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Hermeneutical Analysis of the Determinants of Obesity using Neutrosophic Cognitive Maps

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Resume. Obesity is a chronic, non-contagious disease to which attention has been paid worldwide at all times, but current studies are focused on childhood and adolescent obesity after the Covid-19 pandemic. The reason lies in the fact that the younger the child, the greater the risk of developing complications during his life. That is why it is established as a problem to be analyzed from various points of view. Consequently, this study aims to develop a causal analysis of the determinants of childhood and adolescent obesity in post-COVID-19 Ecuador using Neutrosophic Cognitive Maps from a hermeneutical point of view. The authors consider as an idea to defend that by analyzing the determining factors of childhood and adolescent obesity after the influence of Covid-19, it will be possible to strengthen the coordination and articulation mechanisms of the State, which allow the development of strategic actions to prevent overweight and obesity in the population. To achieve this, a referential framework for child-adolescent obesity was established, a working procedure was elaborated combining the hermeneutical method with neutrosophic cognitive maps for the causal analysis, and conclusions were issued where strategies were established according to the observed patterns and world trends in the face of the phenomenon that allow the development of strategic actions to prevent overweight and obesity.

Keywords: child-adolescent obesity, factors, neutrosophic cognitive maps, strategies.

1 Introduction

Overweight and obesity have become one of the main global health problems, affecting all age and socioeconomic groups [1]. According to UNICEF, the Covid-19 pandemic threatens to increase the number of overweight and obese children in countries like Ecuador. As stated in [2], 35 out of every 100 children between the ages of 5 and 11 are overweight or obese in Ecuador. It is predicted that in 2030 the number of deaths due to obesity will add 13,000 people to the 22,000 who currently die each year in Ecuador [2-12]. According to the data presented by [12], from 2012 to date there has been an increase in overweight and obesity at the national level and the problem is generalized to new-age groups. Previously, they were mainly presented in adults and older adults. Now it has even spread to children [12], as can be seen in the following figure:
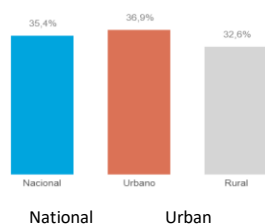
Figure 1. Overweight and obesity in Ecuador 2020, in children from 5 to 11 years old. Source: [2]

The causes of obesity are multiple and complex. In general, it is accepted as an energy imbalance between the calories consumed and the calories used through exercise and daily activities, so the body stores excess calories in the form of fat [13]. It is said to be a multifactorial disease, but it is mainly associated with inadequate eating habits and little physical activity. Various epidemiological studies hypothesize that obesity has its origin in fetal nutrition or lactation (programming theory) [14]. However, it can be said that it is not simply the result of overeating. Other factors lead to it [2, 12-18].

Obesity is a chronic, non-contagious disease to which worldwide attention has been paid at all times, but current studies are focused on childhood and adolescent obesity. The reason lies in the fact that the younger the child, the greater the risk of developing complications during his life. Moreover, the chances of persisting obesity into adulthood are 20% at 4 years of age, and 80% at adolescence. Therefore, the prevention of the disease from an early age plays an important and decisive role in human health [3, 14, 19, 20].

For all the above-mentioned, it is decided to focus this investigation mainly on these age groups. Due to the importance of prevention and the possibility of adopting proactive strategies. According to [2], child overweight is a structural problem since it reflects the poverty that exists in Ecuador, which has not been addressed from an integral perspective, so it is decided to expose this as a problem to be analyzed. It is necessary to say that the object and field of the present investigation have a certain level of subjectivity, so it is convenient to analyze the problem situation from various points of view. Consequently, it is advantageous to use the hermeneutical method in an environment of uncertainty to establish a quantitative causal analysis.

After a review of the bibliography and consultation with several authors [21-36], it is decided that, due to its versatility in the investigation of causal factors, the Neutrosophic Cognitive Maps (NCM) will be chosen from the theory of neutrosophy proposed by Florentin Smarandache, for the treatment of neutralities. Which generalizes theories [35] and it has numerous applications in many fields. Moreover, its use enriches the possibilities of analysis, mainly due to the addition of the notion of indeterminacy and the possibility of calculating using linguistic terms that is more natural for experts [37].

NCMs according to [13], are a way of representing knowledge using a graph, the strength between the relationship can be measured, which is why it is used in social studies [11] [14]. Due to this, the main objective of this research is to develop a causal analysis of the determinants of child and adolescent obesity in post-covid-19 Ecuador using NCM from a hermeneutical perspective. Furthermore, the authors consider it an idea to defend that when analyzing the determining factors of Child and adolescent obesity after the influence of Covid-19, the State's coordination and articulation mechanisms will be strengthened, allowing the development of the strategic actions necessary to prevent overweight and obesity.

To achieve this objective, the following specific objectives must be executed:
1. Establish a reference framework for childhood and adolescent obesity
2. Develop a working procedure combining the hermeneutical method with NCMs for causal analysis.
3. Partial conclusions where strategies are established according to the observed patterns and world trends in the face of the phenomenon.

From now on, the document is structured according to the stated objectives.

2 Referential framework of childhood obesity

Through a web search, we obtained the references shown in [1-20], about which can be said that:
1) 100% agree that obesity is a concern of all countries regardless of their economic status and that it affects all ages, triggering chronic health problems such as diabetes, high blood pressure, heart disease, and other non-contagious chronic diseases. This is the main concern of its condition in children so prevention is necessary.
2) 60% agree that this social problem has increased enormously after the pandemic in Ecuador, affecting especially children and adolescents.
3) Few studies have been done on children up to preschool age. From the study carried out in [14], it was detected that in the group of obese or overweight children it was evidenced that there was an association between the alteration of the state of nutrition due to excess and the variables: family history of obesity, birth weight, and abdominal circumference. It can be said that the highest values have been found in female infants and urban areas. It was also shown that there was a significant relationship between children born macro-fetus and obesity, so family history should also be considered. Parents reported physical activity and eating habits. Despite the lack of association between these variables, there was a trend towards a decrease in the intensity of physical activity in obese children. Although many parents think that preschoolers are very active, which would favor a higher energy expenditure, various studies show that physical activity is low [14].

4) Epidemiological studies, the experts consulted, as well as the interview with obsessed parents and children established the following as causal factors:

a) Age: As you get older, hormonal changes and a less active lifestyle contribute to the arrival of obesity. Furthermore, in children, it has been perceived that insufficient maternal breastfeeding implies a tendency to obesity since breast milk is replaced by other nutritional components sometimes unsuitable for the infant. As people get older, their habits change, including eating habits. It has been noted that adolescents whose schools are close to unsuitable food sources tend to consume more of these during their teaching day.

b) Female sex: mainly associated with pregnancy and menopause. Obesity also occurs in women who have polycystic ovary syndrome, which is an endocrine condition that prevents proper ovulation. Being a man would decrease the probability of being overweight by 6 percentage points

c) Ethnicity: Obesity is highly prevalent in Afro-descendants and people of Hispanic origin. To have indigenous origin would increase the probability of being overweight or obese by about 9 percentage points.

d) Unhealthy eating: in the last 50 years there has been a universal tendency to eat foods rich in fat, salt, and sugar. Too many calories are consumed, fast foods and high-calorie drinks are abused. Too high consumption of cereals (rice, pasta, bread), oils and fats, sugars, and sweets. In turn, it was found that the consumption of sweetened beverages exceeds the consumption of fruits and vegetables. Similarly, the consumption of meals prepared outside the home, which in the urban region consumption is higher, probably due to the greater access and availability of these foods compared to the rural area. This could be related to the high consumption of fats and sugars found in meals prepared outside the home. Consumption of packaged products, high-energy snacks, soft drinks, little intake of fruits and vegetables. It has been stated that adolescents tend to be the majority group in the consumption of these types of products.

e) Sedentary lifestyle: a sedentary way of life due to the automation of work activities, modern means of transport, and a greater urban life, which influences the decrease in the practice of physical exercise. Sports activities at school are not relevant in the case of schoolchildren whose mothers have a high educational level. One possible explanation is that the homes of the schoolchildren that make up this group would have more resources to practice sports outside of school. On the other hand, schoolchildren belonging to groups with a lower socioeconomic level would face more restrictions to access instances for physical activity outside of school [19].

f) Sociocultural and economic factors: it is associated with a lower level of education and a lower level of income to buy healthy food. Poverty in general, since it does not allow access to healthier food due to its price and is linked to the low educational level of parents, leads to promoting the consumption of canned, packaged, and chemically processed foods. In the same way, advertising affects this group, since they tend to be a victim of excess promotion for the consumption of this type of food. In the same way, the characteristics of the neighborhood, the population density, and the availability of healthy food. Among other characteristics, they can influence the creation of an environment that increases the probability that a person will be overweight or obese. The mother's education is influential in obesity only for the segment of schoolchildren with mothers with a high educational level, decreasing by 14.2 percentage points the probability that the schoolchild is overweight in relation to those who have mothers with a low educational level.

g) Behavioral factors: that is, unhealthy lifestyles where there is incorrect food consumption, smoking, and alcohol intake, as well as incorrect sleeping habits. It is observed that a shorter distance between the school and the nearest fast food restaurant could be especially detrimental for schoolchildren of high socioeconomic status. This is possibly explained because, although the schoolchildren that make up this group have greater flexibility in choosing their diet, they also have greater purchasing power in relation to those with a lower socioeconomic level. To the detriment of their nutritional condition, schoolchildren with a high socioeconomic level are more likely to afford and consume this type of food without adult supervision.

h) Genetic factors: some genetic studies have determined that obesity can be inherited with genes that influence the amount of body fat and its distribution.

i) Certain medications: some medications can cause weight gain if not compensated by diet or exercise: among these medications are some antidepressants, anticonvulsants, steroids, antipsychotics, diabetes medications, and beta-blockers.

3 Methods

For the development of this research, a quantitative methodology was used because it allows precise analysis with numerical percentages. In addition, the method of documentary research, bibliographic, field and observational research, inductive/deductive method was used to conduct the hermeneutical analysis. This method allows establishing and analyzing different perspectives and compares them with the literature consulted. The following form of hermeneutical analysis was taken:
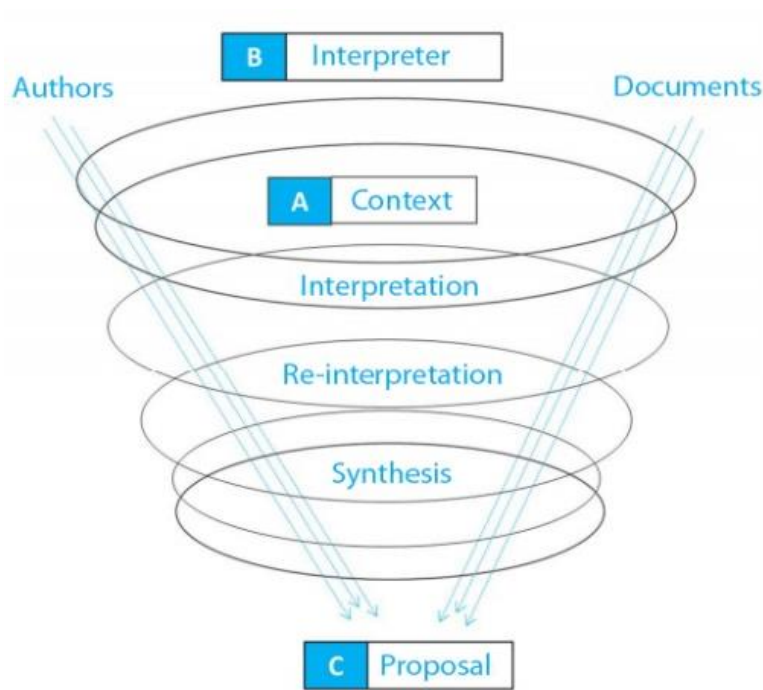

Figure 2. Hermeneutical spiral general design. Source: [38].

The literature consulted [38-48], allowed us to know that this method offers the possibility of interpreting the same problem from different points of view. With which it is possible to integrate the problem analyzed from various perspectives and adopt dynamic positions. In this reality of the author of the text, of the text itself, and the interpreter's environment, a dialogue is conjugated. Therefore, it is said that it is an interpretive activity and answers, between the horizons that merge, due to the close relationship between asking and understanding.

Reason for which it is said to be characterized by a high level of subjectivity and therefore there is uncertainty. In other words, hermeneutics tends to qualitative interpretation, which leads to subjectivity in knowledge, and although the scientific method owes its roots to hermeneutics, it seems a contrasting form of knowledge in which hermeneutics no longer has a place. That is why its fusion with neutrosophy and the NCMs is convenient.

For a better understanding of data processing with NCMs, the following is exposed:

Starting from the previous elements, in this particular work, the use of Neutrosophic Cognitive Maps (NCMs) is proposed considering the advantages that this technique offers compared to other soft-computing techniques, in terms of interpretability, scalability, aggregation of knowledge, dynamism, and its ability to represent feedback and indeterminacy relationships [36]. NCMs were introduced by [49] in 2003. NCMs are an integration of the Fuzzy Cognitive Maps (FCMs) introduced by Kosko in 1986 and the Neutrosophic Sets (NSs) introduced by Smarandache in 1995 [21]. This technique overcomes the inability of traditional FCMs to represent indeterminacy. The inclusion of indeterminacy establishes that neutrality and ignorance are also forms of uncertainty.[21] exposes that FCMs constitute a technique that has received increasing attention due to its possibilities for representing causality. The following is a set of definitions necessary for working with NCMs. First, let formally expose the original definition of neutrosophic logic as it is shown in [31].

Definition 1. Let $N = \{(T, I, F): T, I, F \in [0,1]\}$ be a *neutrosophic set of evaluations*. v: $P \rightarrow$N is a mapping of a group of propositional formulas into N, i.e., each sentence p∈ is associated to a value in N, as it is exposed in Equation 1, meaning that p is T% true, I% indeterminate and F% false.

$$v(p) = (T, I, F) \tag{1}$$

Hence, the neutrosophic logic is a generalization of fuzzy logic, based on the concept of neutrosophy according to [30, 35].

Definition 2. (See[28, 29]) Let K be the ring of real numbers. The ring generated by K∪I is called a *neutrosophic ring* if it involves the indeterminacy factor in it, where I satisfies $I^2 = I$, I+I = 2I, and in general, I+I+...+I = nI, if k∈, then k.I = kI, 0I = 0. The neutrosophic ring is denoted by K(I), which is generated by K∪I, i.e., K(I) = <K∪I>, where <K∪I> denotes the ring generated by K and I.

Definition 3. A *neutrosophic matrix* is a matrix A = [a$_{ij}$]$_{ij}$ i =1, 2, …, m and j = 1, 2, …, n; m, n≥1, such that each a$_{ij}$∈K(I), where K(I) is a neutrosophic ring, see [32]. Let us observe that an element of the matrix can have the form a+bI, where "a" and "b" are real numbers, whereas I is the indeterminacy factor. The usual operations of neutrosophic matrices can be extended from the classical matrix operations.

For example, $\begin{pmatrix} -1 & I & 5I \\ I & 4 & 7 \end{pmatrix} \begin{pmatrix} I & 9I & 6 \\ 0 & I & 0 \\ -4 & 7 & 5 \end{pmatrix} = \begin{pmatrix} -21I & 27I & -6+25I \\ -28+I & 49+13I & 35+6I \end{pmatrix}$

Additionally, a *neutrosophic graph* is a graph that has at least one indeterminate edge or one indeterminate node [26, 31]. The *neutrosophic adjacency matrix* is an extension of the adjacency matrix in classical graph theory. $a_{ij} = 0$ means nodes i and j are not connected, $a_{ij} = 1$ means that these nodes are connected and $a_{ij} = I$, which means the connection is indeterminate (unknown if it is or if not). Fuzzy set theory does not use such notions. On the other hand, if the indetermination is introduced in a cognitive map as it is referred to in [25], this cognitive map is called a neutrosophic cognitive map, which is especially useful in representing causal knowledge [24, 35]. It is formally defined in Definition 4.

Definition 4. A *Neutrosophic Cognitive Map* (NCM) is a neutrosophic directed graph with concepts like policies, events, among others, as nodes and causalities or indeterminacy as edges. It represents the causal relationship between concepts.

The measures described below are used in the proposed model, they are based on the absolute values of the adjacency matrix [25]:

- Outdegree (v_i) is the sum of the row elements in the neutrosophic adjacency matrix. It reflects the strength of the outgoing relationships (c_{ij}) of the variable:

$$od(v_i) = \sum_{i=1}^{n} c_{ij} \tag{2}$$

- Indegree (v_i) is the sum of the column elements. It reflects the strength of relations (c_{ij}) outgoing from the variable.

$$id(v_i) = \sum_{i=1}^{n} c_{ji} \tag{3}$$

- Total centrality (total degree td (vi)), is the sum of the indegree and the outdegree of the variable.

$$td(v_i) = od(v_i) + id(v_i) \tag{4}$$

The variables are classified according to the following criteria, see [50]:

a) The transmitting variables are those with od (vj)> 0 and id (vi) = 0.
b) The receiving variables are those with od (vj) = 0 and id (vi)> 0.
c) The ordinary variables satisfy both od (vj) ≠ 0 and id (vi) ≠ 0.

The static analysis is applied using the adjacency matrix, considering the absolute value of the weights [26]. Static analysis in Neutrosophic Cognitive Maps (NCM), see [24], initially contains the neutrosophic number of the form (a + bI), where I = indetermination [23]. Then, it requires a process of de-neutrosophication as proposed in [25], where I ∈ [0, 1] and it is replaced by their values maximum and minimum.

Finally, we work with the average of the extreme values, which is calculated using Equation 5, which is useful to obtain a single value as it is referred to in [25]. This value contributes to identifying the characteristics to be attended, according to the factors obtained, for our case study.

$$\lambda([a_1, a_2]) = \frac{a_1 + a_2}{2} \tag{5}$$

Then,

$$A \succ B \Leftrightarrow \frac{a_1 + a_2}{2} > \frac{b_1 + b_2}{2} \tag{6}$$

Then, the authors of the investigation, based on the exposure for the hermeneutical method and the NCM, decided to elaborate a work procedure. Equations 2-6 will merge with [41, 43] of the heuristic method, as shown below:
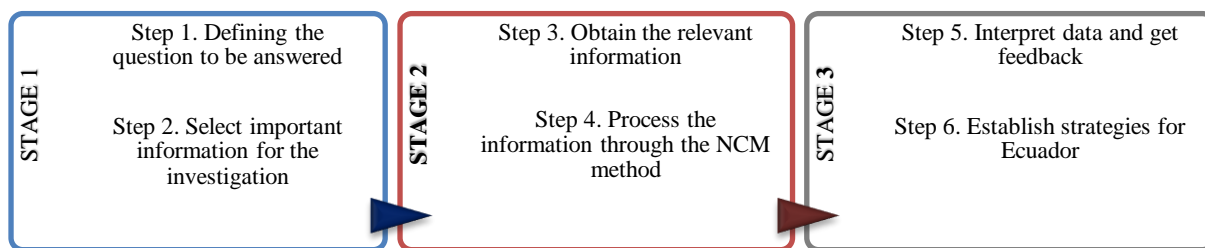
STAGE 1	STAGE 2	STAGE 3
Step 1. Defining the question to be answered	Step 3. Obtain the relevant information	Step 5. Interpret data and get feedback
Step 2. Select important information for the investigation	Step 4. Process the information through the NCM method	Step 6. Establish strategies for Ecuador

Figure 3. Elaborate procedure.

4 Application of the designed procedure

Step 1. Define the question to be answered: Which causal factor of obesity has the highest level of influence?

Step 2. Select the important information for the investigation: Information was selected from three different points of view:

- Medical: it was obtained from the medical repositories on the web.
- Ecuadorian news: in Ecuadorian news, magazines of national political interest were investigated, and experts' criteria.
- Patient perception: the criteria set out in the obese patient surveys were taken into account.

Step 3. Obtain the relevant information

The information was processed according to the perspectives selected in the previous step

- Medical: the main causal factors of obesity were obtained.
- Ecuadorian news: medical experts (10) and non-medical experts (5 teachers, 4 psycho-pedagogues) were taken.
- Patient perception: 7 patients diagnosed with obesity were consulted in an institution.
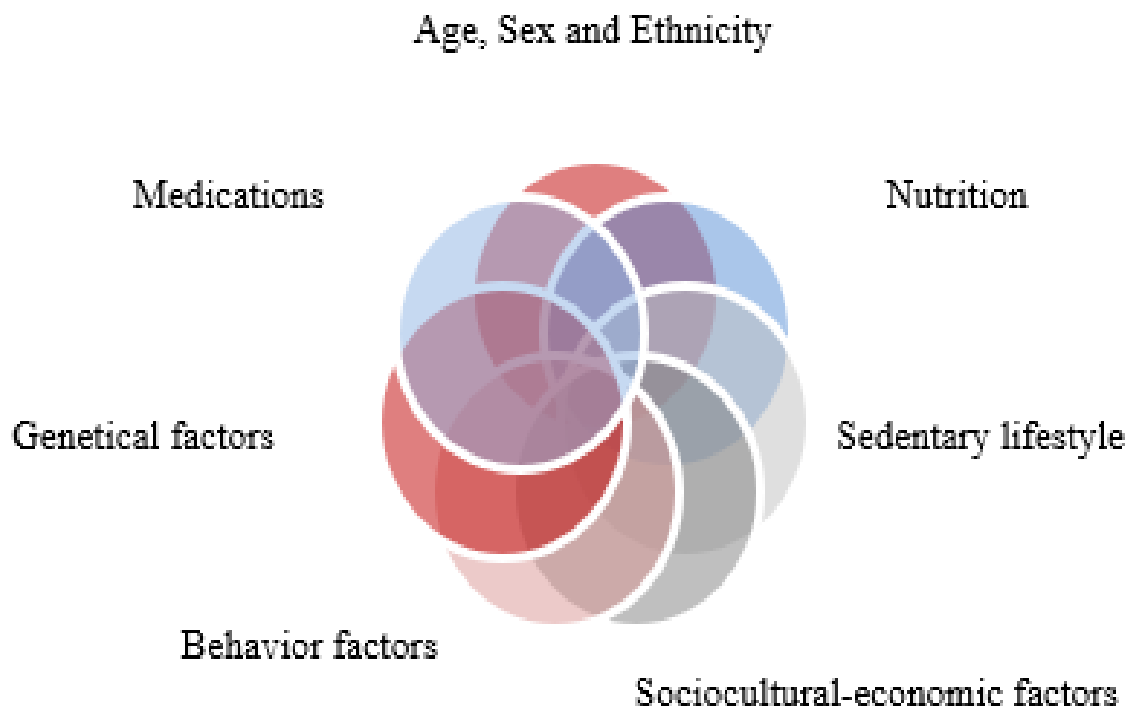
The information is shown in Figure 4.

Figure 4. Diagnosed causal factors of obesity.

Step 4. Process the information using the neutrosophic method (NCM)

$$
E(X)=\begin{pmatrix}
0 & 1 & 0.5 & 0.5 & 0.8 & 0.6 & I & 0.8 & 1 \\
1 & 0 & 0.7 & I & 0.7 & I & 0 & 0.7 & 1 \\
0.8 & 0.9 & 0 & 0 & 0.5 & 0 & 0 & 0.6 & 0.9 \\
0.3 & 0 & 0 & 0 & 0 & 0 & 0.7 & I & I \\
1 & 1 & 1 & 0 & 0 & 1 & 0 & 0.5 & 0.6 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 0.8 & 0.9 \\
0 & 0 & 0 & 1 & 1 & 0.4 & 0 & 0.7 & 0 \\
1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0
\end{pmatrix}
$$

$$
E(X)=\begin{pmatrix}
0 & 1 & 0.5 & 0 & 1 & 0.6 & 0 & 0.2 & 1 \\
1 & 0 & 0.7 & 0 & 0.5 & 0.5 & 0 & 0.3 & 1 \\
0.7 & 1 & 0 & 0 & 0 & 0 & 0 & 0.5 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
1 & 1 & 1 & 0 & 0 & 1 & 0 & 0.5 & 1 \\
1 & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & I & 1 \\
1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 1 \\
1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 0
\end{pmatrix}
$$

$$
E(X)=\begin{pmatrix}
0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\
1 & 0 & 1 & 0 & 0.5 & 1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0
\end{pmatrix}
$$

Figure 5. Neutrosophic adjacency matrix "Doctors", "Non-doctors" and "Patients".

Perspectives	Doctors			Non-Medical Experts			Patients		
Factors	id	od	td	id	od	td	id	od	td
Age	0.7625	0.7125	1,475	0.8142	0.6142	1.4285	0.5555	0.3333	0.8889
Sex	0.7375	0.6375	1,375	0.8571	0.5714	1.4285	0.6667	0.3889	1.0556
Race	0.65	0.4625	1.1125	0.7428	0.4571	1.2	0.5556	0.1111	0.6667
Medicines	0.5	0.25	0.75	0	0.1428	0.1428	0.3333	0	0.3333
Feeding	0.75	0.6375	1.3875	0.7857	0.7857	1.5714	0.7222	1	1,7222
Sedentary lifestyle	0.6875	1.0875	1,775	0.5857	0.8571	1.4428	0.6667	1	1.6667
Genetic factors	0.525	0.3875	0.9125	0.2857	0.2857	0.5714	0.4444	0.1111	0.5556
Factors Behavioral	0.7	0.875	1,575	0.5	1	1.5	0.3333	0.6667	1
Sociocultural-economic factors	0.7375	1	1.7375	1.1428	1	2.1428	0.2222	0.8889	1.1111

Table 1. Static analysis of the adjacency matrix by perspectives

Step 5. Interpret the data and get feedback

Question: Which causal factor of obesity has the highest level of influence?

Answer: Taking into account the perspectives analyzed, the factors are ordered according to their level of influence as follows:

Outlook	Medical		Non-Medical Experts		Patients	
Factors	Order	Classification	Order	Classification	Order	Classification
Age	4	Transmitter	5	Transmitter	6	Transmitter
Sex	6	Transmitter	6	Transmitter	4	Transmitter
Race	7	Transmitter	7	Transmitter	7	Transmitter
Medicines	8	Transmitter	9	Receiver	9	Receiver

Feeding	5	Transmitter	2	Transmitter	1	Transmitter *Highly influential*
Sedentary lifestyle	1	Transmitter	4	Transmitter	2	Transmitter *Highly influential*
Genetic factors	9	Transmitter	8	Transmitter	8	Transmitter
Behavioral factors	3	Transmitter	3	Transmitter *Highly influential*	5	Transmitter
Sociocultural-economic factors	2	Transmitter *Highly influential*	1	Transmitter *Highly influential*	3	Transmitter

Table 2. Analysis of the results.

Despite the existence of variability in the order of the results, the 3 groups agree in the first four places in the factors that, according to their criteria, promote obesity. The data was presented in a brainstorming session before the experts consulted in a general way. They all agreed with the results and expressed that there may be variations in the ratings given if the experts' panel is changed.

It was possible to know during the feedback that in the case of the assessments according to the sex and age factors, the experts were guided by the real conditions that women in Ecuador have. The high level of discrimination due to these factors is a trigger for situations that prevent a proper lifestyle. It was also possible to determine the role of educational centers as trainers since due to the very situation of discrimination and the presence of women of indigenous ethnic groups, there is a low educational level. Therefore, women generally responsible for the care of the home and children, do not assume a healthy lifestyle due to the lack of information and economic situation. That is why education centers, as well as women's aid centers, are so important in this matter.

At another point in the conversation, teachers and parents commented on the need to limit the exposure of children and adolescents to advertising and promoting packaged meals. The "information avalanche" regarding the consumption of this type of substance increases the risk of obesity since it encourages its regular intake. In addition, there is a closeness between the street vendors that offer this type of food in the vicinity of the schools.

Step 6. Establish strategies for Ecuador
1. Establish a communication strategy and social advertising campaign where people can learn about healthy lifestyles in poor communities. Focused mostly on those aimed at the adolescent, poor and female population.
2. Prepare and disseminate guides for proper nutrition and also for physical exercises at home.
3. Establish recreational programs in communities.
4. The sale of products to students should be regulated, which restricts the supply of foods high in fat, sugar, and sodium. More effective monitoring measures are required to ensure compliance.
5. Strengthen educational programs in preschool, primary and secondary centers related to healthy living: diet, physical activity, no alcoholism, and no discrimination. That the rights of children to a full life be advocated.

Conclusions

According to the bibliography consulted, obesity is a consequence of multiple factors such as inadequate eating habits, low consumption of fruits and vegetables, sedentary or unhealthy lifestyles, poverty, low schooling, null or insufficient breastfeeding, culture, advertising, among others. Ecuador is not free from that situation. Today there is an alarm among children and young people whose lives have been affected by the context of the pandemic since inappropriate eating behaviors and a low level of physical activity are some of the most important risk factors for developing obesity. This is why physical activity and proper eating habits should be encouraged. This environment alerts about the urgent need to adopt measures to increase the consumption of fruits and vegetables with respect to the consumption of sugars from food and beverages and packaged foods that contain high content of sugars, fats, and sodium. The sale of such products to students should be regulated. More effective monitoring measures are required to ensure compliance and the establishment of advertising strategies to educate children, adolescents, and mothers for the sake of a culture of healthy living. Including indigenous ethnic groups in this issue is urgent.

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