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Priorization of educational strategies on nutrition and its correlation in anthropometry in children from 2 to 5 years with neutrosophic topsis

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Abstract. The study carried out at the Tajamar Health Center allows the evaluation of the educational strategies to be followed by the mothers of children aged from 2 to 5 years, leading to the definition of a correct nutrition pattern and its correlation with the value of anthropometry by applying the TOPSIS Neutrosophic method. A descriptive, qualitative, quantitative and field study was conducted. In order to determine the level of knowledge of the children's mothers, we used the survey as a technique; which allowed to identify the status of nutrition in which they are and whether the growth and development of each child is according to their age or not. While carrying out the investigation, it was confirmed that there is an eating disorder in children, since 50% of the mothers prepare their food based on carbohydrates. In addition, only 20% of the mothers indicate that they put fruit in their children's lunchboxes; 55% refers to the consumption of junk food. The lack of physical activity is often a risk factor for diseases due to eating disorder. The obtained results allow the implementation of strategies based on the assessment of nutritional status in order to improve the lifestyle of each children.

Keywords: nutrition, anthropometry, eating habits, quality of life.

1 Introduction

Having a balanced diet is a very important factor in the life of every human being. From the birth itself, we can see that this life cycle is the most important thing until adulthood because all the predisposing factors in his life are those who lead to good growth and development and avoid diseases and other complications. [1]

Vargas (2011) carried out a transversal descriptive study "eating habits, nutrition and the level of physical activity not only affect health in the present, but also determine the risk of contracting chronic diseases in the future". The goal of this study was to identify the perception of healthy eating, and the association between eating habits, nutritional status, and level of physical activity in schoolchildren.

Castillo (2016), in a study carried out in Colombia, considers that the general development context is fundamental for children, and within this context the nutritional situation plays a very important role. It was determined that nutrition is one of the decisive factors providing the "context", and no other factor has so much to do with situations that can be controlled by society, institutions and the State.[2-3]

González (2010) about the "nutritional situation of schoolchildren in the community of Madrid. Family conditions" whose objective is to determine the nutritional status and associated factors in the diet, it was determined that according to the results obtained in this paper, where approximately one third of the schoolchildren analyzed have a weight overload, that it is necessary to take actions to reverse this problem. With this regard, it is a priority to improve the living and feeding habits of parents, since they directly influence their children, and they must know the conditions that may affect the aforementioned habits. In this sense, the educational level of the mother seems to be the factor that most influences the type of behaviors that occur in the family. The higher the educational level of the mother the healthier these behaviors are. [1]

This research has a great impact in the field of health, because it makes it possible to determine the nutrition strategies that will allow the implementation of educational strategies contributing to good nutrition in children, ensuring their appropriate growth and development, by encouraging them from a very early age to maintain a good

health status. The chosen strategies must be consistent with a correct anthropometric development. A balanced nutrition in conjunction with physical activity will help them stay in good physical condition allowing growth and development according to their age.

The goal of this research is to determine the best nutrition strategies that will lead to educational improvements to the mothers' knowledge, respecting their beliefs, and educating them with scientifically proven information. That's why the application of education strategies will be of great contribution to the improvement of the quality of life of the inhabitants.

Health professionals have long recognized the importance of establishing healthy nutrition practices. "The diet and exercise adopted during these years are fundamental for development and prepare the ground to acquire lifelong habits that can make the difference between vitality and the absence of it in future years" [5]

Anthropometry has been widely used as a summary indicator of health and nutrition related conditions [6]

Nutrition, meanwhile, includes all those processes through which the body incorporates, transforms and uses the chemical substances (nutrients) contained in food, to carry out different functions such as: covering energy needs, forming and maintaining body structures, regulate metabolic processes and prevent diseases related to nutrition [7]

Infants are vulnerable to food restrictions, which leave sequels in basic areas of their development in medium and long term. It is essential to ensure that the people have access to a healthy diet that contributes to the prevention of alterations of child development. These days, low weight is frequent; and therefore, chronic malnutrition is the most common one and it is expressed in short stature. This form of malnutrition seems to affect mental development, language and motor development [2].

This research will have a great impact in the health field, because it allows to determine in order of analytical hierarchy [8] the best nutrition strategies for a normal anthropomorphic development of the child, guaranteeing to implement educational strategies that contribute to a good nutrition in children ensuring their appropriate growth and development, by encouraging from an early age to maintain a good health status. The eating habits that you implement at this age will keep you until adulthood[3]. A balanced nutrition in conjunction with physical activity will help you stay in a good physical condition allowing growth and development according to your age.

The research is based on improving the knowledge of mothers, respecting their beliefs, and educating with scientifically proven information, which is why the application of education strategies will be of great contribution to the improvement of the quality of life of the inhabitants.

2. Development

2.1. Definition of the criteria to evaluate

To make a correct selection of the nutrition strategy in the case of studies of Tajamar Health Center, according to a correct anthropomorphic development of children, the criteria to be evaluated must first be defined, but first it is necessary to define for this case study. The set of **alternatives** is defined as A*i* and the set of **criteria** to evaluate as C*j*.

We will consider as alternatives, *acceptable nutrition strategies for a correspondence with an adequate anthropometry, which will eventually constitute educational strategies to be followed by mothers*. As a result from the combination of the breakfast food group, the snack food group and the time of physical exercises, and we will define it as follows:

Breakfast: B*j* = (BA*j*, BB*j*, BC*j*) for three basic foods in the breakfast diet
Snack: S*k* = (SA*k*, SB*k*, SC*k*) for three basic foods in the diet for the snack
Exercise: E*i*, the time spent in physical exercises

These *alternatives* were obtained from the combinations of the related patterns in the table (2.1)

Breakfast	**Snack**	**Physical exercises**
Coffee, Bread, Eggs	Apple, Yogurt, Cookies	1 hour
Fruit, Yogurt, Juice	Potatoes, Chitos, Chocolate	2-3 hours
Rice , Meat, Chocolate	Juice, Sandwich	4 hours
Candies, cookies	Fruits	none

Table 2.1 possible feeding strategies

To these three variables that make up the health education strategic *alternatives*, we add a purely quantitative

variable, the anthropometry measure, which allows us to know the growth pattern of each individual.

Anthropometry: AN*t* = (AN1, AN2, .. AN*n*) is the anthropometric pattern of individual t that has a nutrition pattern (B*t*, S*t*, E*t*)

Therefore, in order to get a child *t* to develop with an optimal and adequate anthropometric pattern A*t*, the educational feeding strategy that the mother must follow is (B*j*, S*k*, E*i*).[4, 5] This will achieve a good performance of the biological functions, avoid alterations, predict their health and chances of survival. In the field of populations, it constitutes a valuable element for decision-making in matters of education for public health.

In order to establish a hierarchical order to the strategies in accordance with an adequate nutrition pattern and corresponding to the appropiate growth and development of the child (Anthropometry), we will define as alternatives A*i* = (X1, X2 ... X*n*) the possible educational strategies to follow by mothers, taking into account a pattern of nutrition for their children at breakfast, snack and a measure of physical exercise. These data are extracted from the surveys carried out in the Tajamar Health Center for mothers with children aged from 2 to 5 years. See table 2.1

As criteria C = (C1, C2, … C*n*) the anthropometric patterns defined as

c1: Beneficial

c2: Feasible

c3: neutral

c4: dangerous

These 4 criteria will be weighted through the Analytical Hierarchy Process (AHP) [9] using triangular neutrosophic numbers, [10-11] which implies assigning a relative priority to each criterion according to the degree of influence of the educational strategy with the anthropometric development.

Value	Meaning	NTS
1	Equal influence	(1,1,1); (0.50, 0.50, 0.50)
3	Moderate influence	(2, 3,4); (0.30, 0.75, 0.70)
5	Remarkable influence	(4,5,6); (0.80, 0.15, 0.20)
7	very noticeable influence	(6,7,8); (0.90, 0.10.0.10)
9	absolute influence	(9,9,9); (1.0, 0.0, 0.0)

Table 2.2 Priority scale of the AHP criteria according to the degree of influence using triangular neutrosophic numbers.

The preparation of the table with the surveys has a thorough and careful manual processing so that the information is not biased, the three chosen patterns of the surveys are shown in Table 2.3

Child	Breakfast	Snack	Physical exercises	Cx
one	Candies, cookies	Potatoes, Chitos, Chocolate	none	dangerous
two	Rice, Meat, Chocolate	Fruits	2-3 hours	Beneficial
3	Fruit, Yogurt, Juice	Fruits	1 hour	Feasible

Table 2.3 Strategies for child, breakfast, snack, physical exercises and anthropometry

Only 3 patterns were taken to explain the calculation methodology.

We used the experts' criteria to construct the matrix of binary comparisons Table (2.4) analyzing the degree of influence of the education strategy with the degree of anthropometry, using the correspondence of table (2.2) and (2.3)

	C1	C2	C3	C4
C1	1	3	5	7
C2	7	1	0,5	1
C3	5	1	0,5	0,5
C4	3	2	0,5	3

Table 2.4 Matrix of binary comparisons

2.2. Determination of the relative weights of the criteria

To determine the relative weight, importance or influence of each of the criteria in the final result, we used the binary comparisons method defined in the AHP method, proposed by Saaty in 1980. [14-15]

In order to take into account the dissimilar importance that different strategies may have in the collaborative environment, the weighted average aggregation operator WA, for its acronym in English, is used in this proposal with the calculation of weights through the Analytical Hierarchy Process (AHP) using triangular neutrosophic numbers from table (2.2)

Calculating the average by rows through Equation (2.2), an approximation to the relative weight of each of the criteria C*j* is obtained. It is an approximation since it is based on the subjectivity of the decision maker.

$$Wj = \frac{\sum_{j=m}^{j=1} X_{ij}\ Normalizado}{m} \tag{2.2}$$

The relative weights W*j* are shown in Table 2.4

C*j*	W*j*
C1	4
C2	2,375
C3	1,75
C4	2,125

Table 2.4 Relative weights of the binary comparison matrix

In the previous table it is noticeable how the neutral criterion of anthropometry C3 has the smaller value, which implies an uncertainty in any strategy to follow oriented by this criterion, so it is the least appropriate to choose. It is better to choose strategies that we know where they will lead to, so that we can prevent the consequences of a bad eating habit. It is clear that the best educational strategies are the beneficial and feasible (C1 and C2, respectively).

2.3 Application of the TOPSIS method

Once the values of the relative weights of the criteria have been obtained, the TOPSIS method itself has been applied[13].

First, the decision matrix must be assembled in which the values D*ij* of each of the alternatives A*i* are included for the different criteria C*j*. These values are input data from the results of the surveys and have been worked by the specialist to decide the nutrition educational strategy of the Tajamar Health Center.

As the TOPSIS method requires that all criteria should be aimed at maximizing their values, in those that do not meet this condition the inverse values (1/D*ij*) have been used and the criteria have been converted to maximization.

Table 2.5 shows the values of the decision matrix of the problem to be solved with the TOPSIS method, having already converted the criteria from minimization to maximization in the necessary cases.

	C1	C2	C3	C4
A1	0,0006	0,4	0,1	0,008
A2	0,0003	0,6	0,2	0,0083
A3	0,0003	0,5	0,1	0,0071

Table 2.5 Decision Matrix

Below in Table 5, the values of the Decision Matrix after being normalized using equation (2.3) are shown

$$DN_{ij} = D_{ij} / \sum_{k=n}^{k=1} D_{ij} \tag{2.3}$$

	C1	C2	C3	C4
A1	0,5	0,2811	0,2408	0,3407
A2	0,25	0,3836	0,4379	0,3549
A3	0,25	0,3351	0,3211	0,3042

Table 2.6 Normalized decision matrix

After normalizing and applying the relative weights to the BN*ij*. The BP*ij* results are reflected in table 2.7

Table 2.7 Weighted decision matrix

	C1	C2	C3	C4
A1	0,0142	0,0079	0,0146	0,0737
A2	0,0071	0,0109	0,0266	0,0768
A3	0,0071	0,0095	0,0195	0,0658

Then, the distance of each alternative A*i* to the positive and the negative (or anti) ideal is calculated according to the following formulas:

$$S^{+}{}_{i} = \left[\sum_{i}^{n} |DP_{ij} - DPmax_{i}|^{p}\right]^{1/p} \qquad S^{-}{}_{i} = \left[\sum_{i}^{n} |DP_{ij} - DPmin_{i}|^{p}\right]^{1/p}$$

Where:

- $S^{+}{}_{i}$= distance from A*i* to the positive ideal.
- DP_{ij}= D_{ij} normalized and weighted.
- $S^{-}{}_{i}$= distance from A*i* to the anti-ideal.

In this case p = 1 since the Manhattan distance is used. Table 2.8 shows the values of S + and S - for each alternative.

	S+	S-
A1	0,2175137	0,0374422
A2	0,0723424	0,1826134
A3	0,0489931	0,2059628

Table 2.8 Ideal and anti-ideal distance

Finally, the coefficient of similarity C* has been calculated for each alternative according to equation (2.5)

$$C_{i}^{*} = \frac{S^{-}{}_{i}}{S^{+}{}_{i} + S^{-}{}_{i}} \tag{2.5}$$

3. Results

The results obtained are shown in table 2.9

	Ci *
A1	0,14685741
A2	0,81625518
A3	0,70783707

Table 2.9 Similarity coefficient.

The final result of the study demonstrates that alternative 2 constitutes the most convenient educational alternative, then the number 3 and finally the number 1, this is in terms of health: A1 = Beneficial, A2 = Feasible and A3 = dangerous. See table 2.3

So, the food health education of the mothers should be oriented through the last two nutrition patterns in order to achieve an adequate development in children's health.

4. Conclusion

After applying the TOPSIS method, we have concluded that Alternative 2 is the one that best meets the criteria established by the assessment of eating habits collected in the surveys at the Tajamar Health Center.

It is very important to emphasize that the objective characterization by the specialist when preparing table 2.3 that evaluates the educational strategy to follow with a food habit to obtain the appropriate anthropometry for each particular child coincides with the selection of the priorities of the TOPSIS method. The application of this method, taking into account the influence of all the criteria, adapts very well to the differences in food cultures and possibilities of any population group.

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