THE MATH OF FITNESS

By Eric Kim

How is Math Relevant to Fitness?

- Math helps us to maintain our exercise routines.
- Math is used to calculate short-term and long-term goals.
- Math is used to measure our growth in fitness levels.
- Math can be used to perfect exercise form.
- Math can tell us when to take a water break.

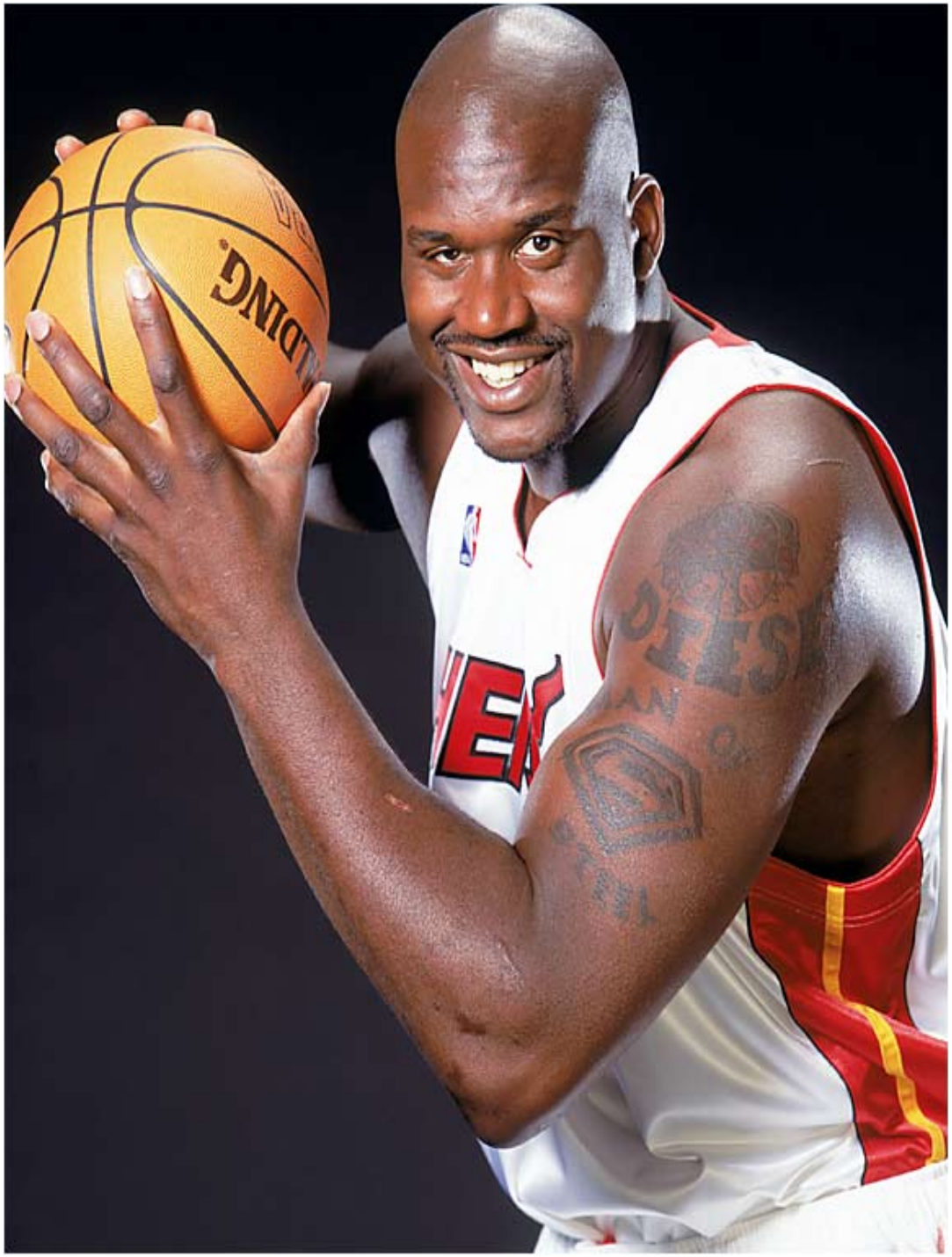
Numbers & Formulas in Relation to Fitness

BMI (Body Mass Index)

- BMI is a used to measure how overweight or obese an individual may be.
- It is calculated from your height and weight.
- BMI is an estimate of body fat and a good gauge of your risk for diseases that can occur with more body fat.
- The Higher BMI, the higher your risk for certain diseases such as cardiovascular disease, high blood pressure, type 2 diabetes, gallstones, breathing problems, and certain types of cancers.

Limits of BMI

- It may overestimate body fat in athletes and others who have a muscular build.
- It may underestimate body fat in older individuals and others who have lost muscle mass.



How To Calculate BMI

Standard Formula

- **BMI = Weight (kg) ÷ Height (m)^2**
- Weight Conversion: wt. in lbs ÷ 2.2 = wt. in kg
- Height Conversion: ht. in inches × 0.0254 = ht. in meters

BMI Categories

- Underweight = < 18.5
- Normal weight = 18.5 – 24.9
- Overweight = 25 – 29.9
- Obese = 30 or greater

Body Fat Percentage

- Common ways of measuring body fat %:
  - Skin Fold Caliper
  - Bioelectric Impedance Analysis
  - Anthropometric (Girth Measurements)
  - Hydrostatic Weighing
  - DEXA Scan (Dual Energy X-ray Absorptiometry)
- Variability in measurements & accuracy
- Variability in costs and accessibility


OMRON
FAT LOSS MONITOR
HEIGHT
FAT
READY
19.5
AGE
BMI
SEX
23.6
LOW
HIGH
On/Off
Down
Up
Start
Set

Body Fat Calculations

- Terminology:
  - Lean Body Mass (LBM)
  - Fat Mass (FM)
  - Body Weight (BW)
  - Desired Body Weight (DBW)
  - Desired Body Fat Percent (DBF%)
  - Percent Body Fat (%BF)

Body Fat Calculations

- **Fat Mass = % Body Fat × Body Weight**
  - Example:

  % Body Fat = 8%

  Body Weight = 160 lbs

  Fat Mass = 0.08 × 160 = 12.8 lbs

- **Lean Body Mass = Body Weight – Fat Mass**
  - Example:

  Lean Body Mass = 160 – 12.8 = 147.2 lbs

Body Fat Calculations

- **% Body Fat = Fat Mass ÷ Body Weight**
  - Example:

  % Body Fat = 12.8 ÷ 160 = 0.08 = 8% Body Fat

- **Desired Body Weight = LBM ÷ (1 – Desired Body Fat %)**
  - Example:

  DBW = 147.2 ÷ (1 – 0.06) = 156.6 lbs

- **Desired Body Fat % = 1 – (LBM ÷ DBW)**
  - Example:

  DBF% = 1 – (147.2 ÷ 156.6) = 0.06 = 6% Body Fat

*General Body Fat Percentage Categories

*American Council on Exercise

Classification	Women (% fat)	Men (% fat)
Essential Fat	10-12%	2-4%
Athletes	14-20%	6-13%
Fitness	21-24%	14-17%
Acceptable	25-31%	18-25%
Obese	32% plus	25% plus

Basal Metabolic Rate (BMR)

- BMR is the minimum calorific requirement needed to sustain life in a resting individual.
- Factors that determine BMR:
  - Genetics
  - Gender
  - Age
  - Muscle Mass
  - Body Temperature
  - Exercise

Calculating Your BMR

- **Harris Benedict Equation:**

Women: BMR = 655 + (4.35 × wt. in lbs.) + (4.7 × ht. in inches) – (4.7 × age)

Men: BMR = 66 + (6.23 × wt. in lbs.) + (12.7 × ht. in inches) – (6.8 × age)

Calculating Your BMR

Activity Level	Daily Calories Needed
Sedentary	BMR × 1.2
Light Exercise (1-3 days/week)	BMR × 1.375
Moderate Exercise (3-5 days/week)	BMR × 1.55
Intense Exercise (6-7 days/week)	BMR × 1.725
Very Intense Exercise (2 extreme workouts per day)	BMR × 1.9

Heart Rate

- **Resting Heart Rate (RHR)** is your heart rate upon waking up in the morning.
- To measure your RHR, use your index and middle finger to place on either your radial artery on your wrist or at your carotid artery in your neck. Next, count the number of beats in 10 seconds and multiply that number by 6.
- **Maximum Heart Rate (HR_{max})** is the highest heart rate an individual can achieve through exercise stress.

Heart Rate Formulas

- HR_{max} = 220 – age
- Heart Rate Reserve (HRR) = MHR – RHR
- Karvonen Formula:
  - (HRR ÷ % Intensity) + RHR = Target Heart Rate (THR)

Heart Rate Training Zones

Zone 1 – Light Exercise	50% – 60%
Zone 2 – Moderate Exercise	60% - 70%
Zone 3 – Endurance Training	70% - 80%
Zone 4 – High Performance Training	80% - 90%

Rate of Perceived Exertion (RPE)

- The RPE Scale is used to measure the intensity of your exercise.
- The RPE scale runs from 0-10.
- The higher the number on the scale, the higher the intensity of the exercise

1 - 10 Borg Rating of Perceived Exertion Scale	
0	Rest
1	Really Easy
2	Easy
3	Moderate
4	Sort of Hard
5	Hard
6	
7	Really Hard
8	
9	Really, Really, Hard
10	Maximal: Just like my hardest race

Conclusion

- Although maintaining fitness is not commonly thought of as a quantitative activity, math is incorporated in all areas of exercise.
- Math gives individuals a tangible way of recording their success and growth in fitness.
- Math can motivate individuals to stay consistent with their exercise routines.

References

- http://www.nhlbisupport.com/bmi/
- http://www.nhlbi.nih.gov/health/public/heart/obesity/lose_wt/risk.htm#limitations
- http://www.acefitness.org/blog/112/what-are-the-guidelines-for-percentage-of-body-fat/
- http://www.acefitness.org/fitnessqanda/fitnessqanda_display.aspx?itemid=325
- http://www.builtlean.com/2010/07/13/5-ways-to-measure-body-fat-percentage/
- http://www.bmi-calculator.net/bmr-calculator/bmr-formula.php
- http://www.shapefit.com/basal-metabolic-rate.html

References Continued…

- http://www.cdc.gov/physicalactivity/everyone/measuring/heartrate.html
- http://www.acefitness.org/newsletters/archive/2010sapsurveyresponse/Math-Formulas-and-Tips.pdf
- http://www.livestrong.com/article/172000-how-to-calculate-heart-rate-training-zones/
- http://my.clevelandclinic.org/heart/prevention/exercise/rpe.aspx