ORIGINAL RESEARCH PAPER

Biological Science

KEY WORDS: BMI, Waist-height ratio, Obesity, Waist-hip ratio, Systolic Blood Pressure, Diastolic Blood Pressure

APPROACHES DIFFER: BMI, WHTR, AND WHR STATISTICAL ANALYSIS AND DERIVATIONS

Aanal Desai Research Scholar at Calorx University

Dr. Pradeep. J. Jha* Research Guide at Calorx University *Corresponding Author

ABSTRACT

In this article we have attempted to redesign and interpret some important facts regarding important features of BMI followed by waist stature ratio and waist hip ratio. We have focused on it pursuing propensity to meet two targets. The basic notion being highly sensitive and also being important indicator pointing at normal and abnormal fitness standards, we decided to simplify its technical intricacies, not deviating from its specified norms, in simple terms. This effort, we think, shall prove highly useful and compatible with a class of people trending to health consciousness.
The second thought is to make simple chart/ table which are self explanatory on the first reading.
There are three different types of measures that we have discussed and tried to inter-relate them using some mathematical notions. To conclude, we simply share emphasis on three body measures- weight, waist, and hips- and their normal brackets.

1 INTRODUCTION:

In this informative and deductive article we have focused on three different types of measures, like 1 BMI, 2 W_AH,R, and $3W_AHR$ (Well mentioned in the Abbreviation part) which are very easy to record individually and in addition to that, without going in to mathematical details, charts, and tables will provide first hand health diagnostics. This, we think will surely help any individual identify his /her status on the scale of different zones of the health predictors derived using these three measures. These three different measures are on the broad scale and may not be considered as conclusive indicators. One does need expert opinion before ending up with only relying on these generalized facts. At the same time we would certainly recommend not to ignore the results given as a result of our efforts to a finer scale. We have tried to simplify making finer refinements but not at a cost of rigor in accuracy.

1.1 Units of Measures

According to the suggested plans we have thought to discuss and to derive more details pertaining to health indicators based on external physic like height, measures of waist, hip and weight which have proven by and large unbiased in predicting the current status and performance of some inner system like cardiovascular system, digestive system, and metabolism process. It is known that any variation, a little away from the normal in the performance of some of the regulatory system, will immediately reflect upon the body and some exterior measures like weight, waist, hip, number of breaths in one minute, number of pulse rate per minute, and some of the important constituents like uric acid, sugar etc. in excretion. We strongly feel that before landing down on the core part it would be immensely useful and informative piece of work to clarify regarding some units and measures.

(a) Notion regarding Weight and Mass:

In the physical sciences, **mass** and **weight** are regarded different and have different units also.

The **mass** of an object is a measure of the amount of matter in the object. Mass of one substance (say mercury) in a unit cube is different than mass of another substance(say silver) in the same unit cube. **Weight** is a measure of the force on the object caused by a gravitational field **(F = m. a)**.

Putting the same in other words, **weight** is how hard gravity pulls on an object.

In physics the standard unit of mass is kilogram (K.G.) in metric system while pounds (lbs) in British system. Unit for **weight** is **Newton= K.G./(meter)^2**.

(b) Conversion from one system to another:

To make the results and formulae discussed in this paper, we need to know some standard results which help conversion between two (Metric and British) well accepted systems.
(1) 1 K.G. = 2.21 lbs, (1 lb. = 0.45 K.G.)
(2) 1 inch (1$^{''}$) **= 2.54** cms. = 0.0254 mts.

In addition to this we note that there are some measures which are unit free and it helps comparison between ratios of two systems; though they are measured using different systems.

Before switching over to the next part we again would like to iterate that the three different notions introduced here are very important and work as sound predictor of some of the systems and its performance. These results have been tested over a long period of time and over different subjects residing in different environment and different atmospheric conditions. Though sincere efforts and proper care for maintaining preciseness have been prioritized, readers are advised to ascertain from some other equally reliable sources also.

2 Three Different Criteria:

Since last two centuries anthropometric indices that can be frequently used as predictor and can be prevalent in epidemiological sciences have been conceived by many visionary scientists possessing a high degree of perspicacity. Some of them which are well established and widely accepted preserving their uniqueness are BMI, WHtR, and WHR. In the following lines we have justified them by adding our views supported by mathematical reasoning.

2.1 BMI:

Reminiscing to the origin of the 'first Idea' we came to know that the BMI was introduced in the early 19th century by a Belgian named **Lambert Adolphe Jacques Quetelet**. He was a mathematician, not a physician. He was influenced by the different types of varying physical structures in human body and was seized by perplexed operations of the different systems residing in a physical body. He founded the science of anthropometry and between the time slot 1830 and 1850 developed the body mass index scale which he propagated calling as the Quetelet Index. In that era it was under the area known as social science The main idea was to generate some decision criteria that can classify a person based on his external features and measures of the body. The mutually exclusive classes being one of underweight, normal weight, overweight, or obese. He was convinced by his visionary

thought process that inner system has a strong influence, in general, on external features.

Based only on external features he thought to design predictors that can classify the physical body in to one of the above mentioned categories and simultaneously it may be, to an extent, possible to alarm about consequences the subject is liable to face as the internal disharmony that has influenced the external measures. Also he knew that shifting from one category to the other one was possible under strict observance of strict dietary control, type of physical exercise, mental state, and firm pursuance to the target.

Body Mass Index, or BMI, is, as discussed above, an predictor index that relates to one's weight to his height. As discussed above in section 1.1 we can adopt any one system either metric system or British system to find BMI. Some conversion results from one system may help you to strictly remain in any one of the system to find his/her BMI.

BMI of a subject = Weight in K.G. / (height in mts.)^2 (1)

According to **Imperial Formula**,

BMI of a subject = [Weight in lbs / (height in inches.)^2] x 703 (2)

Weight and height necessarily be in the same system; either
- 1 weight in K.G and height in meters or
- 2 weight in lbs. and height in inches.

[If a subject has weight 70 K.G. and height 1.67 mts. then his BMI according to above formula (1) is 70/ (1.67)^2 = 25.099 = 25.1 (Approximately)]

2.2 Some Important Deductions:

The formulae that we have shown above have many important features and now we discuss each one of them.

(1) Unit of BMI in metric system is k.g./(mt.)^2 while lbs/(inch)^2 in British system.
(2) For a person with known figure of height in mts. (or inches), BMI depends on weight only i.e. fluctuation in weight will linearly sympathetic to proportional increase or decrease BMI.
(3) Classification of physic, for a given weight and height, is widely accepted under four categories—Underweight, Normal, Overweight, and Obese; these are the different classes related to different results of calculated BMI.

If your **BMI** is: below 18.5 – you're in the underweight **range**. between 18.5 and 24.9 – you are in the healthy weight **range**, between 25 and 29.9 – you are in the overweight **range** and above that the subject is in Obese range

The healthy BMI range is the same for men and women, so the results apply to both. The healthy **normal** weight range is a BMI between 18.5 and 24.9. A body mass index of 22 is in the middle of that range. We illustrate it by citing two examples.

(A) For a subject with a given height **5' 6'' (1.676 mts.)**

Category	Underweight	Normal	Overweight	Obese
BMI (Class/ Range)	< 19	(19.046, 24.86)	(25.02, 29.86)	(29.95,38.93)

(B) For a subject with a given height **5' 2'' (1.575mts.)**

Category	Underweight	Normal	Overweight	Obese
BMI (Class/ Range)	< 19.02	(19.02, 24.69)	(24.87, 29.81)	(29.99, 38.97)

(4) BMI for male and female continues in the same brackets barring certain cases.
(5) We have already said that BMI is a predictor or indicator of soundness of inner systems, a healthy state indicator BMI (range) can also help you keep warned regarding diseases like heart problem related to cardiovascular system, type 2 diabetes and hypertension at bay. This is simply, for a given height, related to increase in weight beyond a normal limit. It indicates a deviation from normal/regular functioning of one or more systems which are associated with body.
(6) BMI is an indicator which is proportional to weight or inversely proportional to the square of measure of height. BMI is basically a quantified measure for the amount of tissue mass, that is muscles, fat and bones, of an individual. However, if you are an athlete or an overall active person, your body weight may be high not because of fat but because of muscle. Muscle is denser than fat and a body with reasonably good muscle means more weight and hence, higher BMI. In such a case or situation BMI falls in Overweight or Obese zone yet it does not alarm for any complication otherwise likely to induce for the subjects falling in such a range. If a subject follows a systematic course of physical exercise on a regular basis then he burns a reasonable amount of fat and gradually reduces fat level accumulation in different areas of the body (like belly, waist, hips etc.) which are commonly known as immediate storage areas and then if not attended to proper remedial actions and in some cases, as observed, appears on different active external organs like hands and feet which are active zones for exertion immediately causing nearest fat deposition area to burn/dissolve at a faster rate. On the other hand, it helps build bone muscles which constitute one of the important weight factor. Researchers, after several sampling in different geographical areas, people with different food habits, have concluded that there is a non-sympathetic correlation between the two attributes fat and bone mass; physical exercise increases bone mass while reducing fat mass.
(7) Normally it is observed that as the height increases (up to a certain age) weight also increases. The weight in the body apportions to 15% to the bones and depending upon metabolism set-up relies on the muscle weight. There are many factors like (i) type of food (2) family traits (3) family circumstances and (4) geographical environment which are mainly responsible for the fat weight and muscle weight , which is, without loss of generality, depends on physical exercises and certain type of physical activities carried out by a person during his routine. There are some mathematical results different for men and women, which formulate ideal body weight (IBW) given below. These are generally applicable to persons above 5' (=60'') in height.
- IBM(in K.G) for Men = 50 + 2.3*(height in inches – 60*)
- IBM(in K.G) for women = 45.5 + 2.3 (height in inches – 60*)[* In place of 60, some consider number between 58 and 60]

All such fluctuations, to some extent, undermine the notion of BMI.

In order to calculate BMI, for a given fixed height the different types of weight groups with a range of 5 K.G. The range of weight considered is 30 K.Gs. to 40 K.Gs. To be more exact, say for a given height 5'6'' (66 inches= 66'') the weight range is (55, 100) K.Gs which is generally capable of handling, ingeneral, the most of the subjects under study.

A Guiding Table for BMI

Table -1

Height	Weight Range (K.G.)	BMI Range	BMI/KG	KG/BMI
5'6'' (1.68 Meters)	[55,60]	[19.5,21.3]	0.36	2.8
	[60,65]	[21.3,23]	0.34	2.9
	[65,70]	[23, 24.8]	0.36	2.8

	[70,75]	[24.8, 26.6]	0.36	2.8
	[75,80]	[26.6, 28.3]	0.34	2.9
	[80,85]	[28.3, 30.1]	0.36	2.8
	[85,90]	[30.1, 31.9]	0.36	2.8
	[90,95]	[31.9, 33.7]	0.36	2.8
	[95,100]	[33.7,35.4]	0.34	2.9

3 Inferences Derived from the Table - 1:

We have seen many results and derivations in above section. A doctor is basically concerned with her patient and advising her when BMI crosses normal limits. When BMI crosses desired limit then it is an indication of onset of certain irregular functioning of certain system that concerns immediately to the incremental weight. [As it is known that the height is constant on a given situation under consideration].

The second rational is that BMI correctly captures the relationship between weight and height.Slope of log(Weight) regressed on log(height) = 2[The derivation is derived using the records of 25 diverse population cases in Europe and Asia.] Referring to the above table, column 4, It reads BMI/ K.G. which means that one k.g. change on either side of your existing weight shall be liable to an increment/ decrement of corresponding change in BMI.

Also referring to the above table, column 5, It reads K.G. / BMI which means that one unit change on either side of your existing BMI shall be liable to an increment/ decrement of corresponding change in existing weight.

Referring to the entries of the fourth and fifth column in the last row, for the given height 5' 6"[1.68 mts.], it conveys that if you change your weight by one k.g., your BMI will change by 0.34 unit. Also it can be interpreted that if you want to change your BMI by one unit then you should change your weight by 2.9 k.g.

4 Waist Height Ratio:

Again moving equally parallel and claimed ideal is one more ratio; WHtR--- Waist Height Ratio. Ideally, up to a certain age, height and waist are correlated sympathetically.

In some cases It is found that waist circumference is in the higher brackets then what it should be in normal or regular cases. Some do attach different causes like family traits, lack of physical exercise, after effect of certain medications followed during long term illness. In such cases measure of waist (waist circumference) may be very low or high then ideally required. Without loss of generality we define a person's **waist-to-height ratio** (**WHtR**), also called **waist-to-stature ratio** (**WSR**) to be a real value which is always less than 1 and a positive number greater than zero.

WHtR = WSR = Waist circumference ÷ measure of height

[1] It is a ratio which is unit free.
[2] Both the measure must be in the same units.
[3] Ideally this ratio, as claimed and theoretically approved, should be equal to ½ (= 0.5)
[4] As the numerator value which corresponds to measure of waist increase then the ratio takes up higher values then 0.5-(the ideal measure).
[5] The WHtR is a measure of the distribution of body fat. Higher values of WHtR indicate higher risk of obesity-related cardiovascular diseases; it is correlated with abdominal obesity. A study over a long period of time on more than 10,000subjects can be considered reasonably sufficient to justify that WHtR is a much better indicating the degree of the risk of heart attack, stroke or death than the more widely used body mass index
[6] Some important derivations are A WHtR of over 0.5 is critical and signifies an increased risk For people under 40 years of age the critical value is 0.5, for people aged 40–50 the critical value is between 0.5 and 0.6, and for people over 50 the critical values start at 0.6. Figures that deviate much from ½ (= 0.5) reflect weak degree of metabolism and hence are an alarm to cardio metabolic system
[7] Some important WHtR(WSR) are given below which are derived based on conclusion of large samples whose members are from different tropical conditions and hence should be regarded nearly ideal.
[8] We note that in the ratio discussed above, the denominator cannot be changed, as it is the height of the subject but depending upon rate of cardio metabolic activities the result is reflected in the numerator which controls the ratio. Ideal ratios is, in general, accepted to be 0.5 and any number above or below 0.5 along with increasing or decreasing value of this ratio calculated at a fixed interval can be regarded suspicious trending to lethal disease.

Table-2

Subjects	Female college swimmer	Male college swimmer	Body builder	Female at increased risk	General healthy cutoff	Males at increased risk	Obese	Substantial risk increase
Waist-to-height ratio	0.424	0.428	0.458	0.492	0.5	0.536	0.577	0.582

WHtR may be advantageous in prediction of risk because it avoids the need for age, sex. and ethnic-specific boundary values" which is directly associated with the geographical climates, genetic traits, food habits, type and nature of physical activities carried out over a long period of time.

5 Waist Hip Ratio: One equally reliable predictor is Waist to Hip ratio. This is again a ratio of measure of waist circumference to the measure encircling the body around the hips. (One may take two or three measurements around the hips and consider the highest observation.) When the body generates a tendency to deposit additional fat it probably begins with prioritization around the abdominal tissues and equally distributing around waist and hip portion. This is the reason which preserves its importance as one of the predictor factors.

Waist to Hip Ratio(WHR) is an effective way to examine regional fat distribution.

Health Risk	Men	Women
High Risk	>1.0	>0.85
Moderate Risk	0.90-1.0	0.80-0.85
Low Risk	<0.90	<0.80

WHR is not considered to be as valid for

- Children
- People who are under feet tall or
- Who have a body mass index (BMI) of 35 or above.

As a comparative, the following table categorizes the boundaries of persons in terms of health:

Children (up to 15)	Men	Women	Categorization	Examples
<=0.34	<=0.34	<=0.34	Extremely Slim	Marilyn Monroe (0.3359)
0.35 to 0.45	0.35 to 0.42	0.35 to 0.41	Slim	
0.46 to 0.51	0.43 to 0.52	0.42 to 0.48	Healthy	Female College Swimmer (0.4240) Male College Swimmer (0.4280) Body Builder (0.4580)

0.52 to 0.63	0.53 to 0.57	0.49 to 0.53	Overweight	Female at increased risk (0.4920) Male at increased risk (0.5360)
	0.58 to 0.62	0.54 to 0.57	Very Overweight	
0.64 =>	0.63 =>	0.58 =>	Obese	

CONCLUSION:

This article on different ratios like BMI, WSR, WHR retains its unique importance as it distinctly defines the deviations of actual measures from ideal limits /brackets is self awakening and alarming one as it is very simple to understand and calculate without going to any consultant for seeking advice. Ideal measures are natural measures which to the most extent for some systems are so perfectly designed that a little variation is capable enough to forecast some future disturbances in a system which results in to irregularities of harmonious and synchronized working of different systems. In short we conclude that at a given stage height and hence relevant measures are ideal indicators to healthy living standards.

ANNAXURE: 1

Height		K.G.	BMI	BMI/K.G.	K.G./BMI
Inches	Mts				
4' 10"	1.47	[40,45)	[18.5,20.8)	0.46	2.17
		[45,50)	[20.8,23.1)	0.46	2.17
		[50,55)	[23.1,25.5)	0.48	2.1
		[55,60)	[25.5,27.8)	0.46	2.17
		[60,65)	[27.8,30.1)	0.46	2.17
		[65,70)	[30.1,32.4)	0.46	2.17
4'11'	1.5	[40,45)	[17.7,20)	0.46	2.17
		[45,50)	[20,22.2)	0.44	2.27
		[50,55)	[22.2,24.4)	0.44	2.27
		[55,60)	[24.4,26.7)	0.46	2.17
		[60,65)	[26.7,28.9)	0.44	2.27
		[65,70)	[28.9,31.1)	0.44	2.27
5'	1.52	[40,45)	[17.3,19.5)	0.44	2.27
		[45,50)	[19.5,21.6)	0.42	2.38
		[50,55)	[21.6,23.8)	0.44	2.27
		[55,60)	[23.8,26)	0.44	2.27
		[60,65)	[26,28.1)	0.42	2.38
		[65,70)	[28.1,30.3)	0.44	2.27
5'1"	1.55	[50,55)	[20.8,22.9)	0.42	2.38
		[55,60)	[22.9,25)	0.42	2.38
		[60,65)	[25,27.1)	0.42	2.38
		[65,70)	[27.1,29.1)	0.4	2.5
		[70,75)	[29.1,31.2)	0.42	2.38
		[75,80)	[31.2,33.3)	0.42	2.38
		[80,85)	[33.3,35.4)	0.42	2.38
		[85,90)	[35.4,37.5)	0.42	2.38
5'2"	1.57	[50,55)	[20.3,22.3)	0.4	2.5
		[55,60)	[22.3,24.3)	0.4	2.5
		[60,65)	[24.3,26.4)	0.42	2.38
		[65,70)	[26.4,28.4)	0.4	2.5
		[70,75)	[28.4,30.4)	0.4	2.5
		[75,80)	[30.4,32.5)	0.42	2.38
		[80,85)	[32.5,34.5)	0.4	2.5
		[85,90)	[34.5,36.5)	0.4	2.5
5'3"	1.6	[50,55)	[19.5,21.5)	0.4	2.5
		[55,60)	[21.5,23.4)	0.38	2.6
		[60,65)	[23.4,25.4)	0.4	2.5
		[65,70)	[25.4,27.3)	0.38	2.6
		[70,75)	[27.3,29.3)	0.4	2.5
		[75,80)	[29.3,31.3)	0.4	2.5
		[80,85)	[31.3,33.2)	0.38	2.6
		[85,90)	[33.2,35.2)	0.4	2.5
5'4"	1.63	[50,55)	[18.8,20.7)	0.38	2.6
		[55,60)	[20.7,22.6)	0.38	2.6
		[60,65)	[22.6,24.5)	0.38	2.6
		[65,70)	[24.5,26.3)	0.36	2.7
		[70,75)	[26.3,28.2)	0.38	2.6
		[75,80)	[28.2,30.1)	0.38	2.6
		[80,85)	[30.1,32)	0.38	2.6
		[85,90)	[32,33.9)	0.38	2.6
5'5"	1.65	[50,55)	[18.4,20.2)	0.36	2.8
		[55,60)	[20.2,22)	0.36	2.8
		[60,65)	[22,23.9)	0.38	2.6
		[65,70)	[23.9,25.7)	0.36	2.8
		[70,75)	[25.7,27.5)	0.36	2.8
		[75,80)	[27.5,29.4)	0.38	2.6
		[80,85)	[29.4,31.2)	0.36	2.8
		[85,90)	[31.2,33.1)	0.38	2.6
5'6"	1.68	[50,55)	[17.7,19.5)	0.36	2.8
		[55,60)	[19.5,21.3)	0.36	2.8
		[60,65)	[21.3,23)	0.34	2.9
		[65,70)	[23,24.8)	0.36	2.8
		[70,75)	[24.8,26.6)	0.36	2.8
		[75,80)	[26.6,28.3)	0.34	2.9
		[80,85)	[28.3,30.1)	0.36	2.8
		[85,90)	[30.1,31.9)	0.36	2.8
		[90,95)	[31.9,33.7)	0.36	2.8
		[95,100)	[33.7,35.4)	0.34	2.9
5'7"	1.7	[50,55)	[17.3,19)	0.34	2.9
		[55,60)	[19,20.8)	0.36	2.8
		[60,65)	[20.8,22.5)	0.34	2.9
		[65,70)	[22.5,24.2)	0.34	2.9
		[70,75)	[24.2,25.9)	0.34	2.9
		[75,80)	[25.9,27.7)	0.36	2.8
		[80,85)	[27.7,29.4)	0.34	2.9
		[85,90)	[29.4,31.1)	0.34	2.9
		[90,95)	[31.1,32.9)	0.36	2.8
		[95,100)	[32.9,34.6)	0.34	2.9
5'8"	1.73	[50,55)	[16.7,18.4)	0.34	2.9
		[55,60)	[18.4,20)	0.32	3.1
		[60,65)	[20,21.7)	0.34	2.9
		[65,70)	[21.7,23.4)	0.34	2.9
		[70,75)	[23.4,25.1)	0.34	2.9
		[75,80)	[25.1,26.7)	0.32	3.1
		[80,85)	[26.7,28.4)	0.34	2.9
		[85,90)	[28.4,30.1)	0.34	2.9
		[90,95)	[30.1,31.7)	0.32	3.1
		[95,100)	[31.7,33.4)	0.34	2.9
5'9"	1.75	[50,55)	[16.3,18)	0.34	2.9
		[55,60)	[18,19.6)	0.32	3.1
		[60,65)	[19.6,21.2)	0.32	3.1
		[65,70)	[21.2,22.9)	0.34	2.9
		[70,75)	[22.9,24.5)	0.32	3.1
		[75,80)	[24.5,26.1)	0.32	3.1
		[80,85)	[26.1,27.8)	0.34	2.9
		[85,90)	[27.8,29.4)	0.32	3.1
		[90,95)	[29.4,31)	0.32	3.1
		[95,100)	[31,32.7)	0.34	2.9
5'10"	1.78	[50,55)	[15.8,17.4)	0.32	3.1
		[55,60)	[17.4,18.9)	0.3	3.3
		[60,65)	[18.9,20.5)	0.32	3.1
		[65,70)	[20.5,22.1)	0.32	3.1
		[70,75)	[22.1,23.7)	0.32	3.1
		[75,80)	[23.7,25.2)	0.3	3.3
		[80,85)	[25.2,26.8)	0.32	3.1
		[85,90)	[26.8,28.4)	0.32	3.1
		[90,95)	[28.4,30)	0.34	3.1
		[95,100)	[30,31.6)	0.32	3.1

5'11"	1.8	[50,55)	[15.4,17)	0.32	3.1
		[55,60)	[17,18.5)	0.3	3.3
		[60,65)	[18.5,20.1)	0.32	3.1
		[65,70)	[20.1,21.6)	0.3	3.3
		[70,75)	[21.6,23.1)	0.3	3.3
		[75,80)	[23.1,24.7)	0.32	3.1
		[80,85)	[24.7,26.2)	0.3	3.3
		[85,90)	[26.2,27.8)	0.32	3.1
		[90,95)	[27.8,29.3)	0.3	3.3
		[95,100)	[29.3,30.9)	0.32	3.1
6'	1.83	[50,55)	[14.9,16.4)	0.3	3.3
		[55,60)	[16.4,17.9)	0.3	3.3
		[60,65)	[17.9,19.4)	0.3	3.3
		[65,70)	[19.4,20.9)	0.3	3.3
		[70,75)	[20.9,22.4)	0.3	3.3
		[75,80)	[22.4,23.9)	0.3	3.3
		[80,85)	[23.9,25.4)	0.3	3.3
		[85,90)	[25.4,26.9)	0.3	3.3
		[90,95)	[26.9,28.4)	0.3	3.3
		[95,100)	[28.4,29.9)	0.3	3.3
6'1"	1.85	[50,55)	[14.6,16.1)	0.3	3.3
		[55,60)	[16.1,17.5)	0.28	3.5
		[60,65)	[17.5,19)	0.3	3.3
		[65,70)	[19,20.5)	0.3	3.3
		[70,75)	[20.5,21.9)	0.28	3.5
		[75,80)	[21.9,23.4)	0.3	3.3
		[80,85)	[23.4,24.8)	0.28	3.5
		[85,90)	[24.8,26.3)	0.3	3.3
		[90,95)	[26.3,27.8)	0.3	3.3
		[95,100)	[27.8,29.2)	0.28	3.5
6'2"	1.88	[50,55)	[14.1,15.6)	0.3	3.3
		[55,60)	[15.6,17)	0.28	3.5
		[60,65)	[17,18.4)	0.28	3.5
		[65,70)	[18.4,19.8)	0.28	3.5
		[70,75)	[19.8,21.2)	0.28	3.5
		[75,80)	[21.2,22.6)	0.28	3.5
		[80,85)	[22.6,24)	0.28	3.5
		[85,90)	[24,25.5)	0.3	3.3
		[90,95)	[25.5,26.9)	0.28	3.5
		[95,100)	[26.9,28.3)	0.28	3.5

REFERENCES:

(1) Body Mass Index, Waist Circumference, and Waist-to- Height Ratio as Predictors of Cardio-metabolic Risk in Childhood Obesity Depending on Pubertal Development; jcem.endojournals.org J Clin Endocrinol Metab, August 2013,98(8):3384–3393

(2) Correlation of Waist Hip Ratio and BMI with Hypertension and Diabetes Mellitus in an Urban Area of Bangalore City; Savita S Patil1, Dinesh R Rajaram2, Nandakumar BS2, Jayasree S Seeri3; National Journal of Community Medicine Volume 6 Issue 1 Jan–Mar 2015

(3) Comparison of waist-to-hip ratio and other obesity indices aspredictors of cardiovascular disease risk in people with type 2diabetes: a prospective cohort study from ADVANCE; Eur J Cardiovasc PrevRehabil. 2011 April ; 18(2): 312–319. doi:10.1097/HJR.0b013e32833c1aa3

(4) Waist-to-height ratio index for predicting incidences of hypertension: the ARIRANG study;Jung Ran Choi, Sang Baek Koh and Eunhee Choi; Choi et al. BMC Public Health (2018) 18:767

(5) Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies; Lawrence de Koning1, Anwar T. Merchant1, Janice Pogue1, and Sonia S. Anand1,2*;European Heart Journal (2007) 28, 850–856

(6) Waist-to-height ratio as an indicator of 'early health risk': simpler and morepredictive than using a 'matrix' basedon BMI and waist circumference ;Margaret Ashwell & Sigrid Gibson; BMJ Open 2016;6;e010159. doi:10.1136/bmjopen-2015-010159

(7) Waist-to-Height Ratio Is More Predictive of Years of LifeLost than Body Mass Index Margaret Ashwell, Les Mayhew, Jon Richardson, Ben Rickayzen; PLOS ONE; September 2014; volume-9; Issue-9; e103483