Littman AJ, Thompson ML, Arterburn DE, Bouldin E, Haselkorn BJ, Boyko EJ. Lower-limb amputation and body weight changes in men. J Rehabil Res Dev. 2015;52(2):XX–XX.
http://dx.doi.org/10.1682/JRRD.2014.07.0166

Online supporting information

Lower-limb amputation and body weight changes in men

Alyson J Littman, PhD, Mary Lou Thompson, PhD, David E Arterburn, MD, Erin Bouldin, Jodie K Haselkorn, MD, Bruce J Sangeorzan, MD, Edward J Boyko, MD

Detailed description of data cleaning procedures

Use of administrative data to assess weight change presents several challenges including large differences in the number and frequency of weight measurements across persons and the potential for measurement or data entry errors (1). Regarding the former, in the current study, the number of weights available per person varied considerably (range: 2–846, mean/median weight measurements of 35/21 and 11/8 in persons with and without an amputation, respectively). Because inclusion of all weights in analyses could result in bias due to extra "weight" being given to people with more measures, who are likely to be different from those with fewer measures (e.g., sicker), we calculated median weights for each 3-month time interval, for a maximum of 14 possible weight measurements per person during 39 months of follow-up.

To address the potential problem of measurement and/or data entry errors, we used a multi-step process to clean and select plausible weights and heights. Plausibility of weights was first considered on a population level and secondly, on an individual level. For the population-level evaluation, we considered weights <75 or >600 lb and heights <4 or >7 feet to be biologically implausible and excluded these from analyses. For the individual-level evaluation, our data cleaning procedures attempted to remove weights that appeared erroneous as determined by

large intra-individual variation over time. Specifically, first, we examined within-day weight measures in cases where >1 weight was obtained on a single day. We eliminated weights measured on the same day that differed by >20 lb from the other same-day weight(s) and by >40 lb from the median weight for the same 3-month time interval and selected one of the remaining weights at random. Next, we examined weights that appeared to be outliers for a 3-month time interval, defined as weights that differed by >40 lb from the median for that time interval. If there were only two weight measurements in a time interval, we eliminated a weight if it differed by >40 lbs from the other weight in that time interval and from the individual's overall median. Finally, in cases where only a single weight measure was available in a given time interval, we considered the weight to be erroneous if it differed by more than 100 lb from the individual's overall median. Approximately 2% of weight measures (of a starting total of 33,448) from amputees and 0.35% of weight measures (of a starting total of 85,670) from nonamputees were considered erroneous and dropped.

Estimation of pre- and post-amputation weights and BMI

For matching purposes, we used a weight measured up to 8 weeks prior to amputation to calculate BMI as weight in kg divided by height in meters squared. In cases where a weight was not available in the 8 weeks prior to amputation (*n* = 72, 9.2%), we estimated pre-amputation weight (Wt_E) as: $Wt_E = Wt_o/(1-P)$ where Wt_o is the post-amputation body weight (measured 2–8 weeks post-amputation) and P is the proportion of total body weight represented by the missing limb (2, 3, 4). We combined Durkin's calculations based on men 55 years and older (2) and expert opinion to estimate % of body weight lost in a transmetarsal, TTA, and TFA. We estimated that in a transmetatarsal amputation, 40% of the foot is removed; in a TTA 100% of

the foot and 50% of the shank is removed; and in a TFA 100% of the foot and shank are removed and 40% of the thigh is removed (5). Applying these percentages to the proportions estimated by Durkin, the final estimated percent of body mass removed during amputation was: 0.52% for a transmetatarsal amputation (1.3 × 0.4), 3.265% for a TTA (1.3 + 3.93 × 0.5), and 9.962% (1.3 + 3.93 + 11.83 × 0.4) for a TFA. We did not estimate any weight loss due to a toe amputation.

Likewise, in cases where a postamputation weight was not available (n = 76, 10.1%), we estimated pre-amputation weight by *adding* weight to post-amputation weight using these same principles. Sensitivity analyses that excluded individuals missing postamputation weight did not differ importantly from analyses that included these individuals.

Littman AJ, Thompson ML, Arterburn DE, Bouldin E, Haselkorn BJ, Boyko EJ. Lower-limb amputation and body weight changes in men. J Rehabil Res Dev. 2015;52(2):XX–XX.
http://dx.doi.org/10.1682/JRRD.2014.07.0166

Supplemental Table 1. Unadjusted (observed) percentage weight changes, including those with missing values

	Level of amputation							
Percent weight change from baseline	**None (n=3790)**		**Partial foot N=396**		**Transtibial N=267**		**Transfemoral N=96**	
	N	%	N	%	N	%	N	%
At ~1 year								
>5 % weight loss	405	(10.7)	51	(9.3)	27	(10.1)	11	(11.5)
Stable weight	2105	(55.5)	163	(33.6)	64	(24.0)	16	(16.7)
5-<10% weight gain	400	(10.6)	72	(15.9)	43	(16.1)	10	(10.4)
≥10% weight gain	215	(5.7)	65	(13.6)	89	(33.3)	28	(29.2)
Missing total	665	(17.6)	45	(11.4)	44	(16.5)	31	(32.3)
No observations available	665	(17.6)	45	(11.4)	44	(16.5)	31	(32.3)
at ~2 years[a]								
>5 % weight loss	489	(12.9)	47	(9.6)	24	(9.0)	9	(9.4)
Stable weight	1743	(46.0)	129	(24.7)	51	(19.1)	14	(14.6)
5-<10% weight gain	392	(10.3)	55	(12.9)	30	(11.2)	11	(11.5)
≥10% weight gain	266	(7.0)	68	(14.9)	89	(33.3)	31	(32.3)
Missing total	900	(23.8)	97	(24.5)	73	(27.3)	31	(32.3)
Death in 2nd year	46	(1.2)	21	(5.3)	10	(3.8)	8	(8.3)
Censoring - subsequent	0	(0.0)	5	(1.3)	6	(2.3)	1	(1.0)

	Level of amputation							
Percent weight change from baseline	**None (n=3790)**		**Partial foot N=396**		**Transtibial N=267**		**Transfemoral N=96**	
	N	%	N	%	N	%	N	%
amputation								
Censoring - administrative	35	(0.9)	13	(3.3)	7	(2.6)	4	(4.2)
No observations available	819	(21.6)	58	(14.7)	50	(18.7)	18	(18.8)
at ~3 years[a]								
>5 % weight loss	513	(13.5)	45	(11.4)	21	(7.9)	9	(9.4)
Stable weight	1600	(42.2)	94	(23.7)	35	(13.1)	4	(4.2)
5-<10% weight gain	369	(9.7)	36	(9.1)	25	(9.4)	8	(8.3)
≥10% weight gain	288	(7.6)	53	(13.4)	80	(30.0)	19	(19.8)
Missing total	1020	(26.9)	168	(42.4)	106	(39.7)	56	(58.3)
Death during follow-up	145	(3.8)	54	(13.6)	28	(10.5)	19	(19.8)
Censoring - subsequent amputation	0	(0.0)	7	(1.8)	7	(2.6)	3	(3.1)
Censoring - administrative	202	(5.3)	58	(14.7)	28	(10.5)	13	(13.5)
No observations available	673	(17.8)	49	(12.4)	44	(16.5)	21	(21.9)

Littman AJ, Thompson ML, Arterburn DE, Bouldin E, Haselkorn BJ, Boyko EJ. Lower-limb amputation and body weight changes in men. J Rehabil Res Dev. 2015;52(2):XX–XX.
http://dx.doi.org/10.1682/JRRD.2014.07.0166
[a]Time windows for ~1, ~2, and~3 years: 10-18 months, 22-30 months, 31-39 months,

respectively

Littman AJ, Thompson ML, Arterburn DE, Bouldin E, Haselkorn BJ, Boyko EJ. Lower-limb amputation and body weight changes in men. J Rehabil Res Dev. 2015;52(2):XX–XX.
http://dx.doi.org/10.1682/JRRD.2014.07.0166

References

1. Noel P, Copeland L, Perrin R, Lancaster A, Pugh MJ, Wang CP, *et al.* VHA Corporate Data Warehouse height and weight data: Opportunities and challenges for health services research. *J Rehabil Res Dev* 2010;**47:** 739-750.

2. Durkin JL, Dowling JJ. Analysis of body segment parameter differences between four human populations and the estimation errors of four popular mathematical models. *Journal of biomechanical engineering* 2003;**125:** 515-522.

3. Osterkamp LK. Current perspective on assessment of human body proportions of relevance to amputees. *J Am Diet Assoc* 1995;**95:** 215-218.

4. Himes JH. New equation to estimate body mass index in amputees. *J Am Diet Assoc* 1995;**95:** 646.

5. Rosenberg DE, Turner AP, Littman AJ, Williams RM, Norvell DC, Hakimi KM, *et al.* Body mass index patterns following dysvascular lower extremity amputation. *Disabil Rehabil* 2013;**35:** 1269-1275.