Investigating factors affecting overweight using fuzzy numbers

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Abstract

In our daily life, we deal with various crises and maybe classifying them will help to solve the problems. One of the biggest crises today is overweight. In this article, using fuzzy simulation, an estimate of the approximate effects of these 4 main factors has been reported. Different factors can influence the amount of food consumed by each person. These factors can be classified as follows :

1. Psychological effects
2. Environmental effects
3. Genetic influences and physical health
4. Habits and preference

Each person has a different reaction to emotional crises, so some people eat a lot and some people eat less. Even the criteria of each person for what they eat is different. The surrounding environment has a significant effect on both nervous tension and our habits. To find genetic effects, one can refer to the first-degree family and understand the effectiveness of this factor from them. Organ defects and physical problems can also cause excess weight. The amount of exercise and interests in choosing food include our preferences. In this article, 44 people were asked a questionnaire. This questionnaire contains 4 questions related to each section and we used the Likert scale to measure the questions.

Introduction

In today's world we are eager to have more of a healthy lifestyle and when we talk about health . Being fit and having ideal body weight is crucial . There are four main factors considered in this research that can heavily affect our body weight . this factores are environmental factors such as ‘’ Is the price of fast food more expensive than homemade food?” which is related to the environment around us . Secondly , there are psychological factors that can affect how much food or snacks we consume over emotional crises or based on our psychological behaviour. as in an article by Front. Psychol., 08 December 2016 Sec. Eating Behavior on the website Emotional Eating Is Not What You Think It Is and Emotional Eating Scales Do Not Measure What You Think They Measure

Suggests that :

Although emotional eating was originally defined as eating in response to negative emotions, there currently are a number of studies that show that a positive mood can also elicit increased food intake (see for an overview Cardi et al., 2015). As such, several researchers have now accepted positive emotions as part of emotional eating. Eating in response to (negative) emotions can be problematic, as shown by studies that have related emotional eating to BMI (Laitinen et al., 2002; Konttinen et al., 2010; Péneau et al., 2013), weight gain (Hays and Roberts, 2008; Koenders and van Strien, 2011), interference with weight loss (Canetti et al., 2009), binge eating (Fischer et al., 2007; Ricca et al., 2009) and depression (Ouwens et al., 2009; Konttinen et al., 2010). In addition, emotional eating can have distressing immediate effects by for example leading to feelings of guilt (Wansink et al., 2003; Dubé et al., 2005; Macht and Dettmer, 2006). Although the concept of emotional eating may sound straight-forward, it is not as simple as is often assumed. In fact, the construct of emotional eating is more nuanced than is typically presented.

Thirdly ,there are habits and a so -called lifestyle which has a great role in our daily life and at last but not the least there are physical factors such as if the candidate suffers from any illness or not .
After gathering all the data by online questionnaires they were presented in data format with a panda library and they were analysed and plotted .
But more important for presenting the data we have used fuzzy numbers .
The idea of fuzzy sets was introduced to the field of knowledge by Professor Lotfi Asgarzadeh,an Iranian scientist, in 1965 with the publication of the article on fuzzy sets. Years ago, we believed that all concepts are based on 0 and 1, but with the passage of time, we became familiar with abstract concepts that allocate a range of numbers based on their concept in a relative manner. In fact, the word fuzzy means: imprecise, unclear and It is vague (floating). As you can access the full explanation of fuzzy logic in the article by **Claudio Moraga** , (PDF) Introduction to Fuzzy Logic .

After answering questions candidates will be categorised by their weight and height differences according to the Broca formulation .
The Broca formula was developed in 1871 by Pierre Paul Broca (a French Army Doctor) to help establish ideal body weight or normal body weight. Initially, the Broca Index (BI) was used to work out the normal weight but was later expanded to ideal Body Weight. Ideal Body weight (kg) = [Height (cm)-100]. This formulation is used to gather data about our applicants and measure how much of these four different categories might have the most influence on them being overweight or underweight.
Details about this formula can be found in articles below:
Broca Index: A Simple Tool to Measure Ideal Body Weight

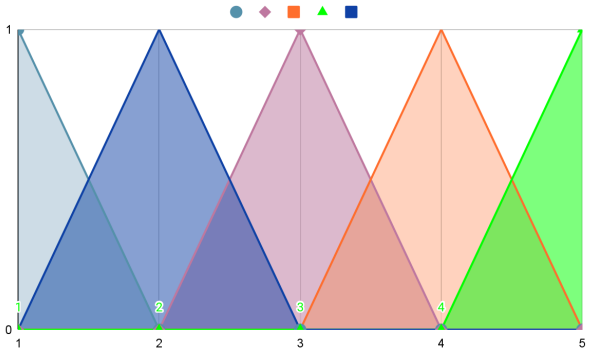
[The use of Broca index to assess cut- off points for overweight in adults: A short review]

Methodology

The Likert scale is a tool for measuring people's attitudes and is used to prepare questionnaires for measuring attitudes in management and humanities. In general, three standard scales have been introduced by Rensis Likert, which are known as five degree, seven degree and nine degree scales. These scales can be used to express agreement or determine the importance of items. Fuzzy set allows an element to belong to a set relatively. This relative membership is represented by the degree of membership. The degree of membership can take a value between zero (for an element that does not belong to the set at all) and 1 (for an element that completely belongs to the set).We display lyrical fuzzy numbers like this.

Triangular fuzzy number	fuzzy number	Verbal scale
(0,0,0.25)	1	very low
(0,0.25,0.5)	2	Low
(0.25,0.5,0.75)	3	medium
(0.5,0.75,1)	4	high
(0.75,1,1)	5	Very high

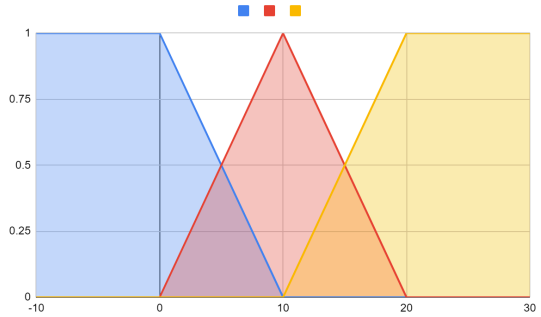
We have used a triangular diagram to display these numbers



Here we have 5 measuring criteria, each of which has 4 effective factors

- Very high
- high
- medium
- Low
- very low

In order to continue the research, we have put people into 3 categories including normal weight, overweight and obese with different degrees of membership.



As can be seen from the table above, we have:

- Normal weight
- Overweight
- obesity

For example, a person whose height and weight difference is 13 is defined in the group of overweight people, but the amount of overweight of this person is determined by his membership degree. It will be equal to 0.7.For example, this person, considering that the equation of the line passing 13 from y=-0.1x+2 will be equal to 0.7. So the degree of membership is (0.7, 13).

data

The questionnaires

Do you overeat in emotional crises such as anger or sadness?

Are you a forward-looking person and think that every action you take in life has consequences?

Do you feel bad and guilty after eating fatty and unhealthy foods?

Do you consider yourself an emotional person who makes most of the decisions with her/him gut feeling rather than logic?

Is your environment full of stress and tension?

Do those around you have a high consumption of fast food?

Is the price of fast food more expensive than homemade food?

Do you choose to go to coffee shops and restaurants in your free time?

Does your first-class family have the same body as you?

To what extent do you suffer from health problems such as diabetes, difficulty moving the body, hormonal problems, etc.?

Do you have a body with very high resistance and you hardly get sick?

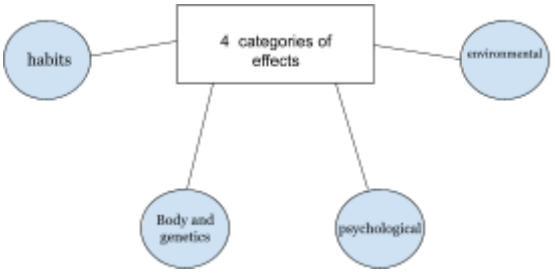
How is your body's metabolism?

Is the taste of food more important to you than the richness and usefulness of the ingredients inside it?
Do you prefer eating large and small meals to small but large meals (snacking)?

Do you have a regular and correct sleeping habit?

How fast do you eat your food?

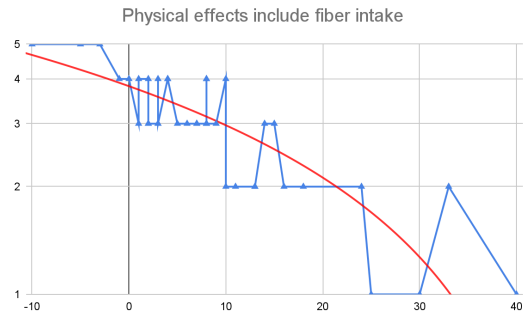
How much fibre do you consume in meals?



This is the questionnaire platform I have used for 40 candidates with different weight and height variations.

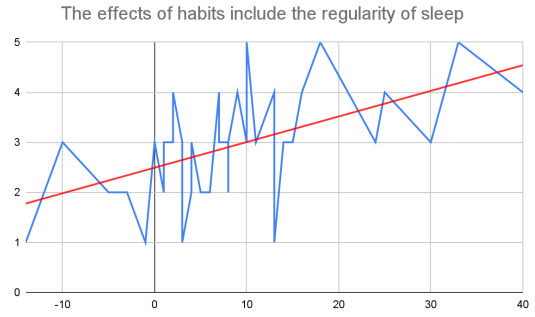
https://survey.porsline.ir/s/mhvweJIM

Result

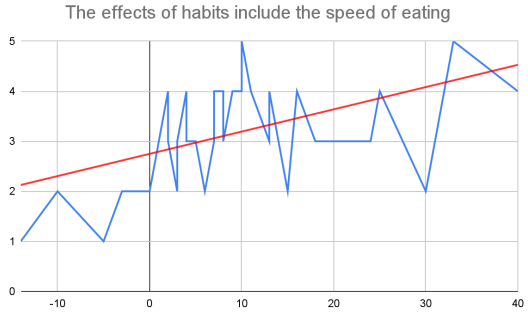


As you can see in the graph above, fibre consumption has a relatively direct relationship with people's weight, for example, people with a normal weight have fibre consumption with a grade of 5 to at least 3.
Pay attention to people who are overweight,as we said, a person with 15 kilos of excess weight and a membership degree of 0.5 has an amount of fibre consumed between 3 and 2, and the higher the membership degree, the lower this amount.

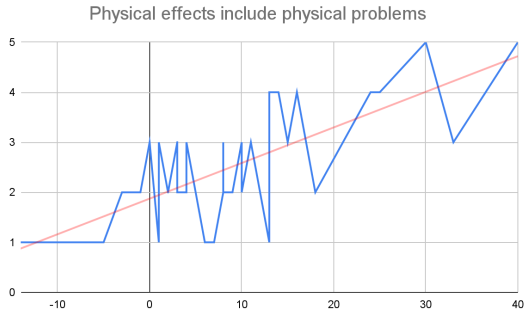
$$(15,0.5) \longrightarrow [3,2]$$
$$(20,1) \longrightarrow [2,1]$$



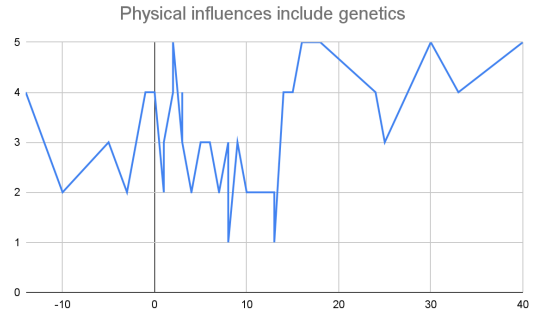
Contrary to what I expected, overweight people sleep more regularly than thin or normal weight people, although as you can see, this approximation has a relatively higher percentage of error.



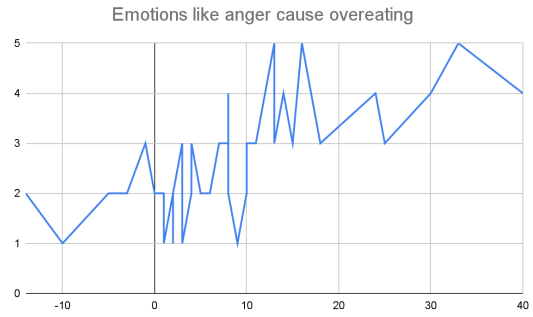
According to the graph above, people with low and normal weights have a low eating speed. However, correct conclusions cannot be drawn in people with average weight or at risk of obesity.
Obese people had a high average eating speed.



As expected, people who do not have physical problems or their diseases are of a low degree are mostly underweight. The presence of physical problems such as foot pain, back pain, and even low metabolism and hormonal problems have a direct effect on very obese people, and these people usually suffer from these problems to a high degree.



Genetic factors did not provide accurate results in our research, so at least in this amount of the population sample, accurate results cannot be obtained. However, it can be said that obese people are generally placed in environments where there are people around them with a high degree of overweight, and this may be The cause of their excessive obesity.



Some emotions have a great impact on our behaviour in dealing with food because foods that have a lot of sugar or fast foods release dopamine momentarily and cause short-term happiness of the consumer. As can be seen in the graph, obese or overweight people reach for food more when they are upset and angry than people with normal weight and thinness.

Discussion

Regarding physical factors such as physical problems, it can be said that there is a two-way relationship with each other because being overweight can cause these problems and diseases such as hormonal and thyroid problems can cause obesity.

If we want to investigate from the genetic point of view and the environment around the person, we did not reach the right result about thin to overweight people, but fat people usually had more weight in their environment.

Regarding emotional factors, we found that overeating due to discomfort is very common, and if people are looking for a healthier diet, they should learn to control their emotions.

Conclusion

Daily habits are directly related to our body and being overweight or normal weight. In fact, if we want to make a change in weight, it is better to first have daily habits. In conclusion, the text highlights the relationship between fibre consumption and weight, eating speed, physical problems, genetic factors, and emotional influences on food behaviour. It suggests that overweight individuals tend to consume less fibre, have higher eating speeds, and are more likely to overeat due to emotional distress. Additionally, it indicates a complex interplay between physical factors, genetics, and emotional well-being in relation to weight management.

Reference

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