta_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \le x \le a_2 \\ \beta_{\tilde{a}}, & \\ \frac{\left(x - a_2 + \beta_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \le a_3 \\ 1, & \end{cases} \quad (3)$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{\left(a_2 - x + \gamma_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \le x \le a_2 \\ \gamma_{\tilde{a}}, & \\ \frac{\left(x - a_2 + \gamma_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \le a_3 \\ 1, & \end{cases} \quad (4)$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0, 1]$, $a_1, a_2, a_3 \in \mathbb{R}$ and $a_1 \le a_2 \le a_3$.

Starting from the reference in Table 1, it is possible to compare the relative importance between two variables. The definition contains the linguistic meaning of how important one variable is over another. The neutrosophic scale gives an equivalent value in the form of TSVNN. This is located in an array.

The following are other concepts needed to apply the Neutrosophic AHP method: A neutrosophic pair-wise comparison matrix is defined in equation 5.

$$\tilde{A} = \begin{matrix} \tilde{1} & \widetilde{a_{12}} & \cdots & \widetilde{a_{1n}} \\ \vdots & \vdots & \ddots & \vdots \\ \widetilde{a_{n1}} & \widetilde{1_{n2}} & \cdots & \tilde{1} \end{matrix} \quad (5)$$

Such that $\tilde{A}$ satisfies the condition $\widetilde{a_{ji}} = \tilde{a}_{ij}\tilde{a}_{ij}^{-1}$,s according to the inversion operator that appears in Definition 3.

Additionally, two indexes are defined to convert a TSVNN into a real numeric value. These indexes are the Score in Equation 6 and Precision in Equation 7:

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \quad (6)$$

$$A(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (7)$$

3.1 Proposal of a method for selecting non-pharmacological treatments for mild cognitive impairment in older adults

The proposed method is designed to support the management flow of selecting non-pharmacological treatments for mild cognitive impairment in older adults. Its inference process is based on the Neutrosophic AHP. Figure 2 shows a diagram illustrating the work flow of the proposed method.

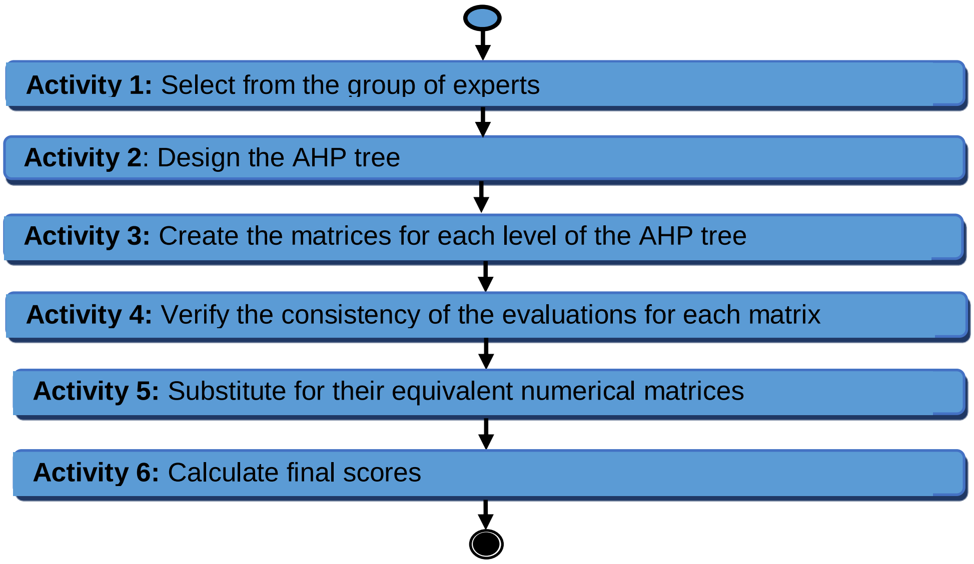

Figure 2: Workflow of the proposed method.

Below is a description of the activities of the Neutrosophic AHP:
Select a group of experts who are capable of conducting the analysis.

The experts must design an AHP tree, like the one shown in Figure 1. This implies that the criteria, sub-criteria and alternatives to carry out the evaluation must be specified.

Create the matrices for each level of the AHP tree for the criteria, sub criteria and alternatives, according to the evaluations of the experts expressed in the form of TSVNN scales, as specified in Equation 5.

These matrices are formed by comparing the importance of each pair of criteria, sub-criteria and alternatives, according to the scales that appear in Table 1.

Verify the consistency of the evaluations for each matrix. For this, it is enough to convert $\tilde{A}$ into a numerical matrix $M = \left(a_{ij}\right)_{nxn}$, such that$a_{ij} = A\left(\tilde{a}_{ij}\right)$ or $a_{ij} = S\left(\tilde{a}_{ij}\right)$, defined in one of Equations 6 and 7, and then apply the methods used in the original AHP. Which consists of:

Calculate the *Consistency Index* (CI) that depends on λ_{max}, the maximum eigenvalue of the matrix M , defined by:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (8)$$

Where n is the order of the matrix.

Calculate the *Consistency Ratio* (CR) with the equation CR = CI/IR, where IR is taken from Table 2.

Order (n)	1	2	3	4	5	6	7	8	9	10
IR	0	0	0,52	0,89	1,11	1,25	1,35	1,40	1,45	1,49

Table 2. IR associated with the order of the matrix

Table 2 shows a set of values that are used as part of the CR calculation, which were obtained experimentally for matrices of order n in the form shown in Equation 5 and are part of the original AHP technique. This guarantees that the consistency between the comparisons given by the expert, if not complete, is at least acceptable, as explained below.

- If $CR \leq 10\ \%$ it is considered that the consistency of the evaluation by the experts is sufficient and the AHP method can be applied. If not, it is recommended that the experts reconsider their evaluations.

2. From here on, the matrices $\widetilde{A}$ are replaced by their equivalent numerical matrices M, calculated in the previous step. Then proceed as follows:
   - Normalize the entries by column, dividing the elements in the column by the total sum.
3. Calculate the total of the averages by rows, each of these vectors is known as a priority vector.

The final scores are calculated starting from the highest level (Objective), to the lowest level (Alternatives), where the weights obtained for the priority vector corresponding to the immediately higher level are taken into account. This calculation is performed by multiplying each row of the matrix of priority vectors of the lower level by the weight obtained by each of these with respect to those of the upper level, then it is added per row and this is the final weight of the element of this matrix.

In the context of this research, an algorithm for decision making based on Neutrosophic AHP[4, 21, 22] and Fuzzy Cognitive Maps is proposed. Fuzzy Cognitive Maps (FCM) extend Cognitive Maps to the fuzzy domain in the interval [-1, 1] to indicate the strength of causal relationships. A FCM consists of three types of causal relationships between vertices: negative, positive, or unrelated [23, 24]. The adjacency matrix representing a FCM allows causal inferences to be made[25].

The implemented resolution algorithm has the following steps:

a. Selection of relevant indicators.
b. Once the relevant indicators have been selected, the causality between them is modeled with the help of a FCM.
c. Static analysis. The following measures are calculated for the absolute values of the adjacency matrix:

Outdegree, denoted by $od(v_i)$, which is the sum for each row of the absolute values of a variable in the fuzzy adjacency matrix. It is a measure of the accumulated strength of the existing connections in the variable.

Indegree, denoted by $id(v_j)$, which is the sum for each column of the absolute values of a variable in the fuzzy adjacency matrix. Measures the cumulative input force of the variable.

The *centrality*, or *total degree*, of the variable is the sum of $od(v_i)$, with $id(v_j)$, as indicated below:

$$td(v_i) = od(v_i), +id(v_j) \tag{9}$$

Finally the variables are classified according to the following criteria, see [14]:

- Transmitting variables are those with $od(v_i) > 0$ and $id(v_j) > 0$
- The receiving variables are those with $od(v_i) > 0$ and $id(v_j) > 0$
- Ordinary variables satisfy both $od(v_i) \neq 0$ and $id(v_j) \neq 0$

d. The study variables are evaluated on a scale from 1(Bad) to 10 (Excellent), where 5 is Regular. For this stage, the weights of each variable obtained from the Neutrosophic AHP are used and the weighted arithmetic mean of the evaluations is found with the weights obtained.

4. Results

This section describes the result of the implementation of the method of selection of non-pharmacological treatment for mild cognitive delay in older adults. The proposal has been fed by risk factors within the House of "Sagrado Corazón de la Ciudad de Ambato" in Ecuador.

The results of the study are shown below. All calculations are carried out with the help of Octave 4.2.1, which is a free software that emulates MATLAB, therefore it contains packages with numerical mathematical methods and operations with matrices.

The concepts that will be taken into account to issue the diagnosis are based on the research carried out in [26] which are listed below:

1. Music therapy,
2. Sensory stimulation,
3. Activities of daily life,
4. Cognitive Stimulation.

There were five experts, from which the median of their qualifications was taken and the following adjacency matrix was obtained, representing the FCM:

Concept	1	2	3	4
1	0	0,75	0,5	0,25
2	0,75	0	0,6	0,5
3	0,5	0,5	0	0
4	0,25	0	0	0

Table 3. Adjacency matrix representing the FCM. Each concept is denoted by the number in which it appears before (Source: The authors).

Note that Table 3 means the causality of the i-th concept by rows over the j-th concept by column. For example, 0.25 is the element that appears in the fourth row, first column of the table, this is interpreted as that both concepts are directly proportional, because 0.2> 0, however it is closer to 0 than 1. Therefore, the relationship tends to be more independent than dependent on each other.

Table 4 contains the calculations of the indexes $od(v_i)$, $id(v_j)$ and $td(v_i)$, plus the classification of each variable.

Variable	*Outdegree*	*Indegree*	*Total degree*	Classification
v_1	1,5	1,5	3	Ordinary
v_2	1,85	1,25	3,1	Transmitter
v_3	1	1,1	2,1	Ordinary
v_4	0,25	0,75	1	Ordinary

Table 4. *Outdegree, indegree, total degree* and classification of each variable (Source: The authors).

Table 4 shows the *Outdegree*, *Indegree* and *Total Degree* measures of the values in Table 3, see Equation 9. This allows each variable to be evaluated in terms of its type[27].

Table 5 summarizes the expert evaluations of the weight of each of the variables that influence the selection of non-pharmacological treatments. The neutrosophic measurement scale in Table 1 is used.

Variable	v_1	v_2	v_3	v_4
v_1	$\tilde{1}$	$\tilde{5}$	$\tilde{3}$	$\tilde{3}$
v_2	$\tilde{7}$	$\tilde{1}$	$\tilde{3}$	$\tilde{3}$
v_3	$\tilde{5}$	$\tilde{1}$	$\tilde{1}$	$\tilde{2}$
v_4	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$	$\tilde{1}$

Table 5: Pair-wise comparison matrix of variables or criteria.

Table 5 describes the relative importance of each variable with respect to the others, according to the values in Table 1.

Subsequently, the elements of Table 5 are converted into numerical values by applying the formula of Equation 7. From the numerical matrix obtained, we have λ_{max}, = 6,0542; CI = 0,008654 and CR = 0,005689; CRX100 = 0,5689% <10%, therefore there is no considerable inconsistency in the evaluations. Once the numerical matrix corresponding to the neutrosophic matrix given in Table 5 was obtained with the help of Equation 7, it is normalized by columns and the arithmetic mean per row is found, giving rise to the weights of each variable, as shown in Table 6.

Table 6 specifies the result of the calculation of the priority vector, these are the weights of each variable in importance.

Variable	Priority vector
v_1	0,375
v_2	0,462
v_3	0,250
v_4	0,062

Table 6. Priority vector for each variable.

Table 7 contains the median of the experts' evaluations for each variable on a scale of 1-10, where 1 means "Bad", 10 "Excellent" and 5 "Regular".

Variable	v_1	v_2	v_3	v_4
Value on a scale of 1-10	6	7	5	3

Table 7. Evaluation of the situation regarding the variables.

The total evaluation is carried out as the weighted arithmetic mean of the values in Table 7, with the weights in Table 6, which yields a value of 5.2507 on a scale of 1 to 10. The media values for "Music Therapy" is 3.75, for "Sensory Stimulation" it is 4.625, for "Activities of daily life" it is 2.501 and for "Cognitive Stimulation" it is 0.625, from which "Sensory stimulation" is recommended as the best treatment.

Conclusions

This investigation developed a method for selecting non-pharmacological treatment for mild cognitive impairment in older adults. The Neutrosophic AHP and Fuzzy Cognitive Maps methods were applied to select the treatment. A case study was implemented based on risk factors within the House of “Sagrado Corazón de la Ciudad de Ambato” in Ecuador. Based on the case study, it was possible to recommend non-pharmacological treatment, demonstrating the applicability of the method. It is also expected that this research can help mental health specialists to examine and diagnose in a more efficient way those older adults affected by mild cognitive impairment.

References

1. H. M. Jani, "Benefiting from online mental status examination system and mental health diagnostic system." pp. 66-70.
2. E. Correa Díaz, “El Perfil Epidemiológico Y Clínico De La Esclerosis Múltiple En El Ecuador,” *Revista Ecuatoriana de Neurología,* vol. 28, no. 2, pp. 59-70, 2019.
3. A. Bozanic, P. Toro, and F. Formiga, “Proyecto DIABDEM: estudio piloto de la prevalencia de deterioro cognitivo en diabetes mellitus en 2 países hispánicos,” *Revista Española de Geriatría y Gerontología,* vol. 54, no. 6, pp. 339-345, 2019.
4. R. G. Ortega, M. L. Vazquez, J. A. Sganderla Figueiredo, and A. Guijarro-Rodriguez, “Sinos river basin social-environmental prospective assessment of water quality management using fuzzy cognitive maps and neutrosophic AHP-TOPSIS,” *Neutrosophic Sets and Systems,* vol. 23, no. 1, pp. 13, 2018.
5. A. G. OEA, “Convención Interamericana sobre la protección de los derechos humanos de las personas mayores,” *Cuaderno Jurídico y Político*, 2015.
6. A. C. Del Ecuador, “Constitución de la República del Ecuador,” *Quito: Tribunal Constitucional del Ecuador. Registro oficial Nro,* vol. 449, 2008.
7. A. G. OEA, “Organización de los Estados Americanos,” 2019.
8. C. Fornés, and A. del Pilar, “¿ Quién cuida a los familiares que cuidan adultos mayores dependientes?,” 2014.
9. F. Smarandache, J. E. Ricardo, E. G. Caballero, M. Y. L. Vasquez, and N. B. Hernández, “Delphi method for evaluating scientific research proposals in a neutrosophic environment,” *Neutrosophic Sets and Systems*, pp. 204, 2020.
10. L. Varela, H. Chávez, M. Gálvez, and F. Méndez, “Características del deterioro cognitivo en el adulto mayor hospitalizado a nivel nacional,” *Revista de la sociedad peruana de medicina interna,* vol. 17, no. 2, pp. 37-42, 2004.
11. R. Matilla-Mora, R. M. Martínez-Piédrola, and J. F. Huete, “Eficacia de la terapia ocupacional y otras terapias no farmacológicas en el deterioro cognitivo y la enfermedad de Alzheimer,” *Revista española de geriatría y gerontología,* vol. 51, no. 6, pp. 349-356, 2016.
12. M. G. Gallego, and J. G. García, “Musicoterapia en la enfermedad de Alzheimer: efectos cognitivos, psicológicos y conductuales,” *Neurología,* vol. 32, no. 5, pp. 300-308, 2017.
13. T. B. Jané, “La estimulación sensorial como elemento fundamental de inclusión,” *Acciónmotriz,* no. 23, pp. 50-53, 2019.
14. D. C. Cárdenas-Poveda, A. F. R. González, S. T. C. Suarez, and N. N. C. Ibáñez, “Estrategias de estimulación cognitiva para la mejora de la atención en adultos con diagnóstico de discapacidad intelectual,” *Psicoespacios,* vol. 11, no. 19, pp. 3-23, 2017.
15. M. Abdel-Basset, M. Mohamed, Y. Zhou, and I. Hezam, “Multi-criteria group decision making based on neutrosophic analytic hierarchy process,” *Journal of Intelligent & Fuzzy Systems,* vol. 33, no. 6, pp. 4055-4066, 2017.
16. T. L. Saaty, “How to make a decision: the analytic hierarchy process,” *European journal of operational research,* vol. 48, no. 1, pp. 9-26, 1990.

17. J. C. S. Morán, J. F. E. Chuga, and W. M. Arias, "Neutrosophic statistics applied to the analysis of socially responsible participation in the community," *Neutrosophic Sets and Systems, Book Series, Vol. 26, 2019: An International Book Series in Information Science and Engineering,* vol. 26, pp. 18, 2019.
18. M. L. Vázquez, and F. Smarandache, *Neutrosofía: Nuevos avances en el tratamiento de la incertidumbre*: Infinite Study, 2018.
19. M. V. Alava, S. P. Delgado Figueroa, H. M. Blum Alcivar, and M. Y. Leyva Vazquez, "Single valued neutrosophic numbers and analytic hierarchy process for project selection," *Neutrosophic Sets and Systems,* vol. 21, no. 1, pp. 13, 2018.
20. M. Leyva-Vázquez, F. Smarandache, and J. E. Ricardo, "Artificial intelligence: challenges, perspectives and neutrosophy role.(Master Conference)," *Dilemas Contemporáneos: Educación, Política y Valore,* vol. 6, no. Special, 2018.
21. N. P. Becerra Arévalo, M. F. Calles Carrasco, J. L. Toasa Espinoza, and M. V. Córdova, "Neutrosophic AHP for the prioritization of requirements for a computerized facial recognition system," *Neutrosophic Sets & Systems,* vol. 34, 2020.
22. M. A. T. Cadena, E. M. P. Medina, M. J. Burgos, and F. J. Vaca, "Neutrosophic AHP in the analysis of Business Plan for the company Rioandes bus tours," *Neutrosophic Sets and Systems,* vol. 34, pp. 16, 2020.
23. O. Mar, I. Ching, and J. González, "Operador por selección para la agregación de información en Mapa Cognitivo Difuso," *Revista Cubana de Ciencias Informáticas,* vol. 14, no. 1, pp. 20-39, 2020.
24. M. A. Calderón Ramírez, J. C. de Jesús Arrias Añez, O. I. Ronquillo Riera, R. G. Herráez Quezada, Á. A. Ríos Vera, J. C. Torres Cegarra, and P. M. Ojeda Sotomayor, "Pestel based on neutrosophic cognitive maps to characterize the factors that influence the consolidation of the neo constitutionalism in Ecuador," *Neutrosophic Sets & Systems,* vol. 26, 2019.
25. S. H. Saleh Al-Subhi, I. P. Pupo, R. G. Vacacela, and P. Y. Pinero Perez, "A New Neutrosophic Cognitive Map with Neutrosophic Sets on Connections: Application in Project Management," *Neutrosophic Sets and Systems,* vol. 22, no. 1, pp. 6, 2018.
26. F. A. Reinoso Cruz, "Prevalencia de deterioro cognitivo leve y rasgos de demencia en adultos mayores de la casa hogar Sagrado Corazón en la ciudad de Ambato," 2019.
27. R. P. Alava, J. M. Murillo, R. B. Zambrano, and M. I. Zambrano Vélez, "PEST Analysis Based on Neutrosophic Cognitive Maps: A Case Study for Food Industry," *Neutrosophic Sets and Systems,* vol. 21, no. 1, pp. 10, 2018.

Received: March 23, 2020. Accepted: July 26, 2020