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FUZZY TOTAL EDGE MAGIC LABELLING OF PLACENTAL BLOOD FLOW FUNCTION

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Abstract:
The placenta's sufficiency or insufficiency can be easily determined by looking at the fuzzy total edge magic label. A baby with inadequate placenta blood flow experiences irregular growth and development defects. This study uses a fuzzy total edge magic label to transform the prenatal blood flow into a graphical representation. Based on the value of the fuzzy total edge magic label, someone can identify if the placenta is normal or abnormal.

Key words: Blood flow, Doppler, Fuzzy total edge magic label, Placenta.
MSC Classification: 05C72,05C78,05C90,54E50,03F55

1.Introduction:

Mathematicians that study relationships between objects study graph theory. "Graphs" here refer to sets of nodes (vertices) joined by edges. Mathematician Leonhard Euler of Switzerland found a solution to the Königsberg bridge puzzle in 1735 [1,2]. Several real-world situations, including social networks, transport networks, and internet connections, can be modelled using graphs. Vertices, edges, degrees, and routes are important ideas [3,4]. Graph theory finds wide-ranging applications in biology, computer science, and optimized issues [5].

The fuzzy graph was first presented by Azriel Rosenfeld in 1975. By integrating the notion of fuzzy graph structures, fuzzy graph theory expands on conventional graph theory. Traditional graphs have edges that are either present or absent, signifying a link that is unambiguous. Fuzzy graphs, on the other hand, accommodate scenarios where connections are not exactly defined by enabling ranges of membership or uncertainty in edge relationships [6,8].

Fuzzy networks allow nodes to describe relationships that are either imprecise or ambiguous by allowing them to belong to distinct subsets to varied degrees. Because of its flexibility, fuzzy graph theory is particularly helpful for modelling real-world situations in which connections might not be binary. Fuzzy adjacency matrices, fuzzy incidence matrix structures, and fuzzy connections constitute essential variables that help to express interactions in a more complex way. Applications of fuzzy graph theory can be found in areas where unpredictability exists, like pattern identification, image processing, and decision-making [7,8]. Fuzzy magic labelling is an innovation concept in graph theory that combines the concepts of fuzzy set theory and traditional magic labelling. Initially magic labelling consisted of assigning labels to vertices or edges in a way that assures certain graph properties hold true. Fuzzy magic labelling develops this idea by adding fuzziness to the labels; rather than crisp labels, vertices or edges are assigned fuzzy labels that reflect degrees of membership in different sets. Fuzzy set theory permits the presentation of unpredictability, inaccuracy, and inconsistency in the labelling process [9]. This extension to fuzzy magic labelling is particularly valuable in situations where precise information is not available, and a more nuanced representation of relationships within a graph is needed. It provides a flexible framework for capturing and analyzing uncertainty in various real-world applications, such as decision-making processes, pattern recognition, and modeling complex systems [10]. The placenta delivers oxygen and nutrients to your baby. Placental insufficiency is when the placenta does not work properly. It's not very common but it is serious, and can affect the growth and wellbeing of your baby [11,12].

2.Definitions:

A fuzzy graph $G = (\sigma, \mu)$ is a pair of functions $\sigma: V \rightarrow [0,1]$ and $\mu: v\ x\ v \rightarrow [0,1]$

Where for all $u, v \epsilon V$,

$\mu(u, v) \leq \sigma(u) \wedge \sigma(v)$

A labelling of a graph is an assignment of values to the vertices and the edges of a graph. The graph G has fuzzy labelling if it is bijective such that the membership value of edges and vertices are distinct and

$\mu(u, v) < \sigma(u) \wedge \sigma(v)$ for all $u, v \epsilon V$

A fuzzy labelling of a graph $G = (\sigma, \mu)$ is said to be a fuzzy total edge magic labelling, if there exists an m such that

$\sigma(x) + \sigma(y) + \mu(xy) = m$ for all $xy \epsilon E\ and\ x, y \epsilon V$

3.Doppler Ultra sound screen test in Fetal Blood circulation (20week):

The placenta delivers oxygen and nutrients to your baby. Placental insufficiency is when the placenta does not work properly. It's not very common but it is serious, and can affect the growth and wellbeing of your baby. If you have placental insufficiency, your baby may not grow as expected, leading to complications during pregnancy or birth. A normal placenta is round or oval-shaped and about 22 cm in diameter. It is 2 cm to 2.5 cm thick and weighs about a pound, but abnormal placenta is below 2 cm thick. Fig.1 (a) image shows a normal placental location, with the placenta attached at the top of the uterus. Fig.1 (b) image showing a small placenta that has partially come away from the wall of the uterus.

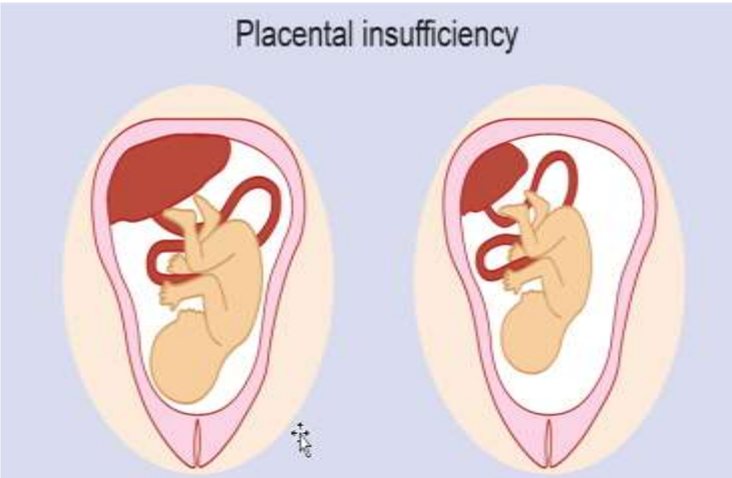

Fig.1 (a, b) Placenta's Sufficiency Placenta and Insufficiency Placenta

Fetal blood circulation is unique, as the fetus receives oxygen and nutrients from the mother's blood through the placenta. The oxygenated blood returns to the fetus through the umbilical vein, bypassing the liver through the ductus venous. In the fetal heart, the majority of the blood entering the right atrium is directed through the foramen ovale to the left atrium, minimizing blood flow to the fetal lungs. The ductus arteriosus allows most of the blood from the pulmonary artery to enter the aorta, bypassing the lungs. This specialized circulation supports fetal oxygenation and nutrient exchange until the baby begins breathing independently at birth. the fetal blood flow is converted into graphical image and fuzzy total edge magic labelling is used. (Fig.2).

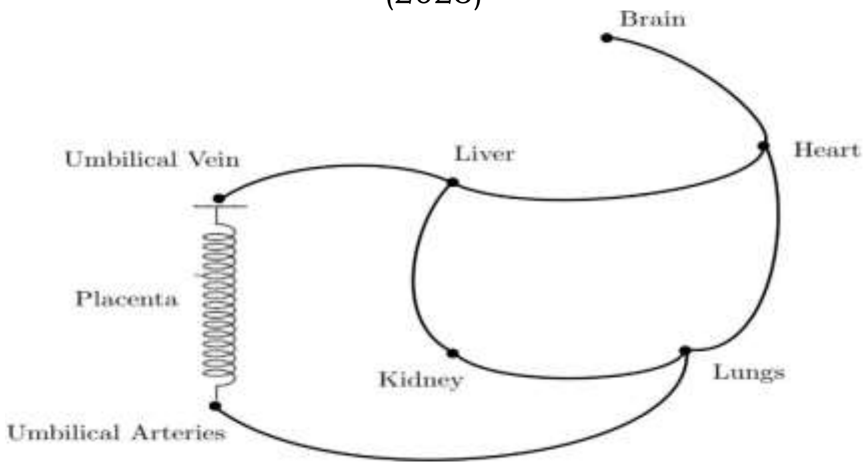

Fig.2. Fetal blood circulation graph

The normal placenta or abnormal placenta can be determined depending on the value of the fuzzy total edge magic label. In this paper, it is proposed that the normal placenta size is 2.2 and the abnormal size is 1.2. Below is a generalized graph of fetal blood circulation graph. (Fig3).

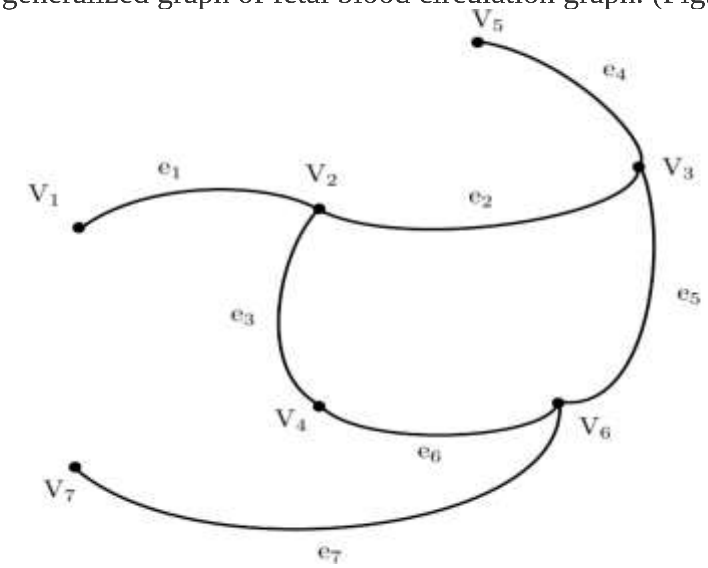

Fig.4. Generalized graph of fetal blood circulation graph

Theorem: 1

Normal placenta graph $NPm, m = 7$ is a fuzzy total edge magic labelling.

Proof:

Let $m \epsilon N$, and $m = 7, V(NPm) = \{v_1, v_2, v_3, v_4, \dots, v_7\}$ and
$E(NPm) = \{e_i = v_i\, v_{i+1} | 1 \le i \le 7\}$ and normal placenta graph be $(NPm) = (V, E)$
For all $i (1 \le i \le m)$, the membership value for the vertices $\sigma: V \to [0,1]$, is defined as follows:
$\sigma(v_i) = (2n^2 - n - 4 - 2i)0.01;\ i = 1,2$
$\sigma(v_{i+2}) = (2n^2 - 2n - 1 - 2i)0.01;\ i = 1,2$
$\sigma(v_{i+4}) = (2n^2 - 2n - 5 - 2i)0.01;\ i = 1,2$
$\sigma(v_n) = (2n^2 - 3n - 4)0.01;\ n = 7$
The membership of edges $\forall\, i, (1 \le i \le 7)$, are defined by the function $\mu: E \to [0,1]$,
$\mu(e_1) = (n^2 + 3)0.01$
$\mu(e_{i+1}) = (n^2 + n - 2 + 2i)0.01;\ \ i = 1,2$
$\mu(e_{2i+2}) = (n^2 + 2n - 5 + 4i)0.01;\ \ i = 1,2$
$\mu(e_5) = (n^2 + 2n + 1)$
$\mu(e_7) = (n^2 + 3n + 2)$
For fuzzy labelling, the main objective of the relations is that $\mu(e_i) < \sigma(v_i) \wedge \sigma(v_{i+1})$
The normal placenta graph is fuzzy total edge magic labelling.

$$\sigma(v_i) + \sigma(v_{i+1}) + \mu(v_i\, v_{i+1}) = \psi$$

The construct ψ of fuzzy total edge magic labelling

$\psi_1 = \sigma(v_1) + \sigma(v_2) + \mu(e_1)$

$\psi_1 = \{[(2n^2 - n - 6)0.01 + (2n^2 - n - 8)0.01 + (n^2 + 3)0.01]\}$

$\psi_1 = (5n^2 - 2n - 11)$

$\psi_1 = 2.2 \quad \rightarrow ①$

$\psi_2 = \sigma(v_2) + \sigma(v_{i+2}) + \mu(e_{i+1})$

$\psi_2 = \{[(2n^2 - n - 8)0.01 + \sum_{i=1}^{2}(2n^2 - 2n - 1 - 2i)0.01 + \sum_{i=1}^{2}(n^2 + n - 2 + 2i)0.01]\}$

$\psi_2 = \{[(2n^2 - n - 8)0.01] + [\sum_{i=1}^{2}(3n^2 - n - 3 + 2i - 2i)0.01]\}$

$\psi_2 = (5n^2 - 2n - 11)0.01$

$\psi_2 = 2.2 \quad \rightarrow ②$

$\psi_3 = \sigma(v_{i+2}) + \sigma(v_{i+4}) + \mu(e_{2i+2})$

$$\psi_3 = \{[\sum_{i=1}^{2}(2n^2 - 2n - 1 - 2i)0.01] + [\sum_{i=1}^{2}(2n^2 - 2n - 5 - 2i)0.01] + [\sum_{i=1}^{2}(n^2 + 2n - 5 + 4i)0.01]$$

$$\psi_3 = \{\sum_{i=1}^{2}(5n^2 - 2n - 11 - 4i + 4i)0.01\}$$

$\psi_3 = (5n^2 - 2n - 11)0.01$

$\psi_3 = 2.2 \quad \rightarrow ③$

$\psi_4 = \sigma(v_3) + \sigma(v_6) + \mu(e_5)$

$\psi_4 = \{[(2n^2 - 2n - 3)0.01] + [(2n^2 - 2n - 9)0.01] + [(n^2 + 2n + 1)0.01]\}$

$\psi_4 = \{(5n^2 - 2n - 11)0.01\}$

$\psi_4 = 2.2 \quad \rightarrow ④$

$\psi_5 = \sigma(v_6) + \sigma(v_7) + \mu(e_7)$

$\psi_5 = \{[(2n^2 - 2n - 9)0.01] + [(2n^2 - 3n - 4)0.01] + [(n^2 + 3n + 2)0.01]\}$

$\psi_5 = \{(5n^2 - 2n - 11)0.01\}$

$\psi_5 = 2.2 \quad \rightarrow ⑤$

$\psi_1 = \psi_2 = \psi_3 = \psi_4 = \psi_5 = \psi$

Normal placenta graph has a connect with the constant ψ value in equation ①, ②, ③, ④ *and* ⑤

Example:1

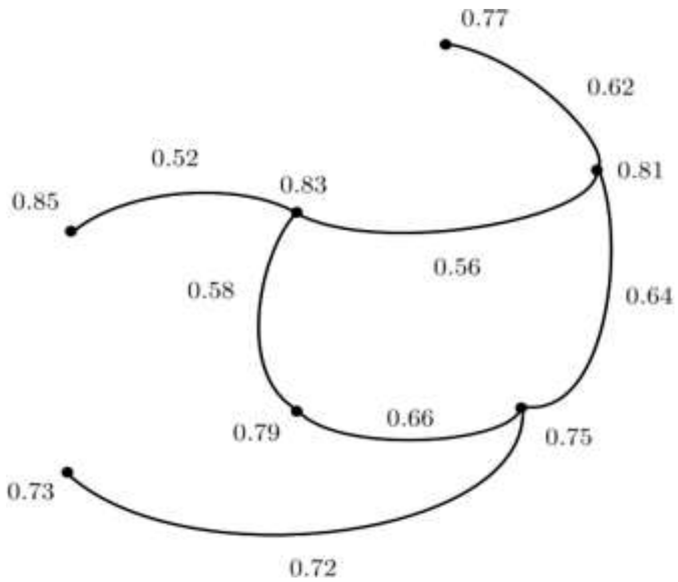

Fig.4. Normal placenta graph NPm

Hence, Fig.4. Normal placenta graph NPm is Fuzzy total edge magic labelling.

Fuzzy total edge magic labelling for constant ψ is 2.2.

Theorem: 2

Abnormal placenta graph ANP_m , $m = 7$ is a fuzzy total edge magic labelling.

Proof:

Let $m \epsilon N$, and $m = 7, V(NPm) = \{v_1, v_2, v_3, v_4, v_5, v_6, v_7\}$ and
$E(NPm) = \{e_i = v_i\, v_{i+1} | 1 \le i \le 7\}$ and abnormal placenta graph be $(ANPm) = (V, E)$
For all $i(1 \le i \le m)$, the membership value for the vertices $\sigma: V \to [0,1]$, is defined as follows:
$\sigma(v_i) = (n^2 - 2 - 2i)0.01;\ i = 1,2$
$\sigma(v_{i+2}) = (n^2 - n + 1 - 2i)0.01;\ i = 1,2$
$\sigma(v_{i+4}) = (n^2 - n - 3 - 2i)0.01;\ i = 1,2$
$\sigma(v_n) = (n^2 - 2n - 2)0.01;\ n = 7$
The membership of edges $\forall\, i, (1 \le i \le 7)$, are defined by the function $\mu: E \to [0,1]$,
$\mu(e_1) = (n^2 - 2n - 3)0.01$
$\mu(e_{i+1}) = (n^2 - 2n - 1 + 2i)0.01;\ \ i = 1,2$
$\mu(e_{2i+2}) = (n^2 - n - 4 + 4i)0.01;\ \ i = 1,2$
$\mu(e_5) = (n^2 - n + 2)$
$\mu(e_7) = (n^2 - 2n - 2)$
For fuzzy labelling, the main objective of the relations is that $\mu(e_i) < \sigma(v_i) \wedge \sigma(v_{i+1})$
The abnormal placenta graph is fuzzy total edge magic labelling.

$$\sigma(v_i) + \sigma(v_{i+1}) + \mu(v_i\, v_{i+1}) = \psi$$

The construct ψ of fuzzy total edge magic labelling

$\psi_1 = \sigma(v_1) + \sigma(v_2) + \mu(e_1)$

$\psi_1 = \{[(n^2 - 4)0.01 + (n^2 - 6)0.01 + (n^2 - 2n - 3)0.01]\}$

$\psi_1 = (3n^2 - 2n - 13)$

$\psi_1 = 1.2 \quad \to 1$

$\psi_2 = \sigma(v_2) + \sigma(v_{i+2}) + \mu(e_{i+1})$

$$\psi_2 = \{[(n^2 - 6)0.01] + [\sum_{i=1}^{2}(n^2 - n + 1 - 2i)0.01] + [\sum_{i=1}^{2}(n^2 - 2n - 1 - 2i)0.01]\}$$

$$\psi_2 = \{[(n^2 - 6)0.01 + \sum_{i=1}^{2}(2n^2 - 3n + 2i - 2i)0.01]\}$$

$\psi_2 = (n^2 - 6)0.01 + (2n^2 - 3n)0.01$

$\psi_2 = (3n^2 - 3n - 6)0.01$

$\psi_2 = 1.2 \quad \to 2$

$\psi_3 = \sigma(v_{i+2}) + \sigma(v_{i+4}) + \mu(e_{2i+2})$

$$\psi_3 = \{[\sum_{i=1}^{2}(n^2 - n + 1 - 2i)0.01] + [\sum_{i=1}^{2}(n^2 - n - 3 - 2i)0.01] + [\sum_{i=1}^{2}(n^2 - n - 4 + 4i)0.01]$$

$$\psi_3 = [\sum_{i=1}^{2}(3n^2 - 3n - 6 - 2i + 2i + 4i)0.01]$$

$\psi_3 = (3n^2 - 3n - 6)0.01$

$\psi_3 = 1.2 \quad \to 3$

$\psi_4 = \sigma(v_3) + \sigma(v_6) + \mu(e_5)$

$\psi_4 = \{[(n^2 - n + 1 - 2)0.01] + [(n^2 - n - 7)0.01] + [(n^2 - n + 2)0.01]\}$

$\psi_4 = \{(3n^2 - 3n - 6)0.01\}$

$\psi_4 = 1.2 \quad \to 4$

$\psi_5 = \sigma(v_6) + \sigma(v_7) + \mu(e_7)$

$\psi_5 = \{[(n^2 - n - 3)0.01] + [(n^2 - 2n - 2)0.01] + [(n^2 + n - 4)0.01]\}$

$\psi_5 = \{(3n^2 - 2n - 13)0.01\}$

$\psi_5 = 1.2 \quad \rightarrow 5$

$\psi_1 = \psi_2 = \psi_3 = \psi_4 = \psi_5 = \psi$

Abnormal placenta graph has a connect with the constant ψ value in equation 1, 2, 3, 4 *and* 5

Example:2

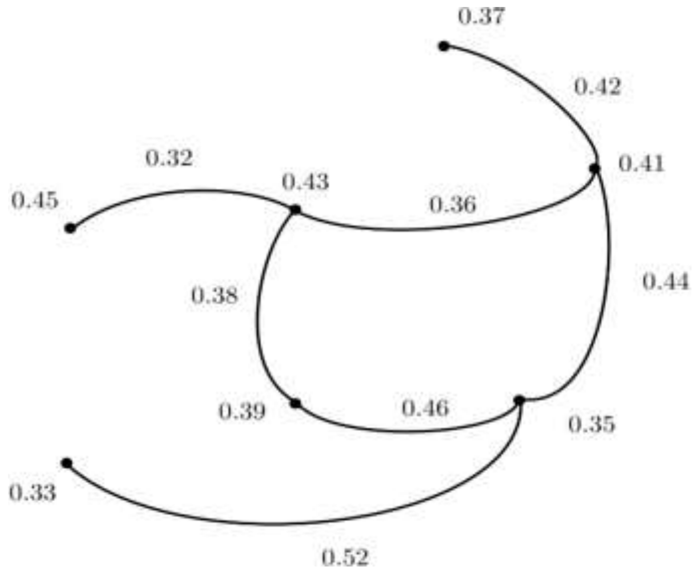

Fig.5. Abnormal placenta graph ANP_m

Hence, Fig.5. Abnormal placenta graph $ANPm$ is Fuzzy total edge magic labelling.
Fuzzy total edge magic labelling for constant ψ is 1.2.

Result and discussion:

Although there is no cure for placental insufficiency, it can be controlled. It is critical to obtain prop er prenatal care and an early diagnosis. Medicines may reduce the risk of birth problems and increas e the baby's chances of developing properly.

It develops when the disease is identified between 12 and 20 weeks in advance.

Conclusion:

Addressing the risk of abnormal placental development involves maintaining a healthy lifestyle, attending regular prenatal check-ups, and following medical advice. Early detection through Doppler ultrasound and other prenatal tests can help manage and address potential issues.

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