Time-restricted eating, body composition, and cancer risk factors

UNIVERSITY OF HAWAI'I CANCER CENTER

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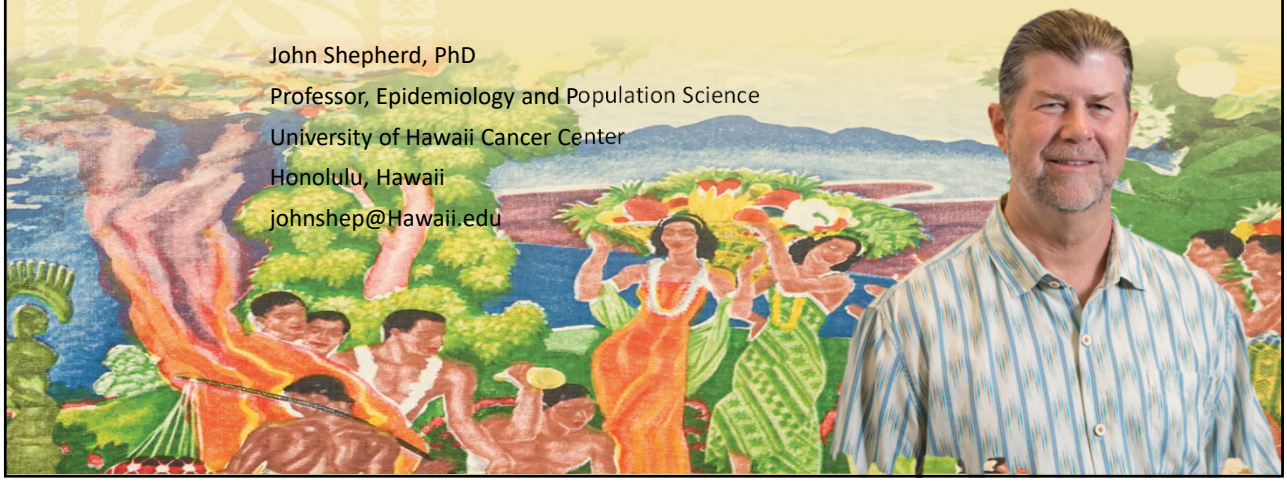


Disclosures – John Shepherd

- Investigator Initiated Grants (Hologic, GE)
- Consulting (Styku, BodySpec)

My Slides

Learning Objectives

- Contrast Time Restricted Eating versus Intermittent Fasting?
- What is the TREAT Study?
- What was the surprising finding of the TREAT study?
- How can you use body composition to monitor lifestyle changes?

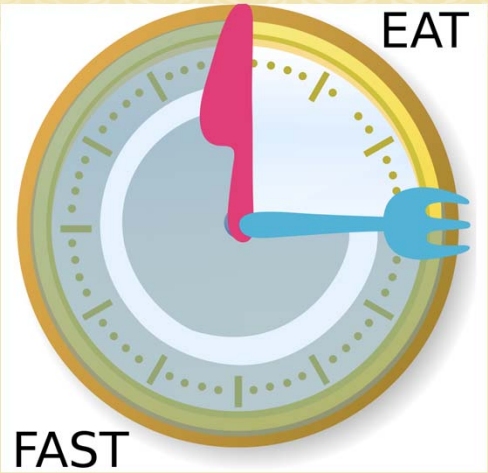
Diet impacts multiple compartments of the body

- Fat Mass
- Fat Distribution
- Muscle Mass
- Quality of Muscle
- Bone Density
- Diabetes Risk?
- Heart Disease Risk?
- Cancer Risk?

- Each year, approximately 6,700 Hawai‘i residents are diagnosed with invasive cancer.
- More than 2,200 Hawai‘i residents die of cancer each year.
- Obesity is responsible for 20%

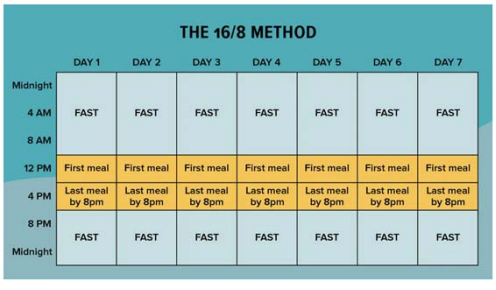
Intermittent Fasting (IF)

- Simple method
- Definition – eating windows separated by defined periods of fasting
- Time Restricted Feeding in obese resulted in reduced weight and better metabolic profile *
- Fasting periods can be from 12 hours to 48 hours or more…

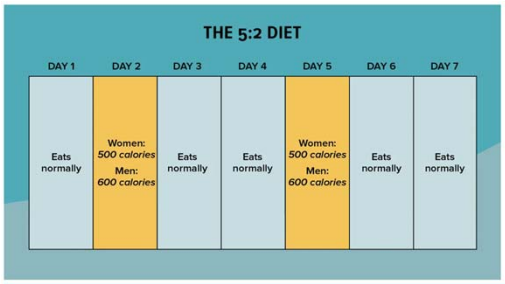


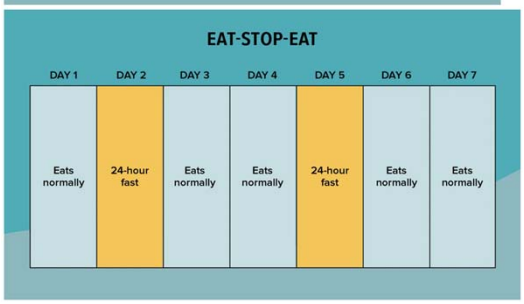
* Chaiz 2014 Cell Metab 20(6):991-1005.

Popular Approaches to Intermittent Fasting



Time Restricted Eating (TRE)
Is a specific subclass of IF where fasting and eating periods are within a 24 hour period

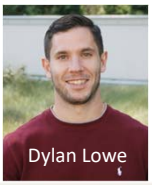


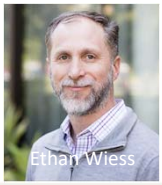


JAMA Internal Medicine | Original Investigation

Effects of Time-Restricted Eating on Weight Loss and Other Metabolic Parameters in Women and Men With Overweight and Obesity
The TREAT Randomized Clinical Trial

Dylan A. Lowe, PhD; Nancy Wu, MS; Linnea Rohdin-Bibby, BA; A. Holliston Moore, PhD; Nisa Kelly, MS; Yong En Liu, BS; Errol Philip, PhD; Eric Vittinghoff, PhD; Steven B. Heymsfield, MD; Jeffrey E. Olgin, MD; John A. Shepherd, PhD; Ethan J. Weiss, MD





IMPORTANCE The efficacy and safety of time-restricted eating have not been explored in large randomized clinical trials.

OBJECTIVE To determine the effect of 16:8-hour time-restricted eating on weight loss and metabolic risk markers.

INTERVENTIONS Participants were randomized such that the consistent meal timing (CMT) group was instructed to eat 3 structured meals per day, and the time-restricted eating (TRE) group was instructed to eat *ad libitum* from 12:00 PM until 8:00 PM and completely abstain from caloric intake from 8:00 PM until 12:00 PM the following day.

DESIGN, SETTING, AND PARTICIPANTS This 12-week randomized clinical trial including men and women aged 18 to 64 years with a body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) of 27 to 43 was conducted on a custom mobile study application. Participants received a Bluetooth scale. Participants lived anywhere in the United States, with a subset of 50 participants living near San Francisco, California, who underwent in-person testing.

MAIN OUTCOMES AND MEASURES The primary outcome was weight loss. Secondary outcomes from the in-person cohort included changes in weight, fat mass, lean mass, fasting insulin, fasting glucose, hemoglobin A_{1c} levels, estimated energy intake, total energy expenditure, and resting energy expenditure.

RESULTS Overall, 116 participants (mean [SD] age, 46.5 [10.5] years; 70 [60.3%] men) were included in the study. There was a significant decrease in weight in the TRE (−0.94 kg; 95% CI, −1.68 to −0.20; $P = .01$), but no significant change in the CMT group (−0.68 kg; 95% CI, -1.41 to 0.05, $P = .07$) or between groups (−0.26 kg; 95% CI, −1.30 to 0.78; $P = .63$). In the in-person cohort (n = 25 TRE, n = 25 CMT), there was a significant within-group decrease in weight in the TRE group (−1.70 kg; 95% CI, −2.56 to −0.83; $P < .001$). There was also a significant difference in appendicular lean mass index between groups (−0.16 kg/m^2; 95% CI, −0.27 to −0.05; $P = .005$). There were no significant changes in any of the other secondary outcomes within or between groups. There were no differences in estimated energy intake between groups.

CONCLUSIONS AND RELEVANCE Time-restricted eating, in the absence of other interventions, is not more effective in weight loss than eating throughout the day.

TRIAL REGISTRATION ClinicalTrials.gov Identifiers: NCT03393195 and NCT03637855

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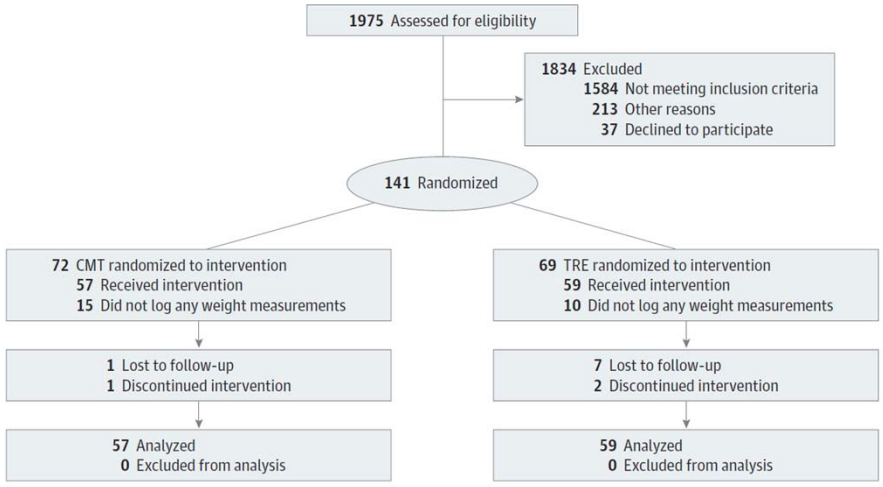
Consort Flow Diagram



CMT = Consistent Meal Timing
TRE = Time Restricted Eating

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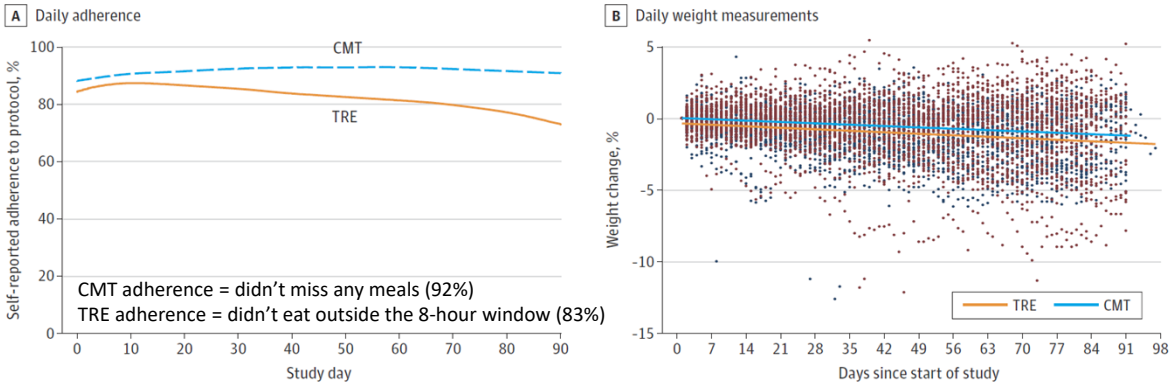
Adherence and Weight Change in the Total Cohort



CMT adherence = didn't miss any meals (92%)
TRE adherence = didn't eat outside the 8-hour window (83%)

CMT = Consistent Meal Timing
TRE = Time Restricted Eating

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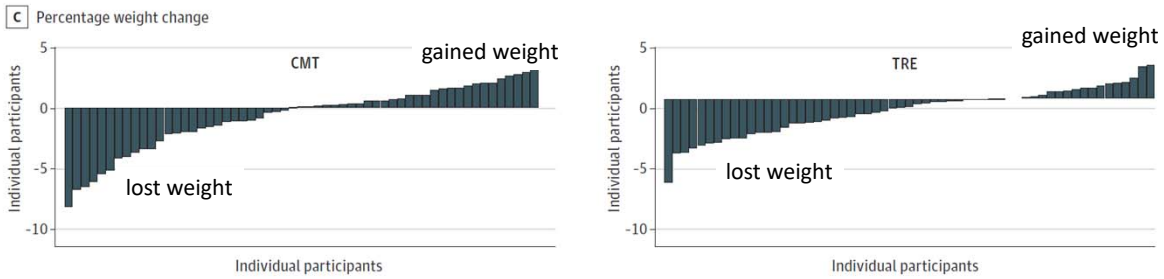
Percent Weight Change



Both the CMT and TRE Groups lost and gained weight

CMT = Consistent Meal Timing
TRE = Time Restricted Eating

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Weight Change in the Total Cohort

Total Cohort (iHealth weight measurements)	CMT (n = 57 included in analysis)				TRE (n = 59 included in analysis)					
	Preintervention	Postintervention	ΔCMT	ΔCMT *P* value	Preintervention	Postintervention	ΔTRE	ΔTRE *P* value	Difference between groups	*P* value
iHealth weight, mean (SD), kg	99.2 (95.1 to 103.3)	98.5 (94.3 to 102.7)	−0.68 (−1.41 to 0.05)	.07	99.2 (95.1 to 103.2)	98.2 (94.1 to 102.4)	−0.94 (−1.68 to −0.20)	.01	−0.26 (−1.30 to 0.78)	.63
Weight change, mean (SD), %	NA	NA	−0.75 (−1.47 to −0.04)	.04	NA	NA	−1.17 (−1.89 to −0.45)	.002	−0.41 (−1.43 to 0.60)	.43

Abbreviations: CMT, consistent meal timing group; NA, not applicable; TRE, time-restricted eating group.

CMT = Consistent Meal Timing
TRE = Time Restricted Eating

After 12 weeks, the TRE group didn't lose significantly more weight than the CMT group, 1.2% versus 0.75% of body weight.

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Body Composition and Energy Expenditure Measures in the In-Person Cohort*

- Only 50 participants
- Primary finding was higher than expected loss in total lean mass (65% versus 20%), appendicular lean mass, and appendicular lean mass index
- No difference within-group or between group for any blood or sleep markers. (data not shown

TRE group lost 0.47 kg or (1 lb) more leg and arm muscle than the CMT group

In-person cohort	CMT				TRE				
	Preintervention (n = 25)	Postintervention (n = 24)	ΔCMT	ΔCMT *P* value	Preintervention (n = 25)	Postintervention (n = 22)	ΔTRE	ΔTRE *P* value	Difference between groups	*P* value
Weight, kg[b]	93.0 (87.4 to 98.5)	92.4 (86.9 to 97.9)	−0.57 (−1.40 to 0.26)	.18	92.6 (87.0 to 98.1)	90.9 (85.3 to 96.4)	−1.70 (−2.56 to −0.83)	<.001[b]	−1.13 (−2.33 to 0.07)	.07
Weight change, %			−0.65 (−1.64 to 0.34)	.19			−1.81 (−2.85 to −0.78)	<.001[b]	−1.16 (−2.59 to 0.27)	.11
Fat mass, kg[b]	30.7 (27.7 to 33.7)	30.6 (27.6 to 33.6)	−0.03 (−0.66 to 0.60)	.93	30.3 (27.3 to 33.3)	29.8 (26.8 to 32.8)	−0.51 (−1.17 to 0.15)	.13	−0.48 (−1.75 to 0.79)	.3
Fat mass, %	33.0 (30.4 to 35.7)	32.9 (30.3 to 35.6)	−0.07 (−0.55 to 0.42)	.78	32.9 (30.3 to 35.6)	32.8 (30.2 to 35.5)	−0.09 (−0.59 to 0.42)	.74	−0.02 (−0.72 to 0.68)	.96
Visceral fat mass, kg	0.625 (0.529 to 0.721)	0.634 (0.537 to 0.730)	0.0088 (−0.0188 to 0.0364)	.53	0.58 (0.48 to 0.67)	0.576 (0.480 to 0.673)	−0.0026 (−0.0314 to 0.0263)	.86	−0.0114 (−0.0513 to 0.0285)	.58
Subcutaneous fat mass, kg	1.95 (1.74 to 2.17)	1.94 (1.72 to 2.16)	−0.013 (−0.066 to 0.040)	.63	1.87 (1.66 to 2.09)	1.84 (1.62 to 2.06)	−0.038 (−0.093 to 0.017)	.17	−0.025 (−0.101 to 0.051)	.51
Lean mass, kg[b]	59.7 (55.3 to 64.1)	59.3 (55.0 to 63.7)	−0.35 (−0.95 to 0.25)	.25	60.0 (55.6 to 64.4)	58.9 (54.5 to 63.3)	−1.10 (−1.73 to −0.48)	<.001[b]	−0.75 (−1.96 to 0.45)	.09
Trunk lean mass, kg	30.5 (28.3 to 32.6)	30.3 (28.2 to 32.5)	−0.15 (−0.54 to 0.24)	.45	30.4 (28.3 to 32.6)	30.0 (27.8 to 32.1)	−0.47 (−0.88 to −0.06)	.024[c]	−0.32 (−0.89 to 0.25)	.27
Appendicular lean mass, kg	25.8 (23.6 to 28.0)	25.6 (23.4 to 27.8)	−0.17 (−0.41 to 0.07)	.16	26.1 (24.0 to 28.3)	25.5 (23.3 to 27.7)	−0.64 (−0.89 to −0.39)	<.001[b]	−0.47 (−0.82 to −0.12)	.009
Appendicular lean mass index, kg/m^2	8.62 (8.10 to 9.14)	8.56 (8.04 to 9.08)	−0.058 (−0.136 to 0.020)	.14	8.80 (8.28 to 9.32)	8.58 (8.06 to 9.10)	−0.220 (−0.301 to −0.139)	<.001[b]	−0.162 (−0.274 to −0.050)	.005
Total body water, kg[c]	42.7 (39.6 to 45.8)	42.1 (39.0 to 45.2)	−0.59 (−1.06 to −0.13)	.01	41.9 (38.6 to 45.1)	41.5 (38.3 to 44.7)	−0.36 (−0.85 to 0.13)	.14	0.23 (−0.44 to 0.91)	.5
Bone mineral content, g	2541.9 (2388.3 to 2695.5)	2546.9 (2393.3 to 2700.5)	5.00 (−8.33 to 18.33)	.46	2511.3 (2357.7 to 2664.9)	2523.2 (2369.6 to 2676.9)	11.95 (−1.97 to 25.87)	.09	6.95 (−12.32 to 26.23)	.48
Circumference, cm										
Waist	106.6 (102.3 to 110.8)	105.9 (101.6 to 110.2)	−0.69 (−4.28 to 2.90)	.71	106.3 (102.1 to 110.5)	104.5 (100.1 to 108.9)	−1.81 (−5.53 to 1.92)	.34	−1.12 (−6.29 to 4.05)	.67
Hip	109.5 (106.2 to 112.8)	109.5 (106.2 to 112.8)	0.01 (−2.16 to 2.18)	.99	111.5 (108.2 to 114.7)	110.2 (106.8 to 113.6)	−1.28 (−3.53 to 0.98)	.27	−1.29 (−4.42 to 1.85)	.42
Waist-to-hip ratio	0.980 (0.957 to 1.004)	0.970 (0.946 to 0.994)	−0.0107 (−0.0287 to 0.0074)	.25	0.953 (0.929 to 0.977)	0.948 (0.924 to 0.973)	−0.0047 (−0.0234 to 0.0140)	.62	0.0060 (−0.0200 to 0.0320)	.65
Circumference, cm										
Bicep	35.4 (34.4 to 36.4)	35.3 (34.3 to 36.4)	−0.04 (−0.46 to 0.38)	.86	35.6 (34.6 to 36.6)	35.3 (34.2 to 36.3)	−0.30 (−0.74 to 0.14)	.19	−0.26 (−0.87 to 0.35)	.41
Thigh	57.5 (55.9 to 59.2)	57.8 (56.2 to 59.5)	0.27 (−0.37 to 0.90)	.41	57.7 (56.1 to 59.4)	57.6 (55.9 to 59.2)	−0.16 (−0.82 to 0.51)	.64	−0.42 (−1.35 to 0.50)	.37
Handgrip strength, kg	30.8 (26.8 to 34.8)	31.1 (27.1 to 35.1)	0.31 (−1.21 to 1.83)	.69	28.3 (24.3 to 32.3)	28.8 (24.8 to 32.8)	0.49 (−1.09 to 2.08)	.54	0.18 (−2.02 to 2.38)	.87
Leg extension peak torque, ft-lb	109.3 (97.1 to 121.4)	100.9 (88.5 to 113.3)	−8.39 (−17.60 to 0.81)	.07	105.8 (93.6 to 117.9)	105.9 (93.4 to 118.4)	0.15 (−9.24 to 9.53)	.98	8.54 (−4.60 to 21.69)	.20
Respiratory quotient	0.741 (0.717 to 0.765)	0.776 (0.752 to 0.801)	0.0348 (0.0119 to 0.0577)	.003	0.765 (0.741 to 0.789)	0.767 (0.742 to 0.792)	0.0028 (−0.0209 to 0.0265)	.82	−0.0320 (−0.0649 to 0.0009)	.06
Resting metabolic rate, kcal/d[b]	1909.7 (1781.2 to 2038.2)	1866.6 (1737.6 to 1995.6)	−43.1 (−104.2 to 18.0)	.17	1920.4 (1791.9 to 2048.9)	1892.3 (1762.0 to 2022.5)	−28.1 (−91.8 to 35.5)	.39	15.0 (−108.1 to 138.0)	.74
Total energy expenditure, kcal/d[b,c]	2772.1 (2563.4 to 2980.7)	2644.7 (2436.1 to 2853.4)	−127.3 (−230.7 to −23.9)	.02	2718.3 (2500.4 to 2936.3)	2540.5 (2322.6 to 2758.4)	−177.9 (−285.9 to −69.9)	.001	−50.6 (−259.2 to 158.1)	.51

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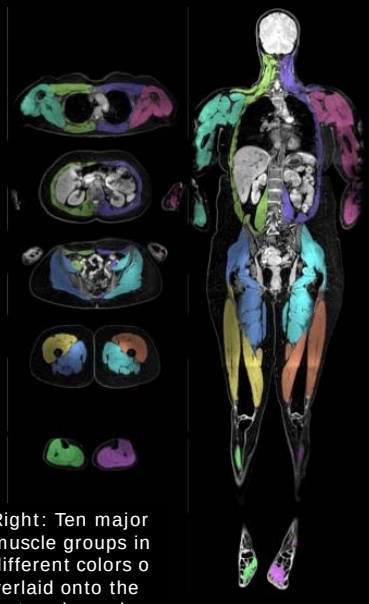
TREAT Study Summary

- In a prospective randomized trial, 16/8 TRE was associated with modest weight loss (~ 1.2%) that was not different that the control group (~0.75%).
- The TRE group lost 1 lb. arm and leg muscle mass compared to the controls
- Other TRE schemes may have different results
- It is important to monitor your fat and lean mass when you change your eating/physical activity routines.
- Maintain **and monitor** your lean mass as you get older to stay highly functional

Monitoring Muscle can be complex

Whole body 3 T MRI, 2-point Dixon imaging



Right: Ten major muscle groups in different colors o verlaid onto the water-channel.

Photo credit: O. Leinhard, Linköping University, Sweden

What about bathroom scale for body composition?

Bottom line: Bathroom scales are good for measuring weight, but highly inaccurate for monitoring for fat and lean mass!

https://abcnews.go.com/Health/comparing-accuracy-body-fat-scales/story?id=40082433

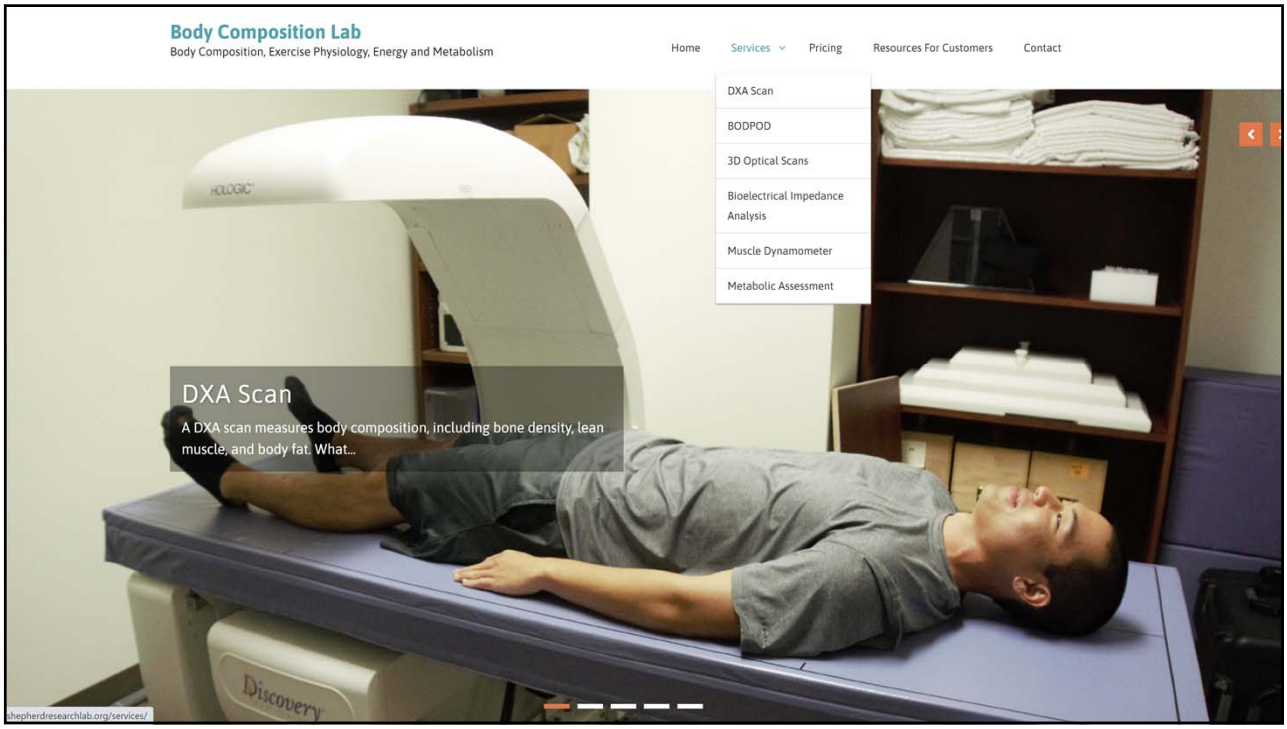
Comparing the Accuracy of Body Fat Scales

Six body fat scales were tested by three users.

By **BECKY WORLEY and SARAH MESSER**
June 24, 2016, 2:08 AM • 2 min read

Comparing the Accuracy of Body Fat Scales

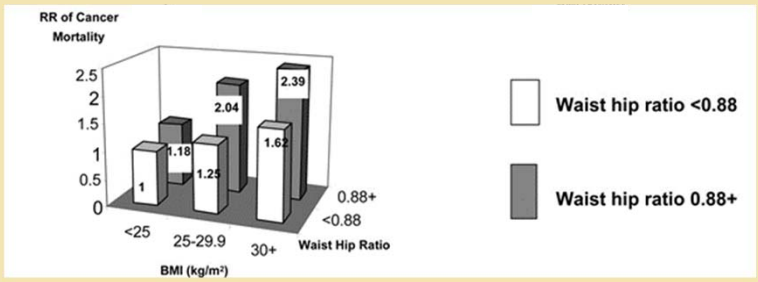
"GMA" invited three women to try six different consumer body fat scales. Here are the results.



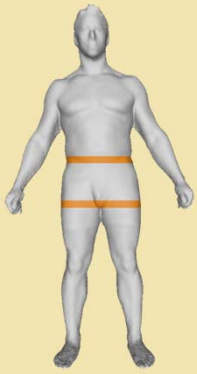
3D Body Scanning

Waist Hip Ratio is associated with mortality risk independent of BMI

Prospective cohort study of 44,636 women, 16 years of follow-up, 3507 deaths, including 751 cardiovascular deaths and 1748 cancer deaths.



Zhang C et al. 2008 AHA Circulation 117(13): 1658-67.



Waist-Hip Ratio

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3D body scans are fast, safe, and convenient

Shape Up! Cohort

- Shape Up! Adults (R01DK109008)– body shape and adult health
- Shape Up! Kids (R01DK111698) – 5 to 17 year olds, accessible measures of body composition using 3D optical
- Shape Up! Keiki (pending R01) – birth to 5 years old, accessible body composition in the very young that don't hold still.
- Partnership of
  - University of California, San Francisco
  - University of Hawaii Cancer Center (Honolulu)
  - Pennington Biomedical Research Center (Baton Rouge)
  - University of Grenoble (France)

John and Steve Heymsfield enjoying a shape-altering beverage

Shape Up! Team 2016

"Just in case you're wondering what happens during a week on a cruise ship!"

MAR 22, 2019		MAR 30, 2019
37.9 %	BODY FAT +3.7 %	41.6 %
66.1 lbs	FAT MASS +12.1 lbs	78.2 lbs
108.6 lbs	LEAN MASS +0.9 lbs	109.5 lbs
174.7 lbs	WEIGHT +13.0 lbs	187.7 lbs

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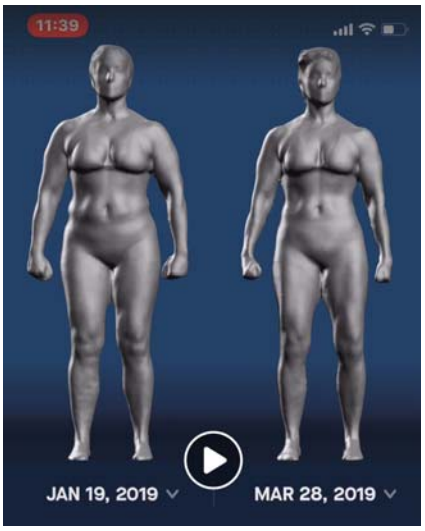
Monitoring shape for interventions



JAN 19, 2019		MAR 28, 2019
33.9 %	BODY FAT -6.4 %	27.5 %
56.0 lbs	FAT MASS -15.2 lbs	40.8 lbs
109.3 lbs	LEAN MASS -1.8 lbs	107.5 lbs
165.3 lbs	WEIGHT -17.0 lbs	148.3 lbs

- 46 yrs old female
- sleeps 6-8 hours a night
- breathing with cold showers. (5 out of 7 days/week)
- hot tub I keep at 107°F. I use it post workout and anytime I feel stiffness. If I wake up in the night I get in it for 15 and then back to bed.
- I train with heavy weights 3x a week for one hour. I have a trainer. I'm committed. I never miss…
- BionicGym – approx. 2 hours/day.

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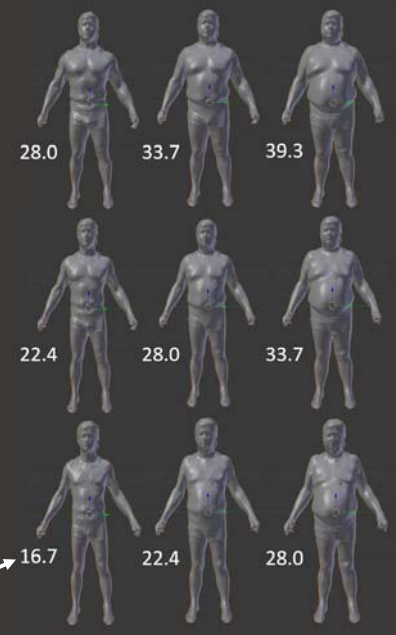
Body Shape Prediction models based on changes in fat and muscle mass (Shape Up! Study)



Changes by 20 kg in Lean

BMI can be the same for dramatically different body compositions

Changes by 20 kg in FAT

BMI

Change in fat, same muscle

Buff John (-20 kg fat)

John

Obese John (+20 kg fat)

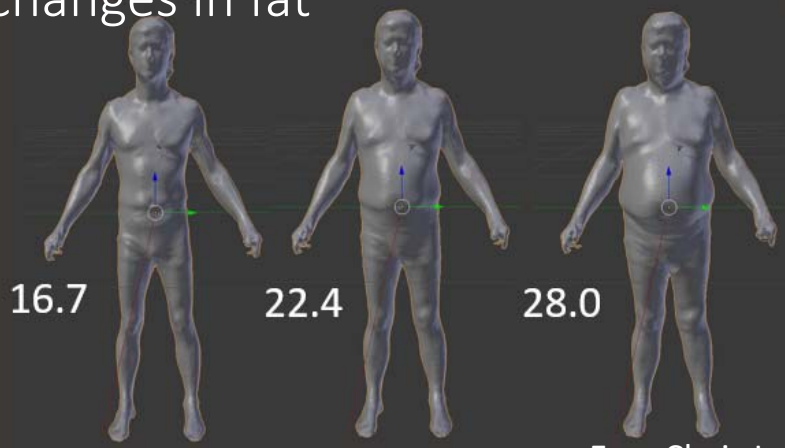
Increase in muscle by 20 kg, changes in fat

Body Builder John (-20 kg fat + 20 kg lean)

Bouncer John (+ 20 kg lean)

Linebacker John (+20 kg fat +20 kg lean)

Decrease in muscle by 20 kg, changes in fat

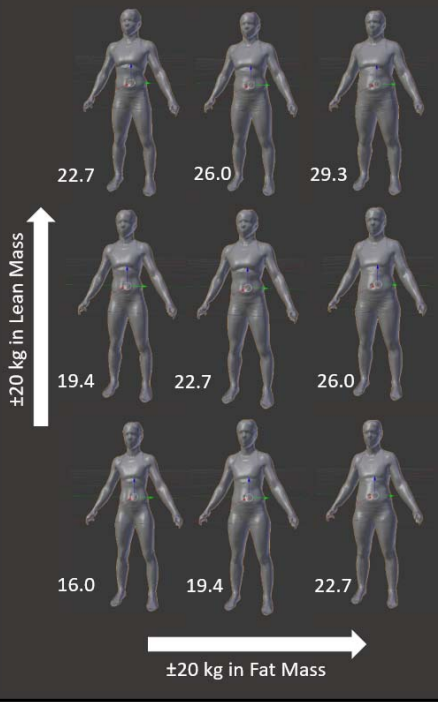


Sarco John? (-20 kg fat - 20 kg lean)

Never Sports John (- 20 kg lean)

Easy Chair John (sarco obese?) (+20 kg fat -20 kg lean)

The 9 Lia Dittons (used with permission)



Why might children be different?

Children are not little adults.

Model available @ http://s.fhg.de/smil

Learning and Tracking the 3D Shape of Freely Moving Infants from RGB-D sequences

N. Hesse, S. Pujades, M. J. Black, M. Arens, U. G. Hofmann, and A. S. Schroeder

Submission to PAMI Special Issue on RGB-D Vision 2018

Fraunhofer IOSB

MAX-PLANCK-GESELLSCHAFT

UNIVERSITÄTS KLINIKUM FREIBURG

LMU KLINIKUM ispz

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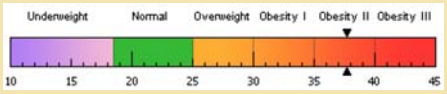
Case Examples

Obesity - Male

Selfie Cell Phone

22 year old
African-American
Male
Weight = 117 kg
Height = 176 cm
BMI = 38



Is this enough information for a targeted intervention?

DXA Body Composition

Obesity - Male

BMI = FMI + LMI

Fat mass Index (FMI)
= 14.5 kg/m2 (Obese Class I – should reduce)

Lean Mass Index (LMI)
= 23.1 kg/m2 (High – OK)

Recommendation:
Reduce Fat Mass Index (down to 6.0 kg/m2)
Keep Lean Mass Index in healthy range (above 16 kg/m2)

Do you think targeting fat and lean interventions is more useful than weight alone?

BMI = 26, Weight = 80.5 kg
FMI = 6.0 , LMI = 20.0

3D Optical

Obesity - Male

In the intervention,

He lost

37 kg weight

26.5 kg Fat

10 kg Lean

BMI was 37, and is now 26 kg/m2

How do you know you are loosing **fat** and not **muscle**?

1. Get your body composition assessed
   - Evaluate risk factors, overall metabolic health
2. Identify goals for health improvement
   - How much fat do you want to loose
   - How much muscle do you want to build?
3. Create a training program around your goals
   - Diet component (energy reduction?, carb/protein ratio?)
   - Exercise component (aerobic, interval, etc.)
4. Monitor your body composition and SHAPE
   - Baseline
   - Mid point assessment (modify program)
   - Final assessment

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Learning Objectives

- Contrast Time Restricted Eating versus Intermittent Fasting?
- What is the TREAT Study?
- What was the surprising finding of the TREAT study?
- How can you use body composition to monitor lifestyle changes?

Mahalo! For More Information…

- Shepherd Research Lab (http://Shapeup.shepherdresearchlab.org)
- University of Hawaii Cancer Center (https://www.uhcancercenter.org/)
- Our funding sources (https://reporter.nih.gov/search/kD2BzLFgbUOs8w4HSD8kjw/projects)
- Our Publications (https://www.ncbi.nlm.nih.gov/myncbi/john.shepherd.1/bibliography/public/)
- Our Team (https://shepherdresearchlab.org/about/our-team/)