



Occupational
Health Clinics
for Ontario
Workers Inc.

Centres de
santé des
travailleurs (ses)
de l'Ontario Inc.

Introduction to the Anthropometric Calculator

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WHAT IS ANTHROPOMETRICS?



Anthropometry is the practice of measuring different aspects of the human body.

- Measures all physical aspects of your body.
- Simple measurements include height and width.
- Measurements such as the length from your elbow to the tip of your finger or the circumference of your skull are some examples.
- In a complete anthropometric survey measurements are taken between every joint and across hinge joints (such as the knee and elbow).

How Are Anthropometric Measurements Taken?



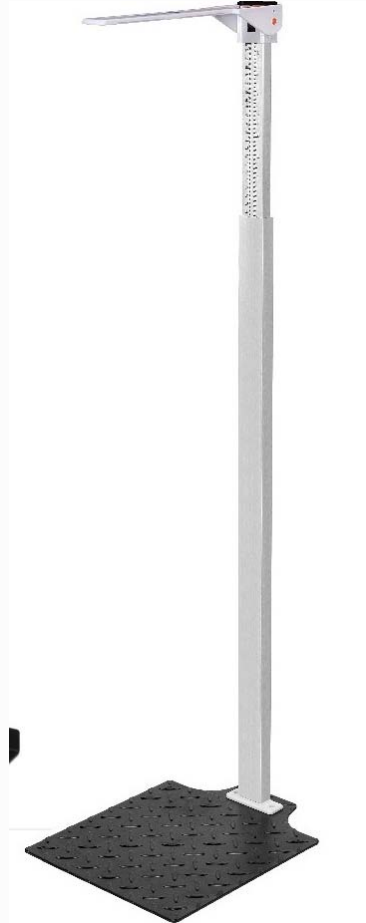
- Body Weight
 - Analog or digital scales



How Are Anthropometric Measurements Taken?



- Height
 - Stadiometer



How Are Anthropometric Measurements Taken?



- Body Segment Lengths
 - Sliding Calipers
 - Thoracometer



How Are Anthropometric Measurements Taken?



- Width, depth and skinfold
- Spreading Caliper
- Pelvimeter



How Are Anthropometric Measurements Taken?



- Circumferences
- Soft measuring tape



Finding Anthropometric Measurements



- Using “anthropometric measurements”
 - > 7,000,000 hits
 - Majority of hits are for
 - Research articles
 - Data for children
 - Nutritional Health

Finding Anthropometric Measurements



- Using “anthropometric measurements for adults”
 - >6,000,000 hits
 - Majority of hits are for
 - Research articles
 - Nutritional Health
 - Often difficult to find actual data tables
 - There is a fee for access

Finding Anthropometric Measurements



- Online sources are often not referenced, or information given where data is from

ANTHROPOMETRIC DATA

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Finding Anthropometric Measurements



- Data may only be given in specific percentiles

Dimension	Men				Women			
	5%	50%	95%	Mean	5%	50%	95%	Mean
Stature (cm)	1.60	1.74	1.85	1.73	1.54	1.64	1.74	1.64
Weight (Kg)	58.00	74.00	95.20	75.73	45.45	56.00	73.10	58.18
CMI (Kg/m)	20.00	24.00	30.00	24.66	17.00	21.00	26.00	21.3
Popliteal height (cm)	38.00	45.00	51.00	44.66	35.00	41.00	46.00	40.66
Buttock-popliteal distance (cm)	37.00	45.00	52.20	44.73	34.00	41.00	48.00	41
Hip width (cm)	38.00	45.00	57.20	46.73	37.45	44.00	54.00	45.15
Elbow height to the seat (cm)	20.00	24.00	30.00	24.66	19.00	24.00	28.00	23.66
Distance between the elbows (cm)	38.00	47.00	59.20	40.06	35.00	42.00	52.00	43

Finding Anthropometric Measurements

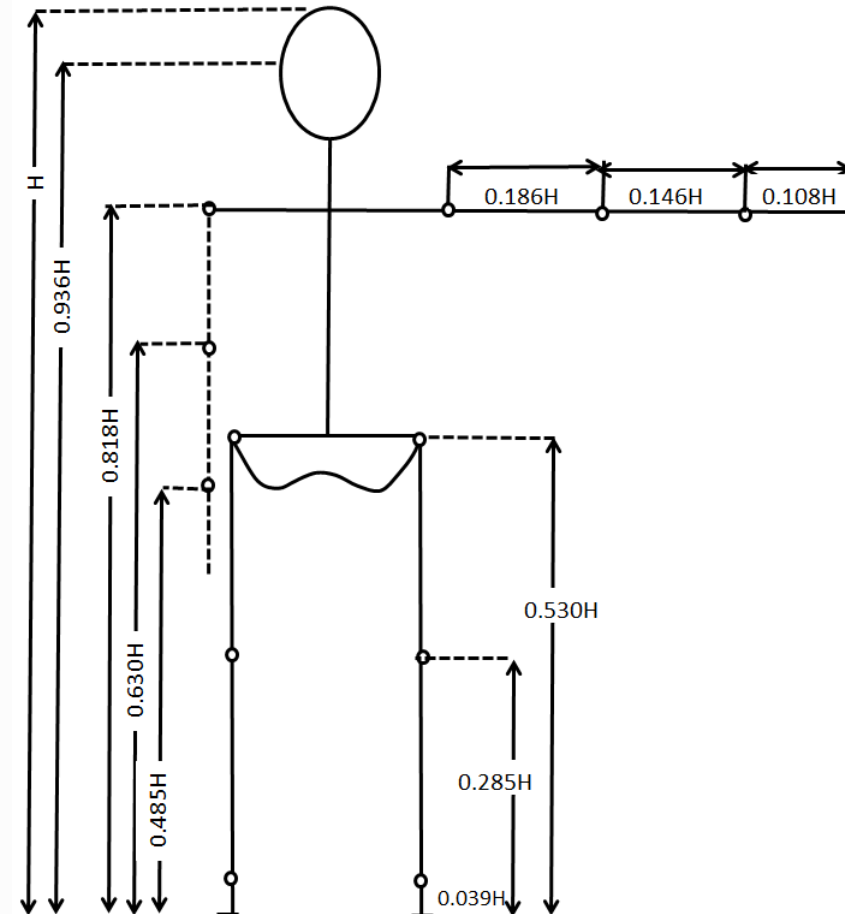


- May not include the height you are looking for i.e. smaller or larger stature
- May have gaps in data due to small sample sizes
- How reliable is the data you found?
- Population may not be what you are looking for
- Some measurements not included

Finding Anthropometric Measurements



- May be based on linked segment/proportionality constant models
- Gender specific?
- Accurate?
- Not all segments correlate well with height





Data Sources

- Most reliable and consistent data sets include:
 - Anthropometric Survey of US Army Personnel
 - 1988 and 2012
 - ANSUR I - 4000 adult US military personnel (1774 men and 2208 women)
 - ANSUR II - 6,000 adult US military personnel (4,082 men and 1,986 women)
 - not an approximation of the US Civilian population i.e. weight
 - free



Data Sources

- Civilian American and European Surface Anthropometry Resource Project
 - 2,400 U.S. & Canadian and 2,000 European civilians
 - 1998-2002
 - \$10,000
 - Summary tables can be found for free
- DINED
 - 40 years of data
 - Must register
 - Non-university access is limited
 - free
- Combined data sets contained ~7000 male and ~5000 female

Anthropometrics Calculator



- Data from ANSUR I, ANSUR II, and DINED were separated by gender
- Data separated (where possible) on ½” inch intervals
- Data for intervals for grouped and averaged within each dataset
- Data converted to metric
- Only most relevant data for Ergonomists/Designers was used
- All three datasets were arranged by stature

Anthropometrics Calculator



- Three separate tables for each dataset separated by height to give summary tables

	A	B	C	D	E	F	G	H	I	J	K	L
1	HEIGHT	HEIGHT	WEIGHT	WEIGHT	Standing S	Standing S	STANDING	STANDING	STANDING	KNEE HEI	STANDING	STANDING
2	55	1397	155	70	44.1	1120.0	39.4	1002.0	14.9	378.5	29.1	738.5
3	57	1448	141	64	46.6	1184.5	42.0	1066.5	15.1	383.5	29.4	747.0
4	57.5	1461	126	57	46.7	1186.0	42.0	1068.0	15.3	388.5	29.7	755.0
5	58	1473	122	55	47.0	1195.0	42.4	1077.0	15.5	393.5	29.9	759.5
6	58.5	1486	114	52	47.6	1209.9	43.0	1091.9	15.6	396.1	30.1	764.0
7	59	1499	118	54	48.2	1224.3	43.6	1106.3	15.7	400.0	30.2	768.0
8	59.5	1511	130	59	48.7	1236.7	44.0	1118.7	15.9	403.8	30.8	782.5
9	60	1524	138	62	49.3	1252.0	44.6	1134.0	16.3	413.2	31.2	791.6
10	60.5	1537	140	64	49.7	1262.7	45.1	1144.7	16.5	419.2	31.4	798.1
11	61	1549	135	61	49.9	1266.5	46.6	1182.5	16.8	427.6	32.7	830.7
12	61.5	1562	147	66	50.3	1278.7	46.9	1191.7	17.1	433.4	32.9	834.8
13	62	1575	139	63	50.7	1287.0	47.2	1198.6	17.2	435.9	33.1	840.6
14	62.5	1588	139	63	51.1	1298.9	47.4	1205.2	17.2	436.5	33.2	843.6
15	63	1600	148	67	51.6	1309.7	47.9	1217.6	17.4	441.3	33.4	849.3



Anthropometrics Calculator

- Data in summary tables then combined with CAESAR summary tables

	A	B	C	D	E	F	G	H	I	J	K
						Standing Shoulder Height	Standing Shoulder Height	STANDING CHEST HEIGHT (in)	STANDING CHEST HEIGHT (mm)	STANDING KNEE HEIGHT (in)	STANDING KNEE HEIGHT (mm)
5		HEIGHT (in)	HEIGHT (mm)	WEIGHT (lbs)	WEIGHT (kg)	(in)	(mm)	HEIGHT (in)	(mm)	HEIGHT (in)	(mm)
6	ANSUR I	62.5	1593	124	56	51	1296	47	1186	17	433
7	ANSUR II	62.5	1588	126	57	51	1305	45	1136	17	427
8	DINED	62.5	1593	145	66	51	1299	50	1282	17	435
9	CAESAR	62.5	1593	147	67	51	1303	45	1136	17	427



Anthropometrics Calculator

- Results were then averaged into one document

		HEIGHT (in)	HEIGHT (mm)	WEIGHT (lbs)	WEIGHT (kg)	Standing Shoulder Height (in)	Standing Shoulder Height (mm)	STANDING CHEST HEIGHT (in)	STANDING CHEST HEIGHT (mm)	STANDING KNEE HEIGHT (in)	STANDING KNEE HEIGHT (mm)
5											
6	ANSUR I	62.5	1593	124	56	51	1296	47	1186	17	433
7	ANSUR II	62.5	1588	126	57	51	1305	45	1136	17	427
8	DINED	62.5	1593	145	66	51	1299	50	1282	17	435
9	CAESAR	62.5	1593	147	67	51	1303	45	1136	17	427
10											
11	Average	62.5	1592	136	62	51	1301	47	1185	17	431

Anthropometrics Calculator



- By combining the datasets
 - Missing measurements and statures are included
 - Results are more representative of general population



Using the Calculator

To begin using the tool, you must first determine which gender, units and type of view you wish to use.

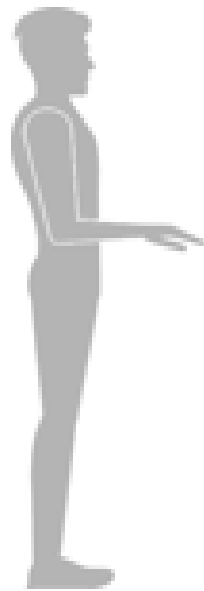


Table View

Figure View

Table View

Figure View

Imperial

Metric

Imperial

Metric

Imperial

Metric

Imperial

Metric



Using the Calculator

- Click on the cell for height you are examining

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Male Impo

Select
Height

Height
(inches)

Weight
(lbs.)

75

218.6

Seated Head Height	Seated Eye Height	Seated Overhead Reach	Seated Politeal Height
57.6	53.3	75.0	19.6

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length	Forearm-Center of Grip Length
15.4	20.7	36.1	15.1

Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth
70.2	46.8	58.9	3.7

Measurement Conversion

Enter mm or cm into empty field to get value in inches

mm

0.0 inches

cm

0.0 inches



Using the Calculator

- A drop-down menu appears

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Select Height Height (inches) Weight (lbs.)

75 218.6

Male Impo

Seated Head Height	Seated Eye Height	Seated Overhead Reach	Seated Politeal Height
57.6	53.3	75.0	19.6

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length	Forearm-Center of Grip Length
15.4	20.7	36.1	15.1

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70.2	46.8	58.9	3.7

Measurement Conversion

Enter mm or cm into empty field to get value in inches

mm ←

0.0 inches

cm ←

0.0 inches



Using the Calculator

- Select the desired height

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Male Imp

Select Height Height (inches) Weight (lbs.)

75 218.6

64.5
65
65.5
66
66.5
67
67.5
68

Measurement Conv

Enter mm or cm into empty field to get value in inches

mm

0.0 inches

cm

0.0 inches

Seated Head Height	Seated Eye Height	Seated Overhead Reach	Seated Politeal Height
57.6	53.3	75.0	19.6

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length	Forearm-Center of Grip Length
15.4	20.7	36.1	15.1

Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth
70.2	46.8	58.9	3.7



Using the Calculator

- Body segment dimensions for that height are displayed

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Select
Height

Height
(inches)

Weight
(lbs.)



65

161.4

Male Imp

Seated Head Height	Seated Eye Height	Seated Overhead Reach	Seated Politeal Height
50.4	46.0	66.3	16.0

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length	Forearm-Center of Grip Length
13.4	18.2	31.5	13.3

Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth
60.6	40.2	50.1	3.4

Measurement Conversion

Enter mm or cm into empty field to get value in inches

mm ←

0.0 inches

cm ←

0.0 inches



Using the Calculator

Male Imperial Data (Inches) - Table View

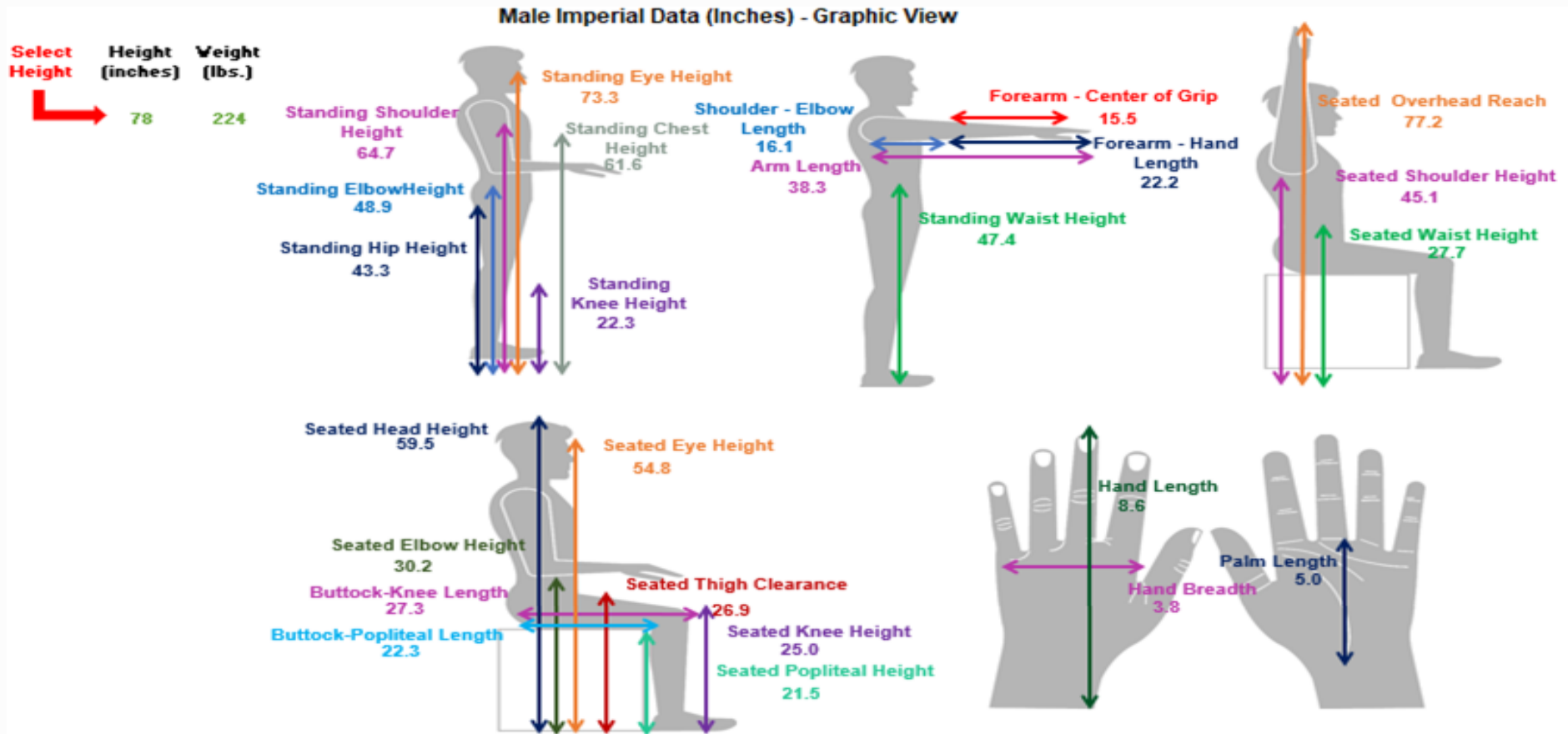
Select Height	Height (inches)	Weight (lbs.)	Seated Head Height	Seated Eye Height	Seated Overhead Reach	Seated Politeal Height	Seated Thigh Clearance	Seated Elbow Height	Seated Buttock Popliteal Length	Seated Buttock-Knee Length	Seated Knee Height	Seated Shoulder Height	Seated Waist Height
	65	161.4	50.4	46.0	66.3	16.0	22.6	24.7	19.4	23.4	20.4	34.3	23.4

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length	Forearm-Center of Grip Length	Standing Knee Height	Standing Hip Height	Standing Waist Height	Standing Shoulder Height
13.4	18.2	31.5	13.3	18.1	34.8	39.0	53.8

Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth	Hand Length	Palm Length
60.6	40.2	50.1	3.4	7.3	4.4



Using the Calculator



Applications of Anthropometric Data



- Nutritional and health status
- Clinical practice
- Clothing design
- Forensics and criminology
- Product/Equipment design
- Ergonomics
- Mismatch



Anthropometry and Health

- Can be used to determine obesity and malnutrition
- Body Mass Index (BMI) is a measure of body fat based on height and weight that applies to adult men and women and is used to determine obesity rates
- Underweight = <18.5
Normal weight = $18.5-24.9$
Overweight = $25-29.9$
Obesity = BMI of 30 or greater



Anthropometry and Health

- BMI Imperial = $((\text{weight}/(\text{height}^2)) * 703)$
- BMI Metric = $((\text{weight}/(\text{height}^2))$
- 69.5" and 191.5 lbs.

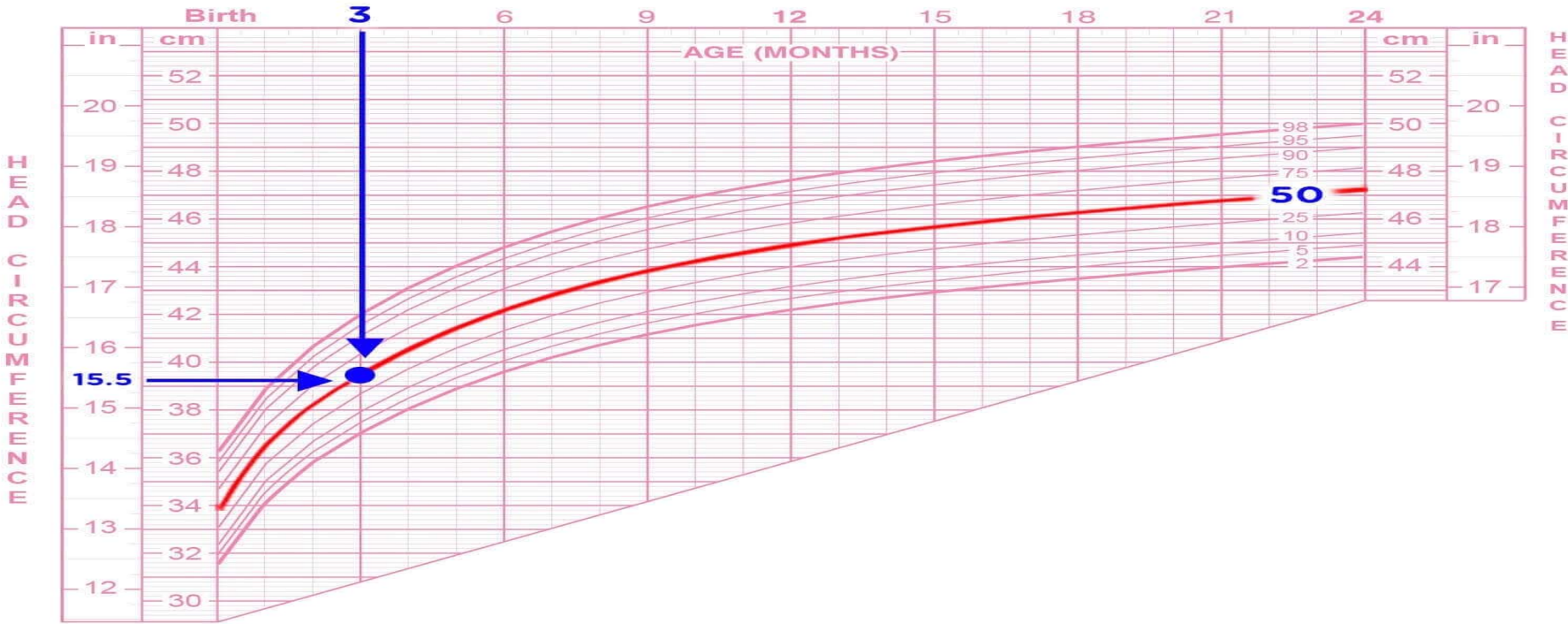
Then BMI = 27.9

Overweight = 25–29.9

Anthropometry and Health



Baby Growth Chart for Girls: Head Circumference





Anthropometry and Forensics

- Series of break-ins have occurred in a neighbourhood
- A smudged handprint was found on a window
- What can this tell us about the burglar?





Anthropometry and Forensics

- We can measure the size handprint
- If 8.1" hand length, then burglar could be:
 - Male 73.5" (6'1 1/2") – 74" (6'2")

Select Height	Height (inches)	Weight (lbs.)	Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth	Hand Length	Palm Length
	73.5	199.0	69.1	46.0	57.4	3.6	8.1	4.8

Select Height	Height (inches)	Weight (lbs.)	Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth	Hand Length	Palm Length
	74.0	221.2	69.7	46.2	57.6	3.6	8.1	4.8

- Female 70" (6') - 70.5" (6' 1/2")

Select Height	Height (inches)	Weight (lbs.)	Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth	Hand Length	Palm Length
	70.0	194.5	65.3	44.6	65.3	3.4	8.1	4.7

Select Height	Height (inches)	Weight (lbs.)	Standing Eye Height	Standing Elbow Height	Standing Chest Height	Hand Breadth	Hand Length	Palm Length
	70.5	173.2	65.9	44.0	65.9	3.4	8.1	4.7

Anthropometrics in the Workplace



- Workplaces must be designed for workers with a wide range of anthropometric characteristics
- For a work area to flow efficiently and productively, the equipment and the people using it must be operating smoothly and cohesively.
- Any obstacle that creates reaching difficulties, congestion or confusion can impair work output and compromise safety.
- Does the person's body size fit in a workplace? If one worker fits in a workplace, can all workers fit there?

Anthropometrics in the Workplace



- **Examples**

- Safe clearances or heights for doorways and walkways
- Appropriate reaching distances for safety cords and equipment controls
- Reach levels and work heights that meet code requirements
- Safety features, including machine guards and protective shields
- Equipment control configurations
- Work station and work flow designs
- Accessible adaptations that comply with ADA laws for people with disabilities.

Examples of Anthropometrics and Ergonomics



Seat Depth	Buttock-Popliteal Height
Monitor Height	Seated Eye Height
Armrest/Desk/Keyboard Mouse Heights	Seated Elbow Height
Seat Height	Seated Popliteal Height
Assembly Line Height	Standing Elbow Height
Depth of Workspace	Arm Length
Mouse Size	Hand Breadth/Hand Length



Examples Using the Calculator

- Laundry Department
 - 5'3" (1.6m) Female worker folds laundry standing at a table (36" high)
 - What height should the folding table be for her?
 - Table should be ~10 cm below standing elbow height (considered light work)
 - Compare to standing elbow height
 - $996.4 \text{ mm} = 99.64 \text{ cm} - 10 \text{ cm} = 89.64 \text{ cm}$ or 35.3"
 - Table is 1.8 cm or 0.7" too high



Height	Weight	Height	Height
1600	64.5	1219.5	1130.3
		Shoulder-Elbow Length	Forearm-Hand Length
		809.7	483.3
		Standing Elbow Height	Standing Elbow Height
			996.4

Examples Using the Calculator



- Office Chair Selection
- Company wants to buy a new chair that is
 - 21" deep seat pan
 - Armrests set at 27.2"
 - Seat height of 25.6"
- Worker is a 5'9" male
- Does the seat fit him?





Office Chair Selection

Male Imperial Data (Inches) - Table View

	Seated Head	Seated Eye	Seated	Seated Popliteal	Seated Thigh	Seated Elbow	Seated		
Selection	Height	Weight	Height	Height	Clearance	Height	Buttock		
Height	(inches)	(lbs.)					Popliteal		
							Length		
	69.0	180.1	53.0	48.3	69.6	17.5	24.1	26.7	20.3

Office Chair Selection



Chair Dimension	Worker Dimension	Difference
Seat Depth = 21"	Seated Buttock-Popliteal Length = 20.3	0.7" too deep
Armrest Height = 27.2"	Seated Elbow Height = 26.7"	0.5" too high
Seat Height = 25.6"	Seated Popliteal Height = 17.5"	8.1" too high



Assembly Line

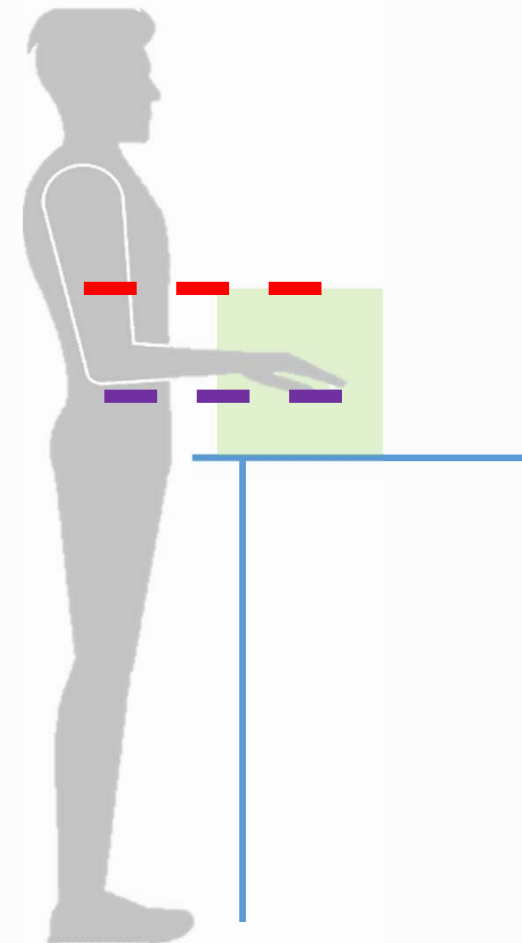
- 5'9" male
- Table is 36" high and 24" deep
- Places items into a box every 2 seconds
- Packing box is 12" high x 12" wide and 12" long.
- Will this area fit him?
- Can he develop long term shoulder issues?



Assembly Line



Worker	Work Area
Standing Elbow Height = 43.1"	Table height = 36"
	Box Height = 12"
	Total height = 48"
Difference	4.9" too high



- But he must also reach up over the box edge to place the first item 12" inside and 12" away from him



Medical Cart

- 5`1`` female - Registered Practical Nurse
- She states she was having problems when using the medical cart.
 - Cart worksurface is designed to be the standing elbow height of the average male (5'10")
 - What would the height of the cart be?
 - Can the worker safely use the working surface of the medical cart?





5'10" Male

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Select
Height

Height
(inches)

Weight
(lbs.)



Measurement Conversion

Enter mm or cm into empty field to get value in inches

mm 

0.0 inches

cm 

Seated Head Height	Seated Eye Height	Seated Overhead Reach
53.8	48.7	70.2

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length
14.5	19.5	34.0

Standing Eye Elbow Height	Standing Elbow Height	Standing Chest Height
65.3	43.5	54.5



5'1" Female

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Select Height Weight
Height (inches) (lbs.)

61 126.6

Measurement Conversion

Enter mm or cm into empty field to get value in inches

mm 0.0 inches

Seated Head Height	Seated Eye Height	Seated Overhead Reach
46.5	43.0	62.5

Shoulder-Elbow Length	Forearm-Hand Length	Arm Length
12.3	18.3	30.6

Standing Eye Height	Standing Elbow Height	Standing Chest Height
57.1	38.0	57.1



Medical Cart

- Cart height = 48.5"
- Worker standing elbow height is 38"
- So cart is 10.5" too high for worker



Can the Current Jobs be Done Safely?



In both examples

- Subjects were often forced to work with their arms elevated and outstretched.
- When the arms are moved away from neutral the ability to generate maximal muscle force is reduced, resulting in the muscle having to work harder to perform the same task that would require less work with the arm in a proper position.
- With the muscles working harder and no longer in a position to generate maximal muscle force, they now become more prone to the risk of injury.

For More Information Contact your Local OHCOW Clinic



1-877-817-0336

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