A Case Study on

WELL-BEING UNCOVERED:

Delving into the Link between Health and Lifestyle

By

SIMRAN KANOJIA

Dr. Homi Bhabha State University, Mumbai

Department of Mathematics

The Institute of Science

Mumbai – 400032

April 2023

Abstract

The body mass index (BMI) is the metric currently in use for defining anthropometric height/weight characteristics of an individual and for categorizing them into groups. The common interpretation is that it represents an index of an individual's fatness just by using height and weight. It also is widely used as a risk factor for the development of the prevalence of several health issues. In addition, it is widely used in determining public health policies. The BMI has been useful in population-based studies by virtue of its wide acceptance in defining specific categories of body mass as a health issue.

The aim of this study is to determine how the factors that contribute to the body mass index (BMI) of a human body and evaluate the eating habits, sleep amount, activeness of the individuals. The study was conducted on about 100 people whose ages were ranging from 17 to 56 years. The data was collected using a questionnaire form that consisted of questions concerning general characteristics of individuals. We explored these issues by investigating numerous potential factors: gender, age, eating habits, diet preferences, sleep schedule, workout preferences, profession and disease possessed. However, it is increasingly noticed several times that BMI is a rather poor indicator of percent of body fat. Importantly, the BMI also does not capture information on the mass of fat in different body sites. The latter is related not only to untoward health issues but to the lifestyle people are following as well. Lastly, current evidences on a sample of data indicates that people following healthy routine tend to have normal BMI and this is age related. All of these issues are hypothetically claimed and concluded for a very small sample under consideration of the population and is discussed in this report quite briefly.

Keywords

Body Mass Index (BMI), Anthropometric, Lifestyle, Meta-analysis

Introduction

Body mass index (BMI) is a commonly used term. In fact, it's been around for more than 150 years and it was developed in 1832 by a Belgian mathematician called LAJ Quetelet.

BMI is the ratio of an individual's height and body weight. It is an indirect measure of your body composition. Healthcare providers and the general public uses BMI as a rough estimate of body fatness. The higher the BMI number, the more body fat. Large amounts of body fat are linked to many serious medical conditions like heart disease, stroke, type 2 diabetes, and certain cancers. A low BMI can indicate anything from mild thinness to something more serious, like malnutrition or eating disorders. While BMI loosely correlates to the amount of body fat versus lean body mass, it is not always an accurate way to diagnose a person's health status. For example, someone with a healthy BMI may have high blood pressure, which would put them at risk of serious health complications. On the other hand, someone in the overweight or obese BMI categories may not have any significant health concerns at the present time. That's why healthcare providers use BMI along with other parameters and risk factors to assess a person's health risk. In general, however, an individual should aim for a body mass index in the healthy weight range.

Calculating BMI,

The formula to calculate BMI is to divide weight in kilograms (kg) by the square of a person's height in meters (m^2)

$$BMI = \frac{weight\ (kg)}{height^2\ (m^2)}$$

In U.S. units, we divide the weight (pounds) by the square of height (inches) and multiply the result by 703.

$$BMI = \frac{weight\ (pounds)}{height^2\ (inches^2)} \times 703$$

Let's say, if a person weighs 160 pounds and stands 70 inches tall, his BMI would be….

$$BMI = \frac{160}{70} \times 703 = 22.96\ kg/m^2$$

Healthcare providers classify BMI values in kg/m^2 as follows:

BMI	Weight Status
Below 18.5	Underweight
Between 18.5 and 24.9	Healthy / Normal weight
From 25 to 29.9	Overweight
Between 30 and 34.9	Class I obesity
From 35 to 39.9	Class II obesity
More than 40	Class III obesity

Factors affecting BMI –

- **Age -**

Muscle mass tends to decrease with age. As a result, older adults may have more body fat than their younger counterparts. However, a BMI in the high-normal to the overweight range for older adults may actually be a good thing. Some studies have shown a slightly higher BMI is associated with lower early-age mortality compared to people with an optimum BMI.

- **Muscle mass -**

Athletes have more lean muscle mass and less body fatness. They may fall in the overweight or obese BMI categories due to their muscle tissue mass, despite being in great general health.

- **Race and Ethnicity -**

The BMI calculator does not differentiate between different races and ethnic groups. However, research has shown that there are genetic and biological differences in muscle mass, fat distribution, and other factors among people of different races. For instance, Black women have a lower risk of metabolic diseases than white women with the same higher BMI values. On the other hand, people of Asian or middle eastern descent may be at high risk of metabolic diseases like diabetes even with lower BMIs.

- **Fat Distribution -**

BMI calculations do not take a person's waist circumference into account. Therefore, two people who are equally tall and weigh the same will have the same BMI. But if one of them has an apple or pear body shape or body types with fat distribution in the lower body, their risk for metabolic diseases and heart disease may be significantly higher.

Keeping all the factors under consideration, hypothetical claims were made on a sample data, to check how much BMI is affected by certain factor.

Scope of the study

Coming across various research papers and verified analysis reports, age is what affect the BMI categorisation and hence the results we are using from last 150 years will be modified in near future and we feel valid and accurate BMI classification will be brought into notice.

Objective

1. To determine whether BMI due to age.
2. To check whether the BMI gets affected by different diet preferences.
3. To decide whether males have meaner BMI then females.
4. To determine does consuming fruits daily suggests that the individual is healthy.
5. To conclude whether sleep duration affects BMI of students.
6. To test if working out regularly suggests that the individual is healthier than those who never workout.

Hypothesis

1. Claim: Test whether the BMI of people with age > 28 is more variable than those with age < 28.

H_0: $\sigma_1^2/\sigma_2^2 \leq 1$
H_1: $\sigma_1^2/\sigma_2^2 > 1$

where,
σ_1^2 = variance in BMI of people with age > 28
σ_2^2 = variance in BMI of people with age < 28
$\delta_0 = 1$

2. Claim: Check whether the average BMI is same for both the diet preferences?

H_0: $\mu_1 = \mu_2$
H_1: $\mu_1 \neq \mu_2$

where,
μ_1 = Mean BMI of Non-vegetarian
μ_2 = Mean BMI of vegetarian
$\mu_0 = 0$

3. Claim: Males have meaner BMI than females for age < 28.

H_0: $\mu_1 < \mu_2$
H_1: $\mu_1 \geq \mu_2$

where,
μ_1 = Mean BMI of Males
μ_2 = Mean BMI of Females
$\mu_0 = 0$

4. Claim: Does consuming fruits everyday suggests that the person is healthy i.e., they have an average BMI > 18.5

H_0: $\mu < \mu_0$
H_1: $\mu \geq \mu_0$

where,
μ = Mean BMI of individuals consuming fruits daily
$\mu_0 = 18.5$

5. Claim: Is there any significant difference in the proportion of the students getting sleep less than 7 hours and those getting more than 7 hours.

H_0: $p_1 = p_2$
H_1: $p_1 \neq p_2$

where,
p_1 = Proportion of students getting sleep less than 7 hours
p_2 = Proportion of students getting sleep more than 7 hours
$p_0 = 0$

6. Claim: Test whether the BMI of people working out daily appear to be more variable than those who never workout.

H_0: $\sigma_1^2/\sigma_2^2 \leq 1$
H_1: $\sigma_1^2/\sigma_2^2 > 1$

where,
σ_1^2 = variance in BMI of individuals never working out
σ_2^2 = variance in BMI of individuals working out everyday
$\delta_0 = 1$

Research Methodology

- Participants:
  This study was conducted on about 100 adults, ages ranging from 17 to 56 years. Before the study, participants were informed about the study and we requested accurate data input.

- Collection of data:
  The primary method was used for data collection. The questionnaire form was made and was used in the study which includes general information about the individuals, questions aim to determine eating habits of individuals, sleep schedule, body activeness. Height and weight were collected and then in excel BMI was calculated. On the basis of BMI value individuals were classified as healthy, underweight, overweight or obese. Workout preferences were classified as those who work out and who never do. Fast food consumption was classified into who prefer home-made food and those who consume fast food at least once a week and this was done by grouping together the preferences of the individuals just to mainly classify into two basic categories.

- Variables used –
  Height, Weight, BMI score, etc.

- Tools and techniques used –
  Body Mass Index, t-statistics, F-statistics, Survey Forms, Ms-excel, Power BI and Python

To wrap up the methodology used in this case study, we transformed the data we received from the respondents and made it ready for analysis purpose. Further, claims on valid facts were made to test it on hypothetical assumption using different statistics as population standard deviation is unknown.

Results and Analysis

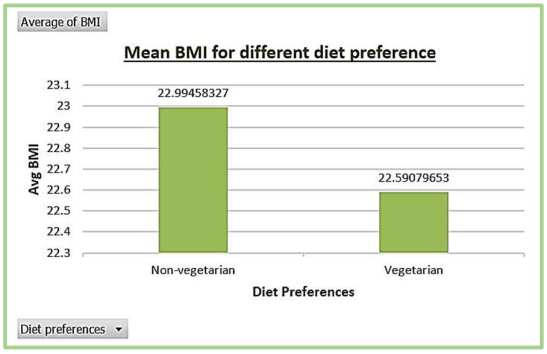
1. We claimed that there is more variation in the BMI of people with age > 28 than with age < 28

   According to the test, it came out that SD of BMI with age > 28 was 5.34 and while of age < 28 it was 4.57 so f statistic shows that are claim was true. As per research muscle mass decreases with age and it might be wise to shift the healthy BMI range for older adults. The same BMI could mean very different things at age 25 VS age 75.

A recent meta-analysis illuminated this conundrum. Researchers found that an overweight BMI did not increase risk of mortality in older individuals, as might be expected, but being underweight did. The authors suggest that World Health Organization amend the healthy weight guidelines for older adults, whose bodies are notably different from those of their younger counterparts.
In older age, body composition changes as fat mass increases and redistributes. Therefore, the current BMI classification may not accurately reflect risk in older adults (65+).

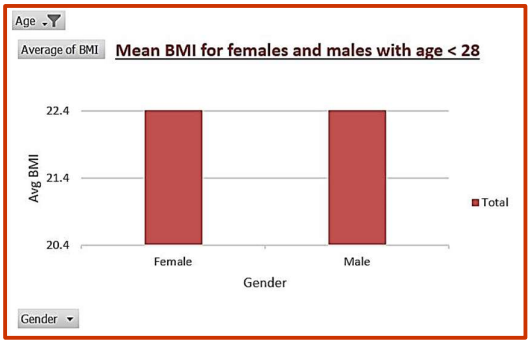
2. <u>Claim was that mean BMI for both the diet preferences i.e., Vegetarian and Non-vegetarian is same</u>

   Test concludes it's not the same. Since, BMI score is independent of the diet preferences we were expecting the same.



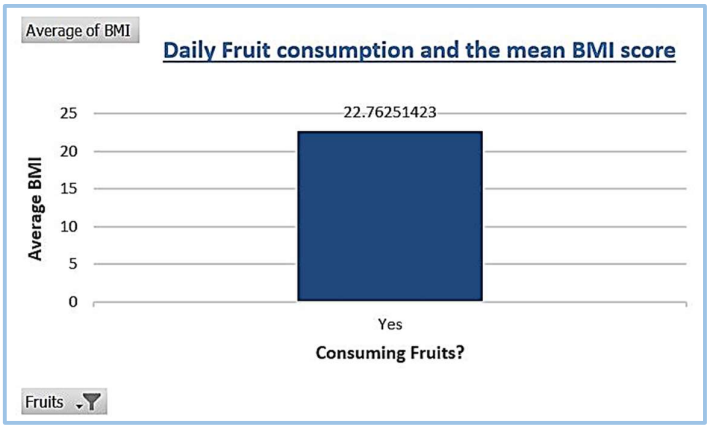
3. <u>We were looking does the males have meaner BMI than the females for age < 28</u>

   For this claim we didn't get strong evidence to reject the fact that mean BMI of males at age < 28 was more than the females at age < 28. Might be the sample is insufficient to claim this true.



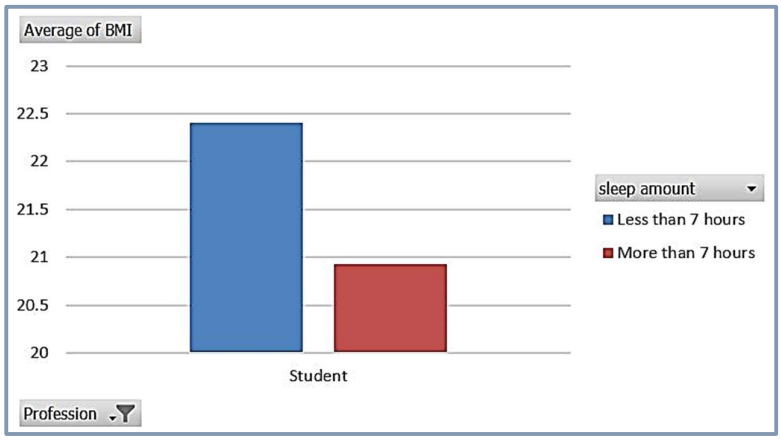
4. We tested that people consuming fruits daily were healthy i.e., BMI > 18.5

   As per the results after applying t-statistic it came out to be true.
   55 out of 107 consumed fruits daily and came out to be as healthy.



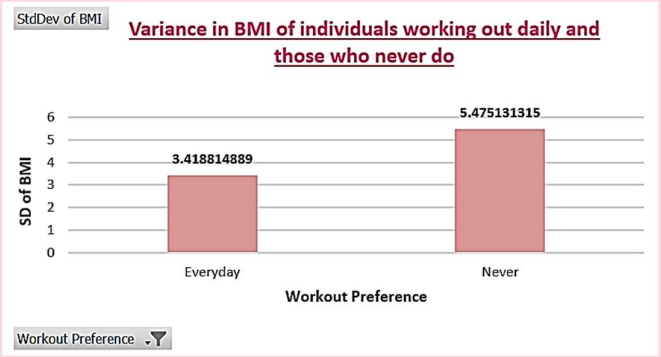
5. We looked for the significant difference in the proportion of the BMI of the students getting sleep less than 7 hours and greater than 7 hours

   And this claim came out with no significant difference between both the proportion. According to the chart below, mean BMI of students getting sleep more than 7 hrs have better BMI score while students getting sleep with less than 7 hours tend to have less good score.

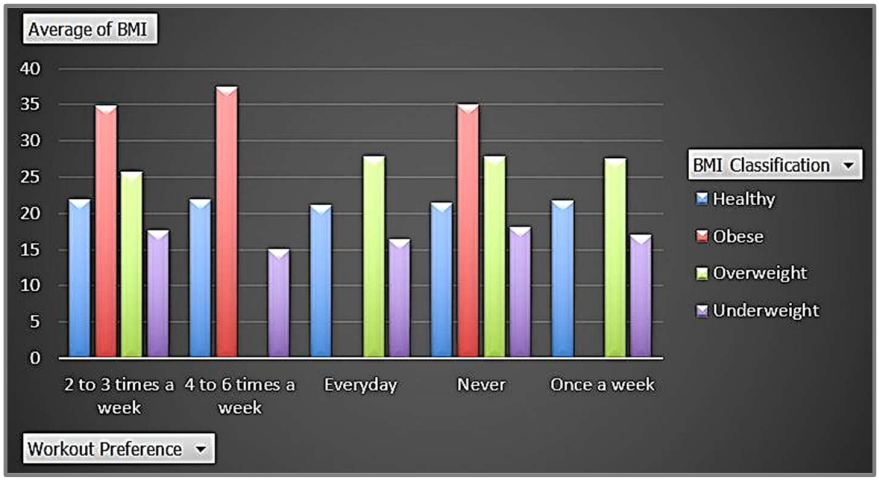


6. Determination of variance in average BMI of people working out daily is more than those who never workout

The test for the sample concludes that the average BMI of people working out daily is more than those who never workout. As per a research study, athlete who do not engage in physical activity increase their activity or detox their health. The findings of study are supported by research that shows a link between obesity and physical activity. Physical activity helps weight gain or lose, so it can be concluded that BMI and physical activity are linked. This means that the higher a person's BMI, the more physical activity that person engages in. Low levels of physical activity can also significantly increase the prevalence of obesity. Obesity occurs when total energy expenditure, including energy for physical activity, exceeds total energy intake. So, the conclusion made for this sample, may vary for the population.



This chart shows physically active individuals sometimes do have BMI > 25 and fall into unhealthy category.



Conclusion

In this study, it is determined that age, gender, profession, workout preferences, diet preferences, sleep duration could explain 30% - 40% of the mean body mass index of individuals. Genetic and environmental factors that have an influence on BMI are needed to be studied in order to more clearly present the factors that affect individuals' health. Sometimes, the BMI score claims that an individual is healthy but he might be suffering from a disease reflecting him as unhealthy. So, the BMI score is not valid enough. Finally, preference should be given to BMI measurement, and our findings suggest that everything should be taken into consideration while making a decision on health.

Further research on different samples and considerably a large sample is needed to make good conclusions after all it's an individual's health so all factors should be taken in notice.

References

- https://journals.lww.com/nutritiontodayonline/fulltext/2015/05000/body_mass_index_
- https://scialert.net/fulltext/?doi=pjn.2014.255.260
- https://www.fitday.com/fitness-articles/fitness/feeling
- https://www.medicalnewstoday.com/articles/bmi-for-women#summary
- https://www.buzzrx.com/blog/target-bmi-for-every-age
- https://norcalbiostat.github.io/AppliedStatistics_notes/bv-ttest.html