



# Study of Knowledge, Attitude, and Practice of Self-medication in Riobamba, Ecuador based on an Indeterminate Likert Scale

Lizbeth Geovanna Silva-Guayasamín<sup>1</sup>, Zully Mayra Romero-Orellana<sup>2</sup>, Lisbeth Josefina Reales-Chacón<sup>3</sup>, Isaac Germán Pérez-Vargas<sup>4</sup>, Sulema de la Caridad Hernández-Batista<sup>5</sup>, Carlos Antonio Escobar-Suárez<sup>6</sup>, María José López-Pino<sup>7</sup> and Josselyn Gabriela Bonilla-Ayala<sup>8</sup>

<sup>1</sup> Universidad Nacional de Chimborazo, Riobamba, Ecuador. Email: lizbethg.silva@unach.edu.ec

<sup>2</sup> Universidad Nacional de Chimborazo, Riobamba, Ecuador. Email: zully.romero@unach.edu.ec

<sup>3</sup> Universidad Nacional de Chimborazo, Riobamba, Ecuador. Email: lisbeth.reales@unach.edu.ec

<sup>4</sup> Universidad Nacional de Chimborazo, Riobamba, Ecuador. Email: iperez@unach.edu.ec

<sup>5</sup> Escuela Superior Politécnica de Chimborazo, Riobamba, Ecuador. Email: sulemadelacaridad@gmail.com

<sup>6</sup> Universidad Regional Autónoma De Los Andes, Ambato, Ecuador. Email: caes2050@hotmail.com

<sup>7</sup> Escuela Superior Politécnica de Chimborazo, Riobamba, Ecuador. Email: mariajose.lopez@espoch.edu.ec

<sup>8</sup> Universidad Técnica de Ambato, Ambato, Ecuador. Email: jg.bonilla@uta.edu.ec

**Abstract.** Self-medication (SM) is a significant public health problem in Riobamba, Ecuador, characterized by the use of drugs without a prescription. This practice carries risks such as inappropriate drug use and antimicrobial resistance. This study assesses the prevalence, associated factors, and attitudes towards SM in Riobamba. To do so, data were collected from 383 city residents, who also responded to a survey. To ensure the accuracy of the results, we asked respondents to answer some questions based on an Indeterminate Likert Scale. In this way, people can evaluate each of the different opinions, thus obtaining a more reliable result of the person's opinion, compared to the classic Likert scale. In addition, the Neutrosophic Similarity theory is used to convert the responses to a nominal scale.

**Keywords:** Self-medication, public health, Indeterminate Likert Scale, triple refined indeterminate neutrosophic set (TRINS), Neutrosophic Similarity.

## 1 Introduction

Self-medication refers to the use of medicinal products by the consumer to treat self-diagnosed disorders or symptoms, or the intermittent or continued use of a medication previously prescribed by a physician. This also includes the use of drugs for other family members, especially children and older adults.

Throughout the history of human care, people have stood out for their knowledge and skill in maintaining life and health. These people, such as Hippocrates, Galen, Avicenna, and Paracelsus, among others, were recognized for their mastery of plants and the creation of the first drugs to treat diseases. Over time, the constant evolution and success of drugs have made them an essential component of therapeutic health management.

The World Health Organization (WHO) includes self-medication as an important part of self-care and considers it a public health resource, especially in primary care within the health system. However, it is necessary to consider that in recent years, this practice has been increasing and has become established as a real public health problem, both in developing and developed countries. This practice entails several risks and many consequences, such as delayed diagnosis of diseases and their prolongation, due to masking symptoms; resistance to medications, especially antibiotics; appearance of comorbidities and even death.

Approximately 71% of men and 82% of women in the United States have resorted to self-medication at least once in their lives. In Latin America, it has been observed that 62.6% of the population self-medicates. There is no representative data on this practice in Ecuador, and even worse for the city of Riobamba, therefore, the local panorama regarding self-medication is unclear.

The type of disease, the social, cultural, and economic status of patients, national laws that regulate the use and sale of drugs, and even the illegal sale of medicines, are factors that give rise to self-medication. Specifically in middle- and low-income countries, the prevalence of self-medication is high, due to limited access to medical care and its high cost, poor conditions in health facilities, and inappropriate behaviors in seeking medical assistance in the general population.

In short, self-medication is a social phenomenon that arises from the human desire to take care of one's health. However, this practice has become so common that public health organizations cannot control it. Self-medication

can become a worldwide problem because it carries more risks than benefits. It has a multifactorial origin, with both its prevalence and its causes varying depending on the geographical area.

Regarding the factors associated with self-medication in Ecuador, self-medication is related to social, cultural, and economic factors, highlighting the commercial practices of the pharmaceutical industry, non-compliance with commercial regulations, lack of patient education, and poor accessibility to medical consultation. This last aspect is also mentioned by some authors, who indicate that other factors associated with self-medication are the high cost of medical care, poor conditions of health centers, and inappropriate behaviors in seeking medical care in the general population.

Although self-medication has been established as a public health problem, this problem has not been studied in depth in Ecuador, since the literature on this topic is very limited, and the available data does not provide relevant data. This is confirmed by those who claim that there has been no local information available in the last 10 years and that the studies that address this topic have not been carried out with a significant sample that would allow these results to be generalized to the population.

Also noteworthy is the limited literature available about this practice in Riobamba. There are few studies that provide relevant data about the prevalence of self-medication and the factors that predispose its initiation and maintenance. From this perspective, this research aims to determine the prevalence of self-medication and the factors associated with self-medication in Riobamba.

For the study, 383 city residents were surveyed using a questionnaire containing questions about self-medication. In addition, the surveyors collected some data from the people interviewed.

In the study, the accuracy of the results was prioritized. This is achieved by capturing people's opinions. These opinions can be defined as apparently contradictory feelings that coexist with each other. That is why respondents are asked to give their opinion based on an Indeterminate Likert Scale [1-7]. This type of scale gives respondents the possibility of scoring for each of the possible values of the Likert scale, instead of selecting a single value.

The Indeterminate Likert Scale is based on the concept of a triple refined indeterminate neutrosophic set (TRINS) [8, 9]. This is a refined single-valued neutrosophic set where the indeterminacy component  $I$  is split into two further components to obtain greater precision about the type of indeterminacy. The values obtained from the Indeterminate Likert Scale are converted into a determinate value concerning a predetermined scale. The conversion is done with the help of Neutrosophic Similarity, like in [1]. Consult about this topic in [10-15].

To carry out the study, this paper is divided into a section called Materials and Methods, where the main concepts of the Indeterminate Likert Scale and Neutrosophic Similarity appear. The section called Results contains the details and results of the study carried out. We finish with the conclusions.

## 2 Materials and Methods

This section contains the basic notions of the Indeterminate Likert Scale [1].

### 2.1 Basic Notions on Indeterminate Likert Scale

**Definition 1** ([1, 16]). The *Single-Valued Neutrosophic Set* (SVNS)  $N$  over  $U$  is  $A = \{ \langle x; T_A(x), I_A(x), F_A(x) \rangle : x \in U \}$ , where  $T_A: U \rightarrow [0, 1]$ ,  $I_A: U \rightarrow [0, 1]$ , and  $F_A: U \rightarrow [0, 1]$ ,  $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$ .

**Definition 2** ([1, 16]). The *refined neutrosophic logic* is defined such that: a truth  $T$  is divided into several types of truths:  $T_1, T_2, \dots, T_p$ ,  $I$  into various indeterminacies:  $I_1, I_2, \dots, I_r$  and  $F$  into various falsities:  $F_1, F_2, \dots, F_s$ , where all  $p, r, s \geq 1$  are integers, and  $p + r + s = n$ .

**Definition 3** ([1, 8, 9]). A *triple refined indeterminate neutrosophic set* (TRINS)  $A$  in  $X$  is characterized by positive  $P_A(x)$ , indeterminacy  $I_A(x)$ , negative  $N_A(x)$ , positive indeterminacy  $I_{P_A}(x)$  and negative indeterminacy  $I_{N_A}(x)$  membership functions. Each of them has a weight  $w_m \in [0, 1]$  associated with it. For each  $x \in X$ , there are  $P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \in [0, 1]$ ,  $w_P^m(P_A(x)), w_{I_P}^m(I_{P_A}(x)), w_I^m(I_A(x)), w_{I_N}^m(I_{N_A}(x)), w_N^m(N_A(x)) \in [0, 1]$  and  $0 \leq P_A(x) + I_{P_A}(x) + I_A(x) + I_{N_A}(x) + N_A(x) \leq 5$ . Therefore, a TRINS  $A$  can be represented by  $A = \{ \langle x; P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \rangle | x \in X \}$ .

Let  $A$  and  $B$  be two TRINS in a finite universe of discourse  $X = \{x_1, x_2, \dots, x_n\}$ , which are denoted by:

$$A = \{ \langle x; P_A(x), I_{P_A}(x), I_A(x), I_{N_A}(x), N_A(x) \rangle | x \in X \} \text{ and } B = \{ \langle x; P_B(x), I_{P_B}(x), I_B(x), I_{N_B}(x), N_B(x) \rangle | x \in X \},$$

Where  $P_A(x_i), I_{P_A}(x_i), I_A(x_i), I_{N_A}(x_i), N_A(x_i), P_B(x_i), I_{P_B}(x_i), I_B(x_i), I_{N_B}(x_i), N_B(x_i) \in [0, 1]$ , for every  $x_i \in X$ . Let  $w_i (i = 1, 2, \dots, n)$  be the weight of an element  $x_i (i = 1, 2, \dots, n)$ , with  $w_i \geq 0 (i = 1, 2, \dots, n)$  and  $\sum_{i=1}^n w_i = 1$ .

The *generalized TRINS weighted distance* is ([1, 8, 9]):

$$d_\lambda(A, B) = \left\{ \frac{1}{5} \sum_{i=1}^n w_i \left[ |P_A(x_i) - P_B(x_i)|^\lambda + |I_{P_A}(x_i) - I_{P_B}(x_i)|^\lambda + |I_A(x_i) - I_B(x_i)|^\lambda + |I_{N_A}(x_i) - I_{N_B}(x_i)|^\lambda + |N_A(x_i) - N_B(x_i)|^\lambda \right] \right\}^{1/\lambda} \quad (1)$$

Where  $\lambda > 0$ .

The Indeterminate Likert Scale is formed by the following five elements:

- Negative membership,
- Indeterminacy leaning towards negative membership,
- Indeterminate membership,
- Indeterminacy leaning towards positive membership,
- Positive membership.

These values substitute the classical Likert scale with values:

- Strongly disagree,
- Disagree,
- Neither agree or disagree,
- Agree,
- Strongly agree.

Respondents are asked to give their opinion on a scale of 0-5 about their agreement in each of the possible degrees, which are "Very disagree", "Disagree", "Neutral", "Agree", and "Very agree". For this, they were provided with a visual scale like the one shown in Figure 1.

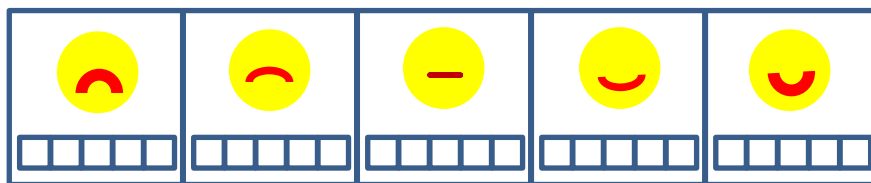


Figure 1. Graphic representation of the proposed Indeterminate Likert Scale. Source: [1].

## 2.2 Neutrosophic Similarity

In order to reduce the number of respondents' evaluations to a more specific scale, the Neutrosophic Similarity theory is used as done in [1].

**Definition 4:** ([1]) The *degree of similarity* between two single-valued neutrosophic sets  $A$  and  $B$  is a mapping  $S: \mathcal{N}(X) \times \mathcal{N}(X) \rightarrow [0, 1]^3$ , where  $\mathcal{N}(X)$  is the set of all single-valued neutrosophic sets in  $X = \{x_1, x_2, \dots, x_n\}$ , such that  $S(A, B) = (S_T(A, B), S_I(A, B), S_F(A, B))$  satisfies conditions (S1)-(S4).

$$(S1) S(A, B) = S(B, A),$$

$$(S2) S(A, B) = \underline{1} = (1, 0, 0) \text{ if and only if } A = B, A, B \in \mathcal{N}(X),$$

$$(S3) S_T(A, B) \geq 0, S_I(A, B) \geq 0, S_F(A, B) \geq 0,$$

$$(S4) \text{ If } A \subseteq B \subseteq C, \text{ then } S(A, B) \geq S(A, C) \text{ is satisfied as well as } S(B, C) \geq S(A, C).$$

**Definition 5:** ([1]) Let  $A, B \in \mathcal{N}(X)$  in  $X = \{x_1, x_2, \dots, x_n\}$ , then a measure of similarity between  $A$  and  $B$  is calculated by  $S(A, B) = (S_T(A, B), S_I(A, B), S_F(A, B))$ , where  $S_T(A, B)$  is the degree of similarity of truthfulness,  $S_I(A, B)$  is the degree of similarity of indeterminacy, and  $S_F(A, B)$  is the degree of similarity of falsity. The formulas for similarity are the following:

$$S_T(A, B) = \left( \sum_{i=1}^n \left[ \frac{\min(T_A(x_i), T_B(x_i))}{\max(T_A(x_i), T_B(x_i))} \right] \right) / n \quad (2a)$$

$$S_I(A, B) = 1 - \left( \sum_{i=1}^n \left[ \frac{\min(I_A(x_i), I_B(x_i))}{\max(I_A(x_i), I_B(x_i))} \right] \right) / n \quad (2b)$$

$$S_F(A, B) = 1 - \left( \sum_{i=1}^n \left[ \frac{\min(F_A(x_i), F_B(x_i))}{\max(F_A(x_i), F_B(x_i))} \right] \right) / n \quad (2c)$$

$$\forall x_i \in X.$$

**Definition 6:** ([1]) Suppose that for each  $x_i \in X = \{x_1, x_2, \dots, x_n\}$  a weight is associated  $w_i \in [0, 1]$  such that  $\sum_{i=1}^n w_i = 1$ . Given  $A, B \in \mathcal{N}(X)$ , then a weighted similarity measure between  $A$  and  $B$  is calculated by

$S_w(A, B) = (S_w^T(A, B), S_w^I(A, B), S_w^F(A, B))$ , where  $S_w^T(A, B)$  is the degree of similarity of veracity,  $S_w^I(A, B)$  is the degree of similarity of indeterminacy, and  $S_w^F(A, B)$  is the degree of similarity of the falsehood. The formulas for similarity are the following:

$$S_w^T(A, B) = \sum_{i=1}^n w_i \left[ \frac{\min(T_A(x_i), T_B(x_i))}{\max(T_A(x_i), T_B(x_i))} \right] \tag{3a}$$

$$S_w^I(A, B) = 1 - \sum_{i=1}^n w_i \left[ \frac{\min(I_A(x_i), I_B(x_i))}{\max(I_A(x_i), I_B(x_i))} \right] \tag{3b}$$

$$S_w^F(A, B) = 1 - \sum_{i=1}^n w_i \left[ \frac{\min(F_A(x_i), F_B(x_i))}{\max(F_A(x_i), F_B(x_i))} \right] \tag{3c}$$

$\forall x_i \in X$ .

**Definition 7:** ([1]) Let  $A, B \in \mathcal{N}(X)$  in  $X = \{x_1, x_2, \dots, x_n\}$ , then a measure of similarity between  $A$  and  $B$  is calculated by  $L(A, B) = (L_T(A, B), L_I(A, B), L_F(A, B))$ , where  $L_T(A, B)$  is the degree of similarity of truthfulness,  $L_I(A, B)$  is the degree of similarity of indeterminacy, and  $L_F(A, B)$  is the degree of similarity of falsity. The formulas for similarity are the following:

$$L_T(A, B) = 1 - \frac{\sum_{i=1}^n |T_A(x_i) - T_B(x_i)|}{\sum_{i=1}^n |T_A(x_i) + T_B(x_i)|} \tag{4a}$$

$$L_I(A, B) = \frac{\sum_{i=1}^n |I_A(x_i) - I_B(x_i)|}{\sum_{i=1}^n |I_A(x_i) + I_B(x_i)|} \tag{4b}$$

$$L_F(A, B) = \frac{\sum_{i=1}^n |F_A(x_i) - F_B(x_i)|}{\sum_{i=1}^n |F_A(x_i) + F_B(x_i)|} \tag{4c}$$

$\forall x_i \in X$ .

**Definition 8:** ([1]) Let  $A, B \in \mathcal{N}(X)$  in  $X = \{x_1, x_2, \dots, x_n\}$ , then a measure of similarity between  $A$  and  $B$  is calculated by  $M(A, B) = (M_T(A, B), M_I(A, B), M_F(A, B))$ , where  $M_T(A, B)$  is the degree of similarity of truthfulness,  $M_I(A, B)$  is the degree of similarity of indeterminacy, and  $M_F(A, B)$  is the degree of similarity of falsity. The formulas for similarity are the following:

$$M_T(A, B) = \frac{1}{n} \sum_{i=1}^n \left( 1 - \frac{|T_A(x_i) - T_B(x_i)|}{2} \right) \tag{5a}$$

$$M_I(A, B) = \frac{1}{n} \sum_{i=1}^n \left( \frac{|I_A(x_i) - I_B(x_i)|}{2} \right) \tag{5b}$$

$$M_F(A, B) = \frac{1}{n} \sum_{i=1}^n \left( \frac{|F_A(x_i) - F_B(x_i)|}{2} \right) \tag{5c}$$

$\forall x_i \in X$ .

**Definition 9:** ([1]) Let  $A, B \in \mathcal{N}(X)$  and  $X = \{x_1, x_2, \dots, x_n\}$ , then a similarity measure based on the distance between  $A$  and  $B$  is calculated by:

$$S^1(A, B) = \frac{1}{1+d(A, B)} \tag{6}$$

Such that  $d(A, B)$  is a distance function between the two single-valued neutrosophic sets.

Let us remember that the distance function satisfies the following axioms  $\forall A, B, C \in \mathcal{N}(X)$ :

- (1)  $d(A, B) \geq 0$  and  $d(A, B) = 0$  if and only if  $A = B$ ,
- (2)  $d(A, B) = d(B, A)$ ,
- (3)  $d(A, C) \leq d(A, B) + d(B, C)$ .

### 3 Results

In our research, we set the following objectives:

1. To assess the level of knowledge about self-medication among the inhabitants of Riobamba.
2. To analyze the attitudes of the inhabitants of Riobamba towards self-medication.
3. To identify the age groups with the highest prevalence of self-medication in the city of Riobamba.
4. To determine the prevalence of self-medication by sex in the population of Riobamba.
5. To identify the types of medications most frequently used in self-medication in Riobamba during the last three months.

6. To quantify the frequency of self-medication in the population of Riobamba in the last three months.
7. To evaluate the correlation between self-medication and factors such as attitude, knowledge, age group, and educational level in the inhabitants of Riobamba.

For the study, we selected 383 inhabitants of Riobamba who were visited. The survey measures the following aspects, as shown in Table 1 about the data of the respondents:

Variables	Dimension	Indicators/ coding
<b>Socio-demographic characteristics</b>	Age	12-17 (1); 18-59 (2); Over 60 (3)
	Sex	Male (1); Female (2)
	City of habitual residence	Yes (1); No (0)
	Parish of habitual residence	Lizarzaburu (1); Maldonado (2); Velasco (3); Veloz (4); Yaruquies (5)
	Marital status	Single (1); Married (2); Widowed (3); Divorced (4); Free Union (5)
	Level of Education	Basic (1); High School (2); Superior (3); Fourth Level (4); Illiterate (5)
	Occupation	Not working (1); Public Sector (2); Private Sector (3); Other (4); Retired (5)
	Field of occupation	Health Sector (1); Other Sector (2); I do not work or study (3)
	Family income	It is barely enough (1); It is not enough (2); It is more than enough (3)
	Health Insurance	Yes (1); No (0)
	Drug allergy	Yes (1); No (2); I'm not sure (3)
Chronic or Congenital Diseases	Cardiovascular diseases (e.g. hypertension) (1) Musculoskeletal disorders (e.g., rheumatoid arthritis, osteoarthritis, osteoporosis) (2) Endocrine disorders (e.g., diabetes mellitus, hypothyroidism) (3) Chronic headache (4) Respiratory conditions (e.g., asthma) (5) Blood diseases (e.g. anemia, leukemia) (6) Otorhinolaryngologic disorders (e.g., sinusitis) (7) Kidney diseases (8) Liver diseases (9) Gastrointestinal conditions (e.g., diarrhea, constipation, gastritis) (10) None (11)	

**Table 1.** Questions regarding the sociodemographic characteristics of the respondents.

Variables	Dimension	Indicators/ coding
<b>Knowledge about self-medication</b>	Self-medication is taking medications without a prescription or supervision from a specialized doctor.	Indeterminate Likert Scale
	Taking medicines from unknown sources or origins, such as medicinal plants, is always safe.	Indeterminate Likert Scale
	If any side effects occur, we should consult a doctor immediately.	Indeterminate Likert Scale
	Taking medications without medical supervision can hide serious symptoms or conditions and lead to their exaggeration.	Indeterminate Likert Scale
<b>Attitude towards self-medication</b>	Self-medication is part of self-care.	Indeterminate Likert Scale
	The general population can prescribe medications appropriately without medical training.	Indeterminate Likert Scale

Some people can properly recognize and diagnose illnesses without consulting a doctor.	Indeterminate Likert Scale
Some people may take medications on their own without consulting a doctor.	Indeterminate Likert Scale
Self-medication is safe and I recommend it to my friends and family.	Indeterminate Likert Scale

**Table 2.** Questions regarding knowledge and attitude towards self-medication. These questions use the Indeterminate Likert Scale.

Variables	Dimension	Indicators/ coding
<b>Self-medication practice</b>	Have you taken any medications on your own without supervision or prescription during the last three months?	Yes (1); No (0)
	How many times have you taken those medications in the last three months?	Less than 3 times (1); 3 to 6 times (2); More than 6 times (3)
	Do these medications help you feel better?	I feel worse (1); There is no difference/I rarely feel better (2); Sometimes I feel better (3); I always feel better (4)
	Where do you get these over-the-counter medications?	From friends (1); From family or relatives (2); On the recommendation of a pharmacist (3); Reusing old prescriptions (5); From old medications at home (6); Others (7)
	What medications have you self-medicated within the last 3 months?	Allergy medications (1); Acne or skin problem medications (2); Fever reducers (3); Vitamins and dietary supplements (4); Sleep aids (5); Steroids or Corticosteroids (6); Birth control (contraceptives, the morning after pill, etc.) (7); Antibiotics (8) Herbal Medicines (9); Eye Drops/Ointments (10); Heartburn Medicines (11); Cough Medicines (12); Laxatives (13); Analgesics (Pain Relievers) (14); Digestive Problem Medicines (15); Others (16)
	Which of the following characteristics do you consider about medications before taking them?	Indications for use (1); Name of the medicine (2); How to take the medicine (3); Possible side effects (4); Duration of use or intake (5); Contraindications (6); Methods of proper storage at home (7); None (8)
	Why did you decide to take the medications without consulting a health professional?	More privacy than going to the doctor (1); Lack of sufficient time to visit a doctor (2); Needed a quick response (3); Lack of nearby hospitals, clinics, or health centers (4); Sufficient knowledge about my health problems from past experiences (5); Mild or minor symptoms (6); Embarrassed to visit and allow examination by a doctor (7); Fear of hospital infections (8); Financial (economic) constraints or lack of health insurance to visit a doctor (9); Others (10)
	How did the COVID-19 pandemic affect your self-medication habits?	Increased since the COVID-19 pandemic (1); No difference (The COVID-19 pandemic did not affect this habit) (2); Decreased (or stopped) since the COVID-19 pandemic (3); I don't remember (4)

**Table 3.** Questions regarding self-medication practices by respondents.

The results in Table 2 are converted into more specific results by the following method:

1. The respondent answers the question with an answer that is a five-fold  $A = \langle a_1, a_2, a_3, a_4, a_5 \rangle$  based  $a_1, a_2, a_3, a_4, a_5 \in \{0, 1, 2, 3, 4, 5\}$  on the scale graphed in Figure 1.
2.  $A_N = \langle x_1, x_2, x_3, x_4, x_5 \rangle$  becomes from  $A$ , where  $x_i = \frac{A}{5}$ ,  $i = 1, 2, 3, 4, 5$ . This makes  $A_N$  a TRINS.

3. If the question is of increasing connotation then it is  $\bar{A}_N = A_N$ , that is, when the answer “agree” rather than “disagree” is the desired one. Otherwise, its negation is taken as  $\bar{A}_N = \langle x_5, x_4, x_3, x_2, x_1 \rangle$ .
4. Each value  $\bar{A}_N$  is then compared with a more approximate qualitative value. To do this, the most similar results are calculated using Neutrosophic similarity, comparing each  $\bar{A}_N$  with  $B_N$ . To do this, we must be guided by Table 4.

Linguistic value	Equivalent TRINS
Very bad	$\langle 0,0,0,0,1 \rangle$
Bad	$\langle 0,0,0,1,0 \rangle$
Neutral	$\langle 0,0,1,0,0 \rangle$
Good	$\langle 0,1,0,0,0 \rangle$
Very good	$\langle 1,0,0,0,0 \rangle$

**Table 4.** Proposed scale to concentrate the results of the responses. Association between a linguistic value and a TRINS.

In practice, the largest  $S^1(\bar{A}_N, B_N)$  using Equation 6 is calculated, where  $B_N$  is a TRINS that appears in Table 4. That is, the TRINS that appear in Table 4 with the greatest similarity between the response given by the interviewee and the TRINS is selected. Then, the linguistic value associated with the selected TRINS is assigned to the response.

Taking into account all these steps, some of the results obtained are shown in Tables 5-11:

		Frequency	Percentage
Valid	Less than 3 times	143	37.3
	From 3 to 6 times	79	20.6
	More than 6 times	26	6.8
	Total	248	64.8
No valid	System	135	35.2
<b>Total</b>		383	100.0

**Table 5.** AM frequency of survey participants.

		Frequency	Percentage
Valid	From friends	45	11.7
	From family members or relatives	68	17.8
	Old medicines at home	10	2.6
	Others	125	32.6
	Total	248	64.8
No valid		135	35.2
<b>Total</b>		383	100.0

**Table 6.** Source of obtaining medications with which survey participants self-medicate.

			AM practice in the last 3 months		Total
			No	Yes	
Gen- der	Male	Count	66	109	175
		% within Sex	37.7%	62.3%	100.0%
	Female	Count	69	139	208
		% within Sex	33.2%	66.8%	100.0%
Total		Count	135	248	383
		% within Sex	35.2%	64.8%	100.0%

**Table 7.** Self-medication practice based on the gender of survey participants.

			AM practice in the last 3 months		Total
			No	Yes	
Age Group	Teenagers	Count	11	16	27
		% within Age Group	40.7%	59.3%	100.0%
	Adults	Count	119	206	325
		% within Age Group	36.6%	63.4%	100.0%
	Older adults	Count	5	26	31
		% within Age Group	16.1%	83.9%	100.0%
Total		Count	135	248	383
		% within Age Group	35.2%	64.8%	100.0%

**Table 8.** AM practice based on the age group of survey participants.

			AM practice in the last 3 months		Total
			No	Yes	
Level of Knowledge about AM	Good knowledge (From “Neutral” to “Very good” in Table 4)	Count	73	107	180
		% within AM Knowledge Level	40.6%	59.4%	100.0%
	Poor knowledge (“Very bad” or “Bad” in Table 4)	Count	62	141	203
		% within AM Knowledge Level	30.5%	69.5%	100.0%
Total		Count	135	248	383
		% within AM Knowledge Level	35.2%	64.8%	100.0%

**Table 9.** AM practice as a function of survey participants’ level of AM knowledge.



			AM practice in the last 3 months		Total
			No	Yes	
Attitude towards AM	Favorable Attitude (From “Neutral” to “Very good” in Table 4)	Count	68	166	234
		% within Attitude toward AM	29.1%	70.9%	100.0%
	Unfavorable attitude (“Very bad” or “Bad” in Table 4)	Count	67	82	149
		% within Attitude toward AM	45.0%	55.0%	100.0%
Total		Count	135	248	383
		% within Attitude toward AM	35.2%	64.8%	100.0%

**Table 10.** AM practice as a function of survey participants' attitudes towards AM.

			AM practice in the last 3 months		Total	
			No	Yes		
The highest level of education achieved	Basic	Count	10	13	23	
		% within the Maximum level of education achieved	43.5%	56.5%	100.0%	
	Baccalaureate	Count	45	106	151	
		% within the Maximum level of education achieved	29.8%	70.2%	100.0%	
	Superior	Count	71	106	177	
		% within the Maximum level of education achieved	40.1%	59.9%	100.0%	
	Fourth Level	Count	9	21	30	
		% within the Maximum level of education achieved	30.0%	70.0%	100.0%	
	Illiterate	Count	0	2	2	
		% within the Maximum level of education achieved	0.0%	100.0%	100.0%	
	Total		Count	135	248	383
			% within the Maximum level of education achieved	35.2%	64.8%	100.0%

**Table 11.** AM practice as a function of the educational level of survey participants

## Conclusion

Analyzing the results obtained and in contrast to previous studies, within the vast panorama of public health, self-medication emerges as a significant challenge in the city of Riobamba. With a prevalence of 64.75% among respondents in the last three months, this practice highlights the urgent need to implement educational and regulatory strategies to mitigate the associated risks and promote responsible use of medications. The study revealed that self-medication is an alarmingly common practice in Riobamba. It was observed that 53% of the population has

poor knowledge about self-medication. This lack of knowledge contributes to the inappropriate use of medications, increasing the risk of adverse effects and health complications. Attitudes towards self-medication in Riobamba are predominantly favorable. This cultural acceptance could be contributing to the high prevalence observed. Self-medication is significantly correlated with factors such as attitude, knowledge, age group, and educational level. Young adults and those with lower educational levels are more likely to self-medicate. Furthermore, health insurance coverage does not appear to be a protective factor, as even those with insurance show a high prevalence of self-medication.

In short, self-medication is a significant public health problem in Riobamba. The results of this study highlight the urgent need to intervene through educational and regulatory strategies. Improving knowledge about self-medication and controlling the sale of medicines are essential steps to reduce the associated risks and promote safer and more responsible use of medicines in the community of Riobamba.

Part of the results obtained is due to the use we made of the Indeterminate Likert Scale, which allowed us to obtain more reliable results than those surveyed thought. We also used the Neutrosophic similarity theory to convert the original data to a more understandable scale.

## References

- [1] Vásquez-Ramírez, M. R., Moscoso-Paucarchuco, K. M., Beraún-Espíritu, M. M., Yupanqui-Villanueva, H. R., Vivanco-Núñez, O. A., Yupanqui-Villanueva, W. F., Fernández-Jaime, R.J., and Gutiérrez-Gómez, E. (2024). Determination of the degree of relationship between Activity Cost and Financial Management in beef cattle production in a region of Peru, based on Indeterminate Likert Scale and Neutrosophic Similarity. *Neutrosophic Sets and Systems*, 64, 84-90.
- [2] Álvarez Tapia, M. E. A., and Narva, C. (2020). Indeterminate Likert Scale for the Analysis of the Incidence of the Organic Administrative Code in the current Ecuadorian Legislation. *Neutrosophic Sets and Systems*, 37, 329-335.
- [3] Kandasamy, I., Vasantha-Kandasamy, W. B., Obbineni, J. M., and Smarandache, F. (2020). Indeterminate Likert scale: feedback based on neutrosophy, its distance measures and clustering algorithm. *Soft Computing*, 24, 7459-7468.
- [4] Leonor, M. M., Easud, G. S., and Fernando, P. P. (2022). Indeterminate Likert Scale in Social Sciences Research. *International Journal of Neutrosophic Science (IJNS)*, 19, 289-289.
- [5] Moscoso-Paucarchuco, K. M., Gutiérrez-Gómez, E., Beraún-Espíritu, M. M., González-Ríos, R. C., and Cárdenas-Bustamante, M. A. (2023). A Neutrosophic approach to Youth University Entrepreneurship in Peru, Based on the Indeterminate Likert Scale. *International Journal of Neutrosophic Science*, 21, 54-54.
- [6] Camayo-Lapa, B. F., Ninozca, F. L. K., Landa-Guadalupe, L. E., Quispe-Solano, M. A., De La Cruz Porta, E. A., Luis, L. B. J., Cabrera-Carranza, C.F., and Mandamiento, A. S. C. (2023). Characterization of social skills and emotion management of students in a public Peruvian university based on Plithogenic Statistics and Indeterminate Likert Scale. *Neutrosophic Sets and Systems*, 62, 28-35.
- [7] Ribadeneira Vacacela, A. S. (2024). A Comparison of Reading Strategies Among Spanish Speaking University Students in Different Programs of English for Specific Purposes Based on An Indeterminate Likert Scale. *Neutrosophic Sets and Systems*, 73, 131-139.
- [8] Concepción, I. P., Aldaz, E. M., Flores, L. G., and González-Caballero, E. (2020). Neutrosophic Scale to Measure Psychopathic Personalities Based on Triple Refined Indeterminate Neutrosophic Sets. *Neutrosophic Sets and Systems*, 37, 61-70.
- [9] Kandasamy, I., Vasantha, W. B., Obbineni, J. M., and Smarandache, F. (2020). Sentiment analysis of tweets using refined neutrosophic sets. *Computers in Industry*, 115, 103180.
- [10] Guo, Y., and Şengür, A. (2014). A novel image segmentation algorithm based on neutrosophic similarity clustering. *Applied Soft Computing*, 25, 391-398.
- [11] Ye, J., and Zhang, Q. (2014). Single valued neutrosophic similarity measures for multiple attribute decision making. *Neutrosophic sets and systems*, 2, 48-54.
- [12] Chai, J. S., Selvachandran, G., Smarandache, F., Gerogiannis, V. C., Son, L. H., Bui, Q. T., and Vo, B. (2021). New similarity measures for single-valued neutrosophic sets with applications in pattern recognition and medical diagnosis problems. *Complex & Intelligent Systems*, 7, 703-723.
- [13] Jafar, M. N., Saeed, M., Saqlain, M., and Yang, M. S. (2021). Trigonometric similarity measures for neutrosophic hypersoft sets with application to renewable energy source selection. *IEEE Access*, 9, 129178-129187.
- [14] Das, R., Mukherjee, A., and Tripathy, B. C. (2022). Application of neutrosophic similarity measures in Covid-19. *Annals of Data Science*, 9, 55-70.
- [15] Jafar, M. N., Saeed, M., Khan, K. M., Alamri, F. S., and Khalifa, H. A. E. W. (2022). Distance and similarity measures using max-min operators of neutrosophic hypersoft sets with application in site selection for solid waste management systems. *IEEE Access*, 10, 11220-11235.
- [16] WB, V., Kandasamy, I., Smarandache, F., Devvrat, V., and Ghildiyal, S. (2020). Study of imaginative play in children using single-valued refined neutrosophic sets. *Symmetry*, 12, 402.

Received: Oct 5, 2024. Accepted: Jan 10, 2025