

## Essential Definitions & Calculations

### Body Mass Index: BMI

It also called **Quetelet Index**. It was invented between 1830 and 1850. The body mass index accounts for differences in body composition by defining the level of adiposity according to the relationship of weight to height, thus eliminating dependence on frame size.



Adult BMI is independent of age. It should be used along with other anthropometric measurement tools like skinfold thickness, waist circumference or waist to hip ratio. BMI does have limiting factors that can skew result classification. For example, an athlete with large muscle mass may have a BMI similar to that of an obese person.

### Formula:

$$\text{BMI} = \frac{\text{Weight}}{\text{Height (m)} \times \text{Height (m)}} \quad \text{Unit: Kg/ m}^2$$

### BMI Classifications:

BMI	Classification
< 18.5	Underweight
18.5 - 24.9	Normal
25 - 29.9	Overweight
30 - 34.9	Obese grade 1
35 - 39.9	Obese grade 2
40 <	Morbidly obese

### BMI Classifications for patients greater than 65 years:

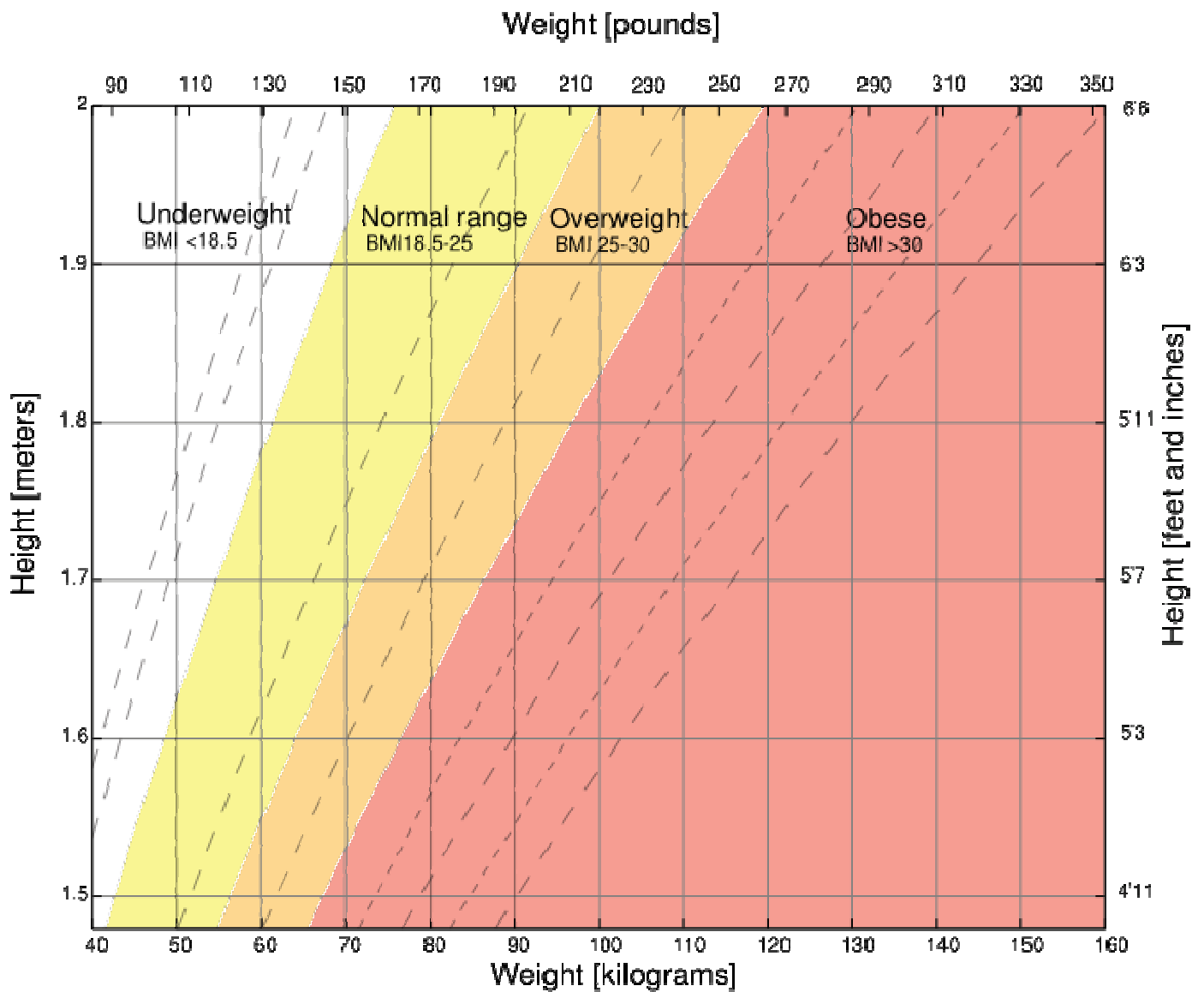
BMI	Classification
< 24	May be associated with health problems
24 - 29	Healthy weight
> 29	May be associated with health problems

### Example:

A man with weight of 70 kg, and height of 170 cm, calculate his BMI?

$$\text{BMI} = \frac{70}{1.7 \times 1.7} = \frac{70}{2.89} = 24.2 \text{ kg/m}^2 \quad (\text{Normal})$$

Examples of BMI charts:



<b>NORMAL WEIGHT (18.5 - 24.9)</b>																	
<b>OVERWEIGHT (25 - 29.9)</b>																	
<b>OBESITY (=&gt; 30)</b>																	
<b>BMI</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>35</b>
<b>Height cms (metres)</b>	<b>Body Weight (kilograms)</b>																
147cm (1.47m)	41	44	45	48	50	52	54	56	59	61	63	65	67	69	72	73	76
150cm (1.50m)	43	45	47	49	52	54	56	58	60	63	65	67	69	72	74	76	78
152cm (1.52m)	44	46	49	51	54	56	58	60	63	65	67	69	72	74	76	79	81
155cm (1.55m)	45	48	50	53	55	57	60	62	65	67	69	72	74	77	79	82	84
157cm (1.57m)	47	49	52	54	57	59	62	64	67	69	72	74	77	79	82	84	87
160cm (1.60m)	49	51	54	56	59	61	64	66	69	72	74	77	79	82	84	87	89
163cm (1.63m)	50	53	55	58	61	64	66	68	71	74	77	79	82	84	87	89	93
165cm (1.65m)	52	54	57	60	63	65	68	71	73	76	79	82	84	87	90	93	95
168cm (1.68m)	54	56	59	62	64	67	70	73	76	78	81	84	87	90	93	95	98
170cm (1.70m)	55	57	61	64	66	69	72	75	78	81	84	87	90	93	96	98	101
172cm (1.72m)	57	59	63	65	68	72	74	78	80	83	86	89	92	95	98	101	104
175cm (1.75m)	58	61	64	68	70	73	77	80	83	86	89	92	95	98	101	104	107
178cm (1.78m)	60	63	66	69	73	76	79	82	85	88	92	95	98	101	104	107	110
180cm (1.80m)	62	65	68	71	75	78	81	84	88	91	94	98	101	104	107	110	113
183cm (1.83m)	64	67	70	73	77	80	83	87	90	93	97	100	103	107	110	113	117
185cm (1.85m)	65	68	72	75	79	83	86	89	93	96	99	103	107	110	113	117	120
188cm (1.88m)	67	70	74	78	81	84	88	92	95	99	102	106	109	113	116	120	123
191cm (1.91m)	69	73	76	80	83	87	91	94	98	102	105	109	112	116	120	123	127
193cm (1.93m)	71	74	78	82	86	89	93	97	100	104	108	112	115	119	123	127	130
<b>BMI</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>	<b>24</b>	<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>	<b>31</b>	<b>32</b>	<b>33</b>	<b>34</b>	<b>35</b>
<b>NORMAL WEIGHT (18.5 - 24.9)</b>																	
<b>OVERWEIGHT (25 - 29.9)</b>																	
<b>OBESITY (=&gt; 30)</b>																	

## Ideal Body Weight: IBW

Ideal body weight can be calculated either by formula or by special tables according to the sex, height and frame size.

It is also called desirable or healthy weight.

### **Formula:**

1. Simplest formula to use is: **22 x H<sup>2</sup>**

Since 22 is the mid point between the normal BMI ranges (appendix 1)

2. (Special for Saudis) Dr.khan & Dr.Al.kanhal 1998 (appendix 2)

Female (kg): 22.1 x Height (m) x Height (m)

Male (kg) : 22.4 x Height (m) x Height (m)

### **Example:**

Sara is 165 cm tall, what is her IBW?

$$IBW = 22.1 \times 1.65 \times 1.65 = 60 \text{ kg}$$

### Or by tables as seen below

### USDA healthy weight ranges

Height*	Weight (in Pounds)*
4'10"	88-119
4'11"	91-124
5'0"	95-128
5'1"	98-132
5'2"	101-137
5'3"	104-141
5'4"	108-146
5'5"	111-150
5'6"	114-155
5'7"	118-160
5'8"	122-164
5'9"	125-169
5'10"	129-174
5'11"	133-179
6'0"	136-184
6'1"	140-189
6'2"	144-195
6'3"	148-200
6'4"	152-205
6'5"	156-211
6'6"	160-216

\*Without shoes  
\*Without clothes

Note: The higher weights in each range apply to people with more muscle and bone, such as many men. Healthy weight range is based on a BMI of 18.5 to 25.

Adapted from *Nutrition and Your Health: Dietary Guidelines for Americans* (Washington, DC: U.S. Departments of Agriculture and Health and Human Services; 2000).

1 pound = 0.454 kg

1 feet = 30 cm

1 inch = 2.54 cm

See appendix 3 for more tables

**Frame size:**

$$R = \frac{\text{Height cm}}{\text{Wrist circumference cm}}$$



<i>Males</i>		<i>Females</i>	
R > 10.4	small	R > 11	small
R = 9.6 – 10.4	medium	R = 10.1 – 11	medium
R < 9.6	large	R < 10.1	large

**% Ideal Body Weight: %IBW**

It can be used to estimate nutritional risk.

$$\%IBW = \frac{\text{Current weight}}{\text{Ideal weight}} \times 100$$

<b>% IBW</b>	<b>Interpretation</b>
< 69	Sever malnutrition
70 - 79	Moderate malnutrition
80 - 90	Mild malnutrition
110 - 129	Overweight
130 - 199	Obese
> 200	Morbid obesity

**Example:**

What is the %IBW of Sara? Knowing that she weighs 75 kg.

$$\%IBW = \frac{75}{60} = 1.25 \times 100 = 125 \% \text{ (over weight)}$$

**Dry weight:**

Is the weight used in calculations for renal, liver or pulmonary patients, it is the actual weight **after** the removal of fluids accumulated in the patient's body before dialysis. The weight **before** the removal of excess fluids is called the **wet weight**.

### Adjusted Body Weight: adj wt (wilkens, 1986)

Use of the actual body weight (ABW) of a person who is more than 125% of ideal body weight (IBW), results in an REE that is too high. The following formula has been recommended to give the weight which be used in calculating REE in obese individuals. The adjusted body weight is used when **BMI  $\geq 30$  kg/m<sup>2</sup>**.

#### **Formula:**

$$\text{Adj wt} = (\text{ABW} - \text{IBW}) \times 0.25 + \text{IBW}$$

#### **Example:**

Sara is 80 kg and 150 cm tall, and after calculating her BMI we found that it is 35.5 kg/m<sup>2</sup>, so how much is her adjusted body weight?

1. IBW =  $22.1 \times 1.5 \times 1.5 = 50$  kg
2. Adj wt =  $(80 - 50) \times 0.25 + 50 = 57.5$  kg

### Usual body weight: UBW

UBW may be a more useful parameter than ideal body weight for those who are ill. Comparing present weight to usual weight allows changes in weight status to be assessed. One problem with usual body weight is that it is dependent on the patient's memory.

### Actual body weight: ABW

ABW reflects a weight measurement obtained at the time of examination. This measurement maybe influenced by changes in the individual's fluid status. It is also named "current weight".

### Percent Usual Body Weight: %UBW (Buchman, 1997)

Usual body weight and weight change can be indicators of nutritional risk, particularly if weight change occurs rapidly or unintentionally, as it reflects changes in body protein, water, minerals, and fat.

$$\%UBW = \frac{\text{Current body weight}}{\text{UBW}} \times 100$$

<b>%UBW</b>	<b>Interpretation</b>
85 - 95	Mild malnutrition
75 - 84	Moderate malnutrition
< 74	Sever malnutrition

**Example:**

Sara usually weighs 65 kg, last week she entered the hospital with a weight of 60kg, calculate her %UBW?

$$\%UBW = \frac{60}{65} = 0.92 \times 100 = 92 \% \text{ (mild malnutrition)}$$

**Percentage Weight Change:** (Blackburn, 1977)

$$\% \text{ wt} = \frac{UBW - ABW}{UBW} \times 100$$

UBW = usual body weight

ABW = actual body weight

<b>Significant % Weight Change</b>		
	<b>Significant wt loss %</b>	<b>Severe wt loss %</b>
<b>1 week</b>	1-2	> 2
<b>1 month</b>	5	> 5
<b>3 months</b>	7.5	> 7.5
<b>6 months</b>	10	> 10
<b>Unlimited time</b>	10-20	> 20

**Example:**

A person currently weighs 68 kilograms; however, last month his weight was 72 kilograms. What is the % of his weight change?

$$\frac{72 - 68}{72} \times 100 = 5.5\% \text{ (weight change over 1 month.)}$$

**Reference:**

ADA manual 6<sup>th</sup> ed.