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ANALYSIS OF NEUTROSOPHIC SETS AND INTUITIONISTIC NEUTROSOPHIC SETS, COMPLEXITY IN MEDICAL DIAGNOSIS

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Abstract This paper explores the analysis of blood sugar levels in diabetic patients in arduous Neutrosophic and Intuitionistic Neutrosophic sets, categorizing the data into three apparatuses truth, indeterminacy, and falsity. Diabetic poses imperative challenges to the medical community, emphasizing the need to understand key factors such as age, weight, and glycemia (insulin level) playing crucial roles in the condition's progression. Using a quantitative approach and secondary data, this study analyzes the relationship between blood sugar levels and these factors to identify the root cause of diabetics, particularly focusing on age and obesity, which are linked to Type 2 diabetes. The incorporation of Neutrosophic sets provides a framework for steering the complexities of diabetics and management, addressing the uncertainty present in medical data. The findings indicate that this analytical approach enhances the accuracy of blood sugar assessments, contributing to better decision-making in patient care and offering insights into identifying at-risk individual .

1 Introduction

The term fuzzy refers to a lack of accuracy or uncertainty in cognition. Fuzzy arithmetic incorporates moral and logical concepts, termed by vague boundaries and uncertainty regarding the set's start and end. This approach uses degrees of truth rather than the binary true or false logic that conventional processors operate on. Fuzzy logic was initially introduced in the 1960s by Lotfi A. Zadeh of the University of California, emphasizing the need for a more nuanced approach to reasoning that accommodates ambiguity and gradations of truth [7, 15].

The Neutrosophic set is a recently developed subset of lookout that studies the origin, nature, and future of impartialities as well as the narratives they talk about other conceptual spectrums [10, 11]. This suggests that there are proportions of truth, falsehood, and indeterminacy in determining whether an element matches the set or not [9, 12]. The typical part of the scenario, when there is some indeterminacy in the space, is represented by the Neutrosophic measure. Table 2 shows the several classes into which the fuzzy membership function is separated. A person is classified as having high blood sugar, for example, if their blood sugar level is 0.6 or higher, which is represented by the letter (T); on the other hand, if it is 0.5, this indicates indeterminacy, and if it is 0.4 or less, it implies false (F).

Mandelbrot first coined the term fractals in 1975. The Latin word fractus, which rises to an uneven surface like that left by a fractured stone, is where the abbreviation originates. Examples of self-similar patterns include rivers, clouds, trees, ferns, various plants, and the circulatory systems of both animals and plants. A mathematical framework to understand these patterns thanks to fractal analysis. Typically, self-similar techniques which might be statistical or experiential are employed with fractals [5]. Dimension, which may be expressed in several ways, is the crucial historical concept for characterizing the roughness of fractal surfaces. Variation is often seen in complex designs, and this variance is sometimes only perceptible at the system level [3, 16].

In the words of Benoit Mandelbrot, a fractal is a subset of a restrained space where the Hausdorff dimension is greater than the topological dimension. Using fuzzy fractals, explore the link between the belongings of crisp values [2]. Type 1 diabetes commonly happens from a young age and is undisclosed as an autoimmune disease. It happens due to an autoimmune reaction from the character, finishing the β-cells in discrete [6, 8]. Type 2 non-insulin reliant on diabetes is presently more regularly in individuals who are weighty and 80% of individual people analyzed with type 2 are weighty [4, 13]. Different type 1, persons with type 2 diabetes do consume β-cells existing, but lack insulin oozing to control glucose levels [1, 14].

It is discussed here, that those with diabetes might categorize the amount of glucose in their body is embodied by true, false, or indeterminate. Preliminaries are discussed in Section 2. In section 3 Case I, the Neutrosophic membership function incorporates aging by adjusting the membership value based on an individual's age, reflecting the variation in blood sugar processing over time and Intuitionistic Neutrosophic Set of membership functions of weight labeled by age is explained in Case II.

2 Preliminaries

2.1 Neutrosophic set

It is generous of usual where the association of an element is resolute by its Neutrosophic possibility [12]. This designates that while assessing whether a component goes in the set, a certain measure is true, a certain percentage is false, and a certain proportion is unclear. Example: Metaphysical claims cannot be classified as true or untrue since they do not have any rights and are free from both data and error [10, 11].

2.2 Intuitionistic neutrosophic set

Let x be a set in X called significant concerning of Neutrosophic Set A of the set X that is $T_{P^*}(x), I_{P^*}(x), F_{P^*}(x) \leq 0.5$. Also, for the Neutrosophic Set the truth, indeterminacy and falsity membership values of all the three cannot be significant [7].

$$P^* =< x, T_{P^*}(x), I_{P^*}(x), F_{P^*}(x) >$$

$$Min\ \{T_{P^*}(x), F_{P^*}(x)\} \leq 0.5$$

$$Min\ T_{P^*}(x), I_{P^*}(x)\} \leq 0.5 \text{ and}$$

$$Min\ F_{P^*}(x), I_{P^*}(x)\} \leq 0.5$$

With the condition $0 \leq T_{P^*}(x) + I_{P^*}(x) + F_{P^*}(x)\} \leq 2$

2.3 Complexity

Complexity has a substantial influence on blood sugar levels that change with age, either rising or falling [3, 16]. The phrase "more than the sum of its parts" refers to roughly that takes numerous pieces that interact with one another in many ways, resulting in an overall appearance that remains greater than the sum of its parts [2, 5]. Blum's speedup theorem states that there is always a program with a lower level of complexity than the target function, implying that there is always a computable function for every complexity measure.

2.4 Medical diagnosis

Applications for medical diagnosis using the Intuitionistic Neutrosophic set technique are covered in this section. Assume that in an imagined pathology, P is a group of patients, D is the diagnosis, and S is a collection of symptoms [8]. The production of insulin, which is necessary to bring blood glucose levels back to normal, is impossible in people without -cells. When blood glucose levels are poorly regulated, diabetes problems arise and eventually contribute significantly to mortality [1, 4]. Daily insulin injections, regular blood glucose monitoring, a balanced diet, and regular exercise are all necessary during the initial phase of diabetes management.

3 Materials and Methods

In this case, charity identifies raised blood sugar levels, as post-meal levels are often greater than pre-meal values. Neutrosophic sets are used to diagnose blood sugar in people aged 19 to 65, classifying results as truth (T), indeterminacy (I), or falsehood (F). In ambiguous the membership values in the table match Case 1, which focuses on this age group. Case 2 investigates the association between fuzzy membership values and variables such as weight, blood sugar levels, and body mass index, which adds complexity to the exploration. Neutrosophic analysis reveals abnormalities, especially when fractures or other complications exist. By addressing the complexity of diabetes diagnosis and management, this method provides a more nuanced knowledge of diabetic patients' medical data.

Case I

Let us elucidate the data in diabetic patients within a specific age range and characterize each data point using membership functions within the interval [0, 1], as shown below.

Table 1. Neutrosophic set of membership values

Age	19	22	25	28	30	32	35	40	45	52	55	61	63	65
Truth	-	1	0.7	-	-	-	1	0.8	1	1	1	0.9	-	-
Indeterminacy	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-
Falsity	0.4	-	-	0	0.2	-	-	-	-	-	-	-	0.2	0

Average total = 8.3/14 = 0.59 is measured as a T_A, I_A, and F_A are fuzzy set on X. Then $T_A, F_A : X$ such that 0.59 satisfies in Neutrosophic set, therefore the T, I, and F are content.

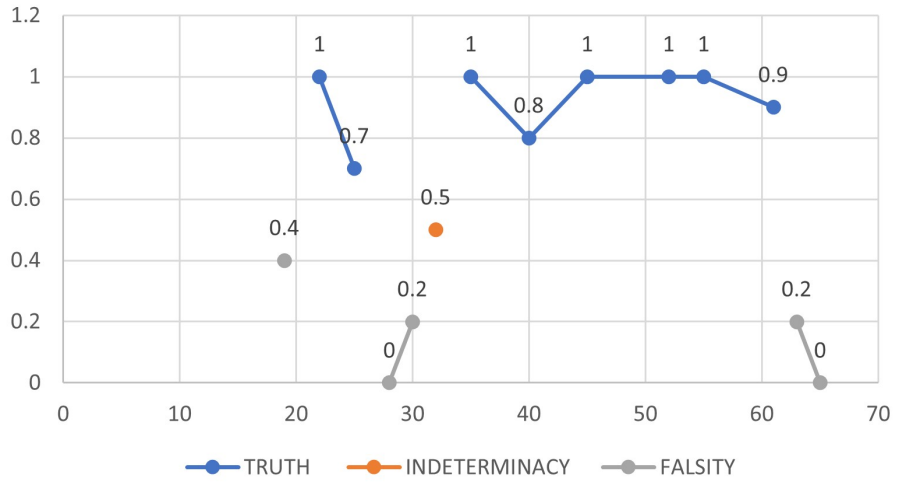

Figure 1. Neutrosophic membership values of Age-Blood sugar

Table 1 displays Fuzzy membership standards for the post-meal blood sugar levels for dissimilar age groups [9].

3.1 Problem

If $\{T_{P^*}(x), I_{P^*}(x), F_{P^*}(x)\}$ are the truth (T), indeterminacy (I), falsity (F) then $T_{P^*}(x) = (1, 0.7, 1, 0.8, 1, 1, 1, 0.9)$,
$I_{P^*}(x) = (0.5)$, $F_{P^*}(x) = (0.4, 0, 0.2, 0.2, 0)$

Solution:
Intuitionistic Neutrosophic set

a) $min\{T_{P^*}(x), F_{P^*}(x)\} \leq 0.5$

$min\{0.7, 0\} \leq 0.5$

b) $min\{T_{P^*}(x), I_{P^*}(x)\} \leq 0.5$

$min\{0.7, 0.5\} \leq 0.5$

c) $min\{F_{P^*}(x), I_{P^*}(x)\} \leq 0.5$

$min\{0, 0.5\} \leq 0.5$

Therefore $0 \leq 0.5 \leq 2$ the values of the Intuitionistic Neutrosophic Set of truth (T), indeterminacy (I), and falsity (F) are pleased.

Case II:

Overweight people are more likely to develop type 2 diabetes, and 80% of people with type 2 diabetes are overweight [6]. This is due to insulin resistence, which occurs when the body creates insulin but does not use it properly. As a result, the body develops resistance to its insulin and attempts to compensate by generating more insulin. [13, 14]. Type 2 diabetes is managed with food, exercise, and a balanced lifestyle, while oral drugs may be prescribed if individuals are unable to regulate the amount of glucose in their bodies through diet and exercise. Insulin injections may be provided in some circumstances; however, this is normally reserved for those with type 1 diabetes [8].

Table 2. Weight-Blood Sugar of Neutrosophic membership values

Weight-A	39	40	42	45	48	49	50	52	62	65	70	80
Truth	1	-	-	0.9	-	-	-	1	0.8	-	-	-
Indeterminacy	-	-	-	-	-	-	-	-	-	-	-	-
Falsity	-	0.2	0.4	-	0.4	0	0	-	-	0.3	0	0.1

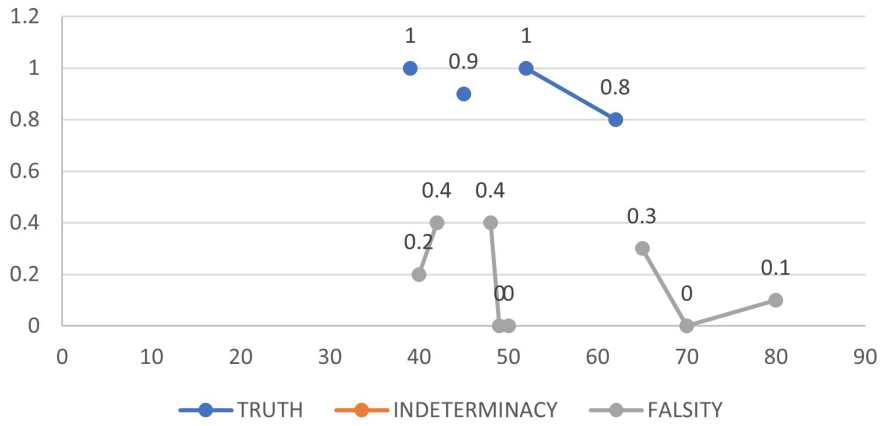

Figure 2. Weight-Blood Sugar of Neutrosophic membership values

Patients' weight and blood sugar levels from Table 2 are shown as fuzzy membership values in Figure 2.

3.2 Problem

If $\{T_{P^*}(x), I_{P^*}(x), F_{P^*}(x)\}$ are the truth (T), indeterminacy (I), falsity (F) then $T_{P^*}(x) = (1, 0.9, 1, 0.8)$,
$I_{P^*}(x) = (\{\ \})$, $F_{P^*}(x) = (0.2, 0.4, 0.4, 0, 0, 0.3, 0, 0.1)$
Solution:
Intuitionistic Neutrosophic set

a) $min\{T_{P^*}(x), F_{P^*}(x)\} \leq 0.5$
$min\{(1, 0.9, 1, 0.8), (0.2, 0.4, 0.4, 0, 0, 0.3, 0, 0.1)\} \leq 0.5$
$min\{0.8, 0\} \leq 0.5$

b) $min\{T_{P^*}(x), I_{P^*}(x)\} \leq 0.5$
$min\{(1, 0.9, 1, 0.8), \{\ \}\} \leq 0.5$
$min\{(0.8, \{\ \})\} \leq 0.5$

c) $min\{F_{P^*}(x), I_{P^*}(x)\} \leq 0.5$
$min\{\{\ \}, (0.2, 0.4, 0.4, 0, 0.3, 0, 0.1)\} \leq 0.5$

Therefore the $0 \leq \{T_{P^*}(x) + I_{P^*}(x) + F_{P^*}(x)\} \leq 0 \leq 2$ the values of the Intuitionistic Neutrosophic set of Truth (T), Indeterminacy (I), and Falsity (F) are satisfied. There are three main categories in the Neutrosophic set to learn about truth, indeterminacy, and falsity. There are several categories in this statement based on blood sugar level and age. For instance, if a person 40 years old develops diabetes in July, they should test again in three months and the results should be normal (0.5) or indicate that the person has diabetes if the condition is present in their body and they have a chance of not having diabetes, which is represented by the Neutrosophic membership functions $\{0, 0.1, 0.2, 0.3, 0.4\}$.

4 Results

4.1 Case I:

In this situation, I state that include Table 1 of Neutrosophic membership values with three categories in the interval [0,1]. It contains a membership value represented in Figure 1 that indicates the total values are between 0 and 3 must satisfy the Neutrosophic membership function and Intuitionistic Neutrosophic set. The age limits range from 19 to 65, however, this does not limit the ability to find the Neutrosophic set or the large data of all age groups to identify the root cause of diabetics.

4.2 Case II:

In this situation, II states that more diabetics have a greater chance of affecting overweight people, indicating Type 2 diabetes. This is because their bodies do not produce enough insulin to regulate diabetics. Table 2 contains this type of weight of Blood sugar level impacted by diabetes that it identifies with the help of Neutrosophic membership values represented in Figure 2 and also provides a problem of Intuitionistic Neutrosophic set which is ≤ 2 and should satisfy the Neutrosophic set.

5 Conclusion

This study demonstrates the application of Neutrosophic and Intuitionistic Neutrosophic sets in evaluating blood sugar levels, considering factors such as age and weight. It employs Neutrosophic sets, which use the membership functions of truth, indeterminacy, and falsity, with values ranging from 0 to 1, to examine blood sugar levels. The study exploits secondary data to categorize positive, negative, and zero values based on Neutrosophic sets. By incorporating uncertainty, this approach provides a more nuanced method of diagnosis for diabetic patients. The paper aims to improve and enhance the understanding of diabetes-related blood sugar fluctuations by identifying root causes and recognizing diabetic conditions through truth (positive

results), indeterminacy (average values that may fluctuate depending on food consumption), and falsity (negative results). The findings indicate that this method is particularly useful for addressing irregularities and complexities in medical data. Future research could expand upon this work by exploring physiological variables or extending this analysis to larger patient populations.

Conflicts of Interest: There is no conflict of interest concerning this paper.

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