Body Mass Index in Diagnosing Obesity in Athletes Vs. General Population

A study to determine the accuracy of BMI as a measure of % fat in athletes and general population

Tag Words: BMI; body mass index; obesity; athletes

Authors: Michael O. Larrow, Sobia Maqsood with Julie M. Fagan, Ph.D

Summary

Body mass index (BMI) is used as a substitute for percent fat (% fat) in classifying obesity among athletes and general population. However, there is no specific criterion for percent fat, and some of studies have examined the accuracy of Body mass index as a measure of % fat. By default, BMI is used to label athletes and young adults as obese. Consequently, it is very hard to understand the accuracy of BMI in athletes and general population, which includes children and teens. In United States the obesity rates are heavily based on calculations of BMI. Body Mass Index is the general formula that has been used since years to get the obesity rates in the country. Thus it is very important to determine the accuracy of the BMI. A high BMI for athletes and children does not mean that they are obese. In many studies it has been stated that BMI does not predict the body fat content accurately and it is not directly relevant to the issue of diagnosis of obesity. When diagnosing or defining obesity, we do not need to estimate body fat content precisely, rather we simply need to set up with confident that any athletes defined as obese has a high body fat content relative to their peer.

It is well recognized that BMI classification is applicable for the general population, but it does not have some limitation. One of these limitations involves the accuracy of using BMI for physically active, trained athletes. Using BMI for athletes can overestimate their level of body fat or % fat because we know that muscles weigh more and are denser than fat. By using other techniques such as waist to hip ratio can always give accurate results on measuring obesity. (SM)

YouTube Video:
Introduction and Statistics:

(SM) During the past 20 years there has been a dramatic increase seen in the obesity rate in United States. It is one of the growing problems. It is sad to hear that America is known home to the most obese people in the world. Obesity is a serious health concern and it is associated with many chronic diseases, including cardiovascular disease, diabetes, arthritis and certain types of cancer. CDC has stated that, obesity in adults has increased by 70% within the past twenty years and obesity in children has tripled in past thirty years. For the last 30 years obesity has been primarily diagnosed by using the body mass index (BMI). It is widely used as an indicator expressing the level of obesity. BMI measurement was first discovered by Adolph’s Quenelle in the 19th century. His observations are based on the body weight, which is directly proportional to the square of the height in adults with normal body frame.

Even though BMI has been comprehensively used in many research and clinical practices, there very few number of studies testing its diagnostic and accuracy. For many years BMI is widely using in the determining or measuring the obesity rate in United States regardless of age, gender, profession. According to the Expert Panel on Evaluation and Treatment of Overweight and obesity in Adults, Body Mass Index of 25-29 is considered overweight and BMI greater than or equal to 30 is measured as obese. Since the Body Mass Index is obtained from mathematical values of body mass and height, it obviously does not take into account body fatness. However, BMI is thought to have an association with current amount of body fat and is shown to be clear-cut and regular indicator of obesity. As we know BMI is the easiest and uncomplicated way to calculate the obesity rate, therefore it is broadly use all over the nation to calculate the body fat of general population. BMI is calculated by multiplying weight in pounds by 703, and then dividing that number by the square of the height measurement in inches. The two instruments that are required are inexpensive, engage very less training to use and are virtually maintenance free and it’s constant values can be found with better precision. This is one of the reasons that BMI is used widely for measuring obesity.

It is well recognized that BMI classification is applicable for the general population, but it does have some limitation. One of these limitations involves the accuracy of using BMI for physically energetic, trained athletes. Using BMI for athletes can overestimate their level of body fat or % fat because we know that muscles weigh more and are denser than fat. It is true for an athlete whose body fat is normal or yet low, but they account for having high BMI rate. Use of body fat % for athletes could be more accurate than BMI in diagnosing obesity. Regardless of potential limitation of BMI, it is frequently used in accessing obesity in trained athletes. In a study, BMI was calculated in basketball players. 95% of the athletes were described as obese, were as it was not true because all these athletes carried massive body muscles, which do not account for obesity. Muscles in
common weigh more than body fat. Sometimes it is very tough to measure the body fat of an athlete through BMI calculations.

http://topics.info.com/BMI_379
http://en.wikipedia.org/wiki/Body_fat_percentage
https://sakai.rutgers.edu/portal/site/9e307b1b-d95e-40b2-9578-dd9c0446bac6/page/65e0bc8d-559d-48e4-860f-706bdf135539

**ACCURACY OF THE BMI FORMULA:**

(SM) The US Department of Health and Human Services stated that BMI calculations does not distinguish between weight that comes from muscle mass and weight from fat. Some additional methods such as waist circumference were recommended by the US department of health for determining obesity among high trained athletes. For instance a Basketball player weight will consist of more muscle than fat. Athletes with high BMI due to muscles often don’t have any fitness or health issues, which often are associated with high BMI. Future BMI does not take account into gender, age or muscle mass. Nor does it make a distinction between lean body mass and fat body mass. Because most of the people today’s world lead quite sedentary lives and are not so energetic, the formula tacitly assumes low muscle mass and high comparative fat content. Another factor that should not be considered in BMI measurements is age. An older person might have the same Body Mass Index as of a younger person, but additional testing might disclose that the older person has a higher body fat content. This is familiar in older people because the level of activity with the rate of metabolism falls quickly. In more aged people, the BMI calculator most of the times underestimates the amount of body fat, as muscle mass is gone due to age. The Body Mass Index calculations and figures gives most of the wrong answers for a huge and significant section of the population namely healthy and most fit.

It is embarrassing for one the most scientific and medically advanced nation in the world to base their suggestions on how to prevent one of the leading causes of obesity on simply measuring the weight and height calculation which is not even accurate for the athletes and certain population when they are perfectly healthy. One of the problems with the BMI formula is that the exponent of 2 in the denominator of the formula is arbitrary. It meant to reduce variability in the BMI associated only with the difference in size, rather than the different in the weight comparative to one’s ideal weight. If taller people were simply scaled-up versions of shorter people, the appropriate exponent would be 3, as the weight would increase with the cube of height. We have already seen that BMI formula problem starts to show up for exceptionally tall and short people. As we can see that most of the athletes are taller and they have extra muscle mass, therefore there BMI indicates them as obese. The Body Mass Index formula problems results in taller people having a reported BMI that is unusually high contrast to their actually body fat levels. Short people such as children or infant have low BMI as compare to their fat level. Due to the imprecision of BMI, a different scale was invented called the Ponderal Index PI. In PI, the weight in kg is divided by the height in cube. Now the problem with the pineal
index is that taller people are not just “scaled up” short people, but they have a tendency to have narrow frames in proportion to their height. Most of the scientists have suggested that instead of cubing or squaring the heights, it would be more suitable to use an exponent of anywhere between 2.3 to 2.8. Most of the people are not willing to change and countless people are using and relying on BMI these days.

The Body Mass Index formula has allowed the doctors and other health professionals to discuss under and over weight problems more objectively with patients. Yet, Body Mass Index is more controversial because most of the people, including physicians, have come to rely on its obvious numerical ability for medical diagnosis, but it was never the BMI's purpose; it is meant to be used as an easy means of categorizing sedentary individuals with an average body composition. For these individuals, the present value settings are as follows: a BMI of 18 to 25 indicates optimal weight; a BMI lower than 18 imply the person as underweight while a number above 25 indicate the overweight. Above 30 shows a person obese. The problem I have with the BMI formula, however, is that it breaks down when using it to determine obesity when measuring weight lifters and athletes. According to the BMI calculations, all of our Mr. Olympia contenders and many athletes are consider as “obese”. Below are few of the examples.

- Jay Cutler (Mr. Olympia): 5’9” and 275 lbs., BMI= 40.6 (grossly obese)
- Arnold Schwarzenegger (as Mr. Olympia): 6’2” and 245 lbs., BMI= 31.5 (obese)
- Manny Ramirez: 6’ and 210 lbs., BMI= 28.5 (nearly obese)
- Labron James: 6’5” and 250 lbs., BMI= 29.6 (nearly obese)
- Ladanian Tomlinson: 5’10” and 221 lbs., BMI= 31.7 (obese)

http://chefjays.com/n-1799-

I believe that these athletes are healthier and fit. These athletes are taller and have more muscle than an average person, which categorize them as obese according to the BMI formula. This current BMI formula use to measure obesity needs to be revised to be
a universal formula for obesity to truly accounts for different body types. We all know that muscle naturally weigh more than fat and we can simply not rely on this formula.

http://www.ideal-weight-charts.com/body-mass-index-formula.html
https://sakai.rutgers.edu/portal/site/9e307b1b-d95e-40b2-9578-dd9c0446bac6/page/65e0bc8d-559d-48e4-860f-706bfdf135539
http://topics.info.com/BMI_379

**Athlete’s BMI V.S. Body Fat:**

(ML) In athletes muscle accounts for more when judging if they are healthy or not. Because the BMI does not account for people’s muscles mass, it is not a true indication of how healthy or in shape someone is. Rutgers football players BMI and Body fat percentage.

<table>
<thead>
<tr>
<th>height</th>
<th>weight</th>
<th>body fat</th>
<th>bmi</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'3</td>
<td>270</td>
<td>15.4</td>
<td>33.8</td>
</tr>
<tr>
<td>6'2</td>
<td>235</td>
<td>13.2</td>
<td>30.2</td>
</tr>
<tr>
<td>6'2</td>
<td>241</td>
<td>11.7</td>
<td>31</td>
</tr>
<tr>
<td>6'6</td>
<td>255</td>
<td>13.5</td>
<td>29.5</td>
</tr>
<tr>
<td>6'5</td>
<td>279</td>
<td>16.4</td>
<td>33.2</td>
</tr>
<tr>
<td>5'6</td>
<td>200</td>
<td>9.5</td>
<td>32.3</td>
</tr>
<tr>
<td>6'2</td>
<td>230</td>
<td>13.1</td>
<td>29.6</td>
</tr>
<tr>
<td>5'11</td>
<td>220</td>
<td>11.7</td>
<td>30.7</td>
</tr>
</tbody>
</table>

The chart above shows some Rutgers football players that have had their BMI and Body fat percentage taken. All that are listed are shown to have been considered overweight or obese according to the BMI. Some even considered morbidly obese. All of these come with a connotation of being out of shape and at serious health risks. But when we take the Body fat percentage we see that all of the athletes are in shape and with minimal health risk. As compared to the body fat percentage chart and BMI chart below.

**Body Fat Percentage Categories**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Women (% fat)</th>
<th>Men (% fat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Fat</td>
<td>10-12%</td>
<td>2-4%</td>
</tr>
<tr>
<td>Athletes</td>
<td>14-20%</td>
<td>6-13%</td>
</tr>
</tbody>
</table>
BMI Categories:

- Underweight = <18.
- Normal weight = 18.5–24.9
- Obesity = BMI of 30 or greater

BMI Screening Guidelines in Schools:

Schools in Massachusetts seem to be one of the few states that have guidelines for screening children in schools. They made sure to notify people of why they would screen children. The goal of the Massachusetts Department of Public Health’s (MDPH) Body Mass Index (BMI) Screening Guidelines for Schools is to provide school staff with the necessary information and tools to successfully collect heights and weights, calculate BMI, effectively communicate results to parents and guardians in a sensitive and confidential manner, and provide the data to the MDPH. Steady with this goal, schools are required by Massachusetts General Law to provide health screenings for students (M.G.L. Chapter 71, Section 57 and 105 CMR 200.000) and follow up with the results of these screenings with families and referrals to primary health care providers as necessary.

- Identify students who may be at nutritional health risk.
- Identify students who are at risk for eating disorders.
- Identify students who are underweight, overweight or obese or at risk of becoming overweight or underweight.
• Encourage discussions between families and health care providers about their child’s growth and development.
• Promote healthy eating and active living in the school community.
• Assist the MDPH in monitoring BMI trends among children and adolescents in communities across the state.

Assessing the weight status of non-ambulatory students with special health care needs requires special consideration as children may not be able to stand up or lie flat. Alternate methods are available for measuring children requiring special accommodations.

In general, the purpose of measurements for children who may have atypical growth patterns should be for monitoring the progress of the individual child over time and not used to compare the child with others, even those who may have similar conditions. Remember that BMI is used to indicate measures of body fatness. With some conditions that involve muscle wasting and abnormal bone growth, the standard BMI reference percentile curves would not be an appropriate comparison point. BMI is more prevalent because when assessing a child’s BMI because the muscle does not account for as much as an adult

**RESEARCH STUDY ON BMI:**

(SM) Researchers who study large groups of people rely most of the time on BMI calculations because it has simple figures to calculate and they just ask people how much they weigh and how tall they are, and then do the math (weight in kilograms divided by height in meters squared). Averaged across many people, BMI is sometimes a fine indicator of morbid obesity. People who have BMI roughly 40, for example, are bound to be carrying too much around the middle and other body parts. But when we look at certain individuals, BMI may be way off the mark.

A new study was published in Medicine & Science in Sports & Exercise, were the researchers calculated both Body Mass Index and body fat percentage for 450 college students. To obtain the body fat, they used a BOD POD which is a laboratory test that mimics underwater weighing but need the subjects to sit in a dry chamber rather than getting into water. The study results demonstrated that male and female college athletes, as well as male non-athletes, could have a BMI telling they were overweight yet still have healthy levels of body fat, defined as less than 18 percent fat in men and 30 percent in women. Moreover, non-athlete women with a BMI indicating a normal weight could have too much body fat. Excessive amount of heavy muscle mass in the athlete’s accounts for the higher BMI, yet the athletes had low body fat because they were in good shape. Even some of the young non-athlete men could be fit and muscular yet not excessively fat. For women, the study showed, thin aren’t everything. Those who were slim yet didn’t work out to build muscle still could be somewhat fatty. Some individuals, mostly young women, may find that pumping iron puts them into the overweight category per BMI, so they skip weight training altogether which is not excellent.
Main issue for using Body Mass Index is that regardless of age or gender, the similar criteria is used to determine whether one is normal, overweight or obese. However, BMI should be used very cautiously when deciding whether one is obese or not, especially when classifying different categories of people. BMI does not really precisely tell how much fat a person really has; this is due to the character that it cannot really distinguish between body fat and muscle mass. It is especially correct when BMI were used to measure athletes, a large percentage of them were often considered to be obese, where in real fact they are not. Most of the athletes tend to have high BMI due to muscle mass being built up and not due to body fat. For example taking two people with the same height and same weight, where one is an athlete who does more of vigor training with large muscle mass and the other who barely does exercise. Both will have the same BMI, based on the equation alone and both will be regard as falling into the same category, but we know that the athlete is certainly not obese. If Body Mass Index cannot exactly differentiate between muscle and fat, then how do we know whether one has too much body fat or muscle mass. The more exact measurement is to look at body composition instead. The body composition is made up of total body water percentage, body fat, bone mass and muscle fat.

https://sakai.rutgers.edu/portal/site/9e307b1b-d95e-40b2-9578-dd9c0446bac6/page/65e0bc8d-559d-48e4-860f-706b7d105539

ALTERNATIVE METHODS FOR MEASURING BODY FAT:

(SM) There are several alternative methods to BMI. Alternative methods are required to better describe individuals who really have access body fat. BMI sometimes can be way off, especially when it comes to evaluate a particular individual. Waist to hip ratio is another simple method to measure obesity, and the subject is required to stand during the entire measurement. Waist to hip ratio more particularly measures abdominal adipose tissue (circumference) and fat distribution. The waist is the main abdominal circumference midway between the costal margin and the crest of the iliac. The largest circumference underneath the iliac crest is defined as the hip. A waist to hip ratio in women greater than 0.80, and in men greater than 0.90, is a fairly accurate predictor of an increased risk of obesity associated conditions, which is essentially independent of BMI.

The Body Mass Index method has many limitations and at times it can lead to the misclassification of certain individuals such as those with more muscle mass or the elderly. Waist circumference can be a better indicator of health risk than BMI alone, especially when used in combination with BMI. Waist circumference is mostly useful for individuals with a BMI range of 26-35. People with a BMI of more than 35, waist circumference adds little analytical power on the disease risk classification of BMI.

BMI Awareness
Our service primarily focuses on the spreading awareness regarding body mass index. Labeling students as overweight or too skinny based on single height/weight measure at
one point in time is inappropriate. We wanted to spread awareness on measuring body fat using different way other than BMI. There are different body types, most of body types are naturally associated with higher body fat. In our project service we wanted to aware the public that BMI does not directly measure body fatness. For spreading awareness we sent a letter to the American Medical Association and the Department of Education.

**Letter Sent to American Medical Association and Department of Education:**

To whom it may concern,

We are group of Rutgers Students studying on BMI and how it is raising obesity rates in United States. We recently complete a project on BMI and how accurate it is when measuring body fatness in athletes and general population. We have spend several weeks in researching about the Body Mass index and its accuracy and through our research we found out that BMI does not directly measure or indicate body fatness. A muscular student or athletes in schools can have a high BMI-for-age percentile and might have slight body fat. Through our research we found out that when both height and weight are continuously changing, the Body Mass Index is unstable. When BMI is measured in schools, it can be misinterpreted in students because the weight and height growth spurts occur at different times. The Body Mass Index score is applicable for both men and women but it has some limits. One of the limitations is the accuracy of using BMI for athletes. By using BMI chart for athletes it can overestimate their level of body fat and the reason is that muscles are denser than fat and they even weigh more than muscle. Therefore, an athlete’s percentage of body fat can be low or even normal, but the athlete may have high Body Mass Index. Athletes with high BMI do not means that they carry extra weight or they are unhealthy. In, fact some of the famous athletes from Olympics are consider as overweight or obese based on their Body Mass Index when they are perfectly healthy.

Today, BMI is used as screening tool for verifying possible weight problems and obesity rate. One of the reasons why BMI is widely used as a measuring the obesity rate is because it is inexpensive and requires less of time. Our goal is to spread awareness on using different ways to measure obesity rather than just relying on BMI figures. Some of the useful and easy methods for determining the body fatness can include hip-to-waist ratio and skin fold thickness measurements in school and in hospitals. These methods are more accurate in measuring body fatness especially in athletes and children. For athletes with a high BMI, one of these alternative methods should be recommended. Not only will these alternative methods of measuring body fatness will give accurate figures, it will also help in defining the actual obesity rate.

**Editorials:**

**Sobia Maqsood**

Sent to Wall Street Journal (07/27/2011)
Body Mass Index (BMI) is a number calculated from a person's height and weight. It can be calculated quickly and without expensive equipments, however BMI categories do not take into account many factors such muscularity and frame size. One basic problem especially in athletes is that muscle weight contributes to BMI. If we see our athletes BMI, almost all of them are considered as obese or over weight. BMI is particularly inaccurate for athletes who are quite fit, as higher muscle mass trend to put them in obese category. Athletes BMI are one of the factors that are raising the obesity rate in United States.

The public should be aware of this issue and certain actions should be taken to solve the problem as we all know that muscle naturally weigh more than fat and we can simply not rely on BMI formula. Instead of using BMI, body composition for athletes can be often better calculated using measure of body fat, as determined by such techniques as skin fold and waist-to-hip ratio. This type of measuring techniques will give more accurate results on body fat and thus it will significantly drop the obesity rates of the country.

Sobia Maqsood
Rutgers University, New Brunswick, NJ