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ORIGINAL RESEARCH

Weight Change Trajectories After Incident Lower-Limb Amputation

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Abstract

Objective: To characterize weight change after amputation by identifying typical weight trajectories in men with incident lower-limb amputation (LLA) and describing characteristics associated with each trajectory.

Design: Retrospective cohort study and analyzed using group-based trajectory modeling.

Setting: Administrative data.

Participants: Veterans who were men (N=759), living in the Northwest United States, and who had an incident toe, foot, or leg amputation between 1997 and 2008 and at least 18 months of amputation-free survival thereafter.

Interventions: Not applicable.

Main Outcome Measures: Postamputation weight and body mass index change.

Results: The mean weight at baseline was 91.6±24kg (202±53lb), and average follow-up was 2.4 years. We identified 4 trajectory groups for weight change: weight loss (13%), stable weight (47%), slow weight gain (33%), and rapid weight gain (7%). Men with a toe or foot amputation most frequently were assigned to the stable weight group (58%), whereas men with transtibial or transfemoral amputations were most commonly assigned to the slow weight gain group (42% each). Men who died during follow-up were more likely to be assigned to the weight loss group (24%) than men who did not die (11%).

Conclusions: We identified distinct weight change trajectories that represent heterogeneity in weight change after LLA. An improved understanding of factors predictive of weight gain or loss in people with LLA may help better target rehabilitation and prosthetic prescription. Additional research is needed to fully understand the relation between weight change and health status after amputation.

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People who undergo lower-limb amputation (LLA) are at increased risk for weight gain and obesity as a result of physical inactivity and comorbid conditions.[1-3] After amputation, rehabilitation goals include maximizing function and preventing secondary conditions, and excess weight can impede progress toward these goals through multiple pathways.[4-8] Cross-sectional studies show that obesity is more common in those with an amputation than those without an amputation.[2,9] In a previous longitudinal study, people gained weight, on average, during the year after their dysvascular amputation,[10] and recently we found that men with LLA tended to gain weight during the 2 years after amputation and that this weight gain was greater than in a cohort of men without amputation matched on age, diabetes, body mass index (BMI), and calendar year.[11]

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Although weight gain is a concern after LLA, weight loss may also be problematic. Unintentional weight loss is common in older age as comorbidity and frailty increase and may be used as a marker of advancing illness.[12-14] Sohn et al[15] found that veterans who were men, were aged <65 years, had diabetes, and were underweight were 3 times more likely to have an amputation or to die (combined endpoint) during >4 years of follow-up than similar men who were overweight.

Focusing on overall mean weight change, a single average trajectory, may obscure important variability within the population of people with LLA. An improved understanding of factors predictive of weight gain or loss in people with LLA may help better target rehabilitation and prosthetic prescription. Therefore, we conducted a study to characterize weight change after amputation by identifying typical weight trajectories in men with incident LLA and describing characteristics associated with each trajectory. We expected most subjects to gain weight during follow-up, but we hypothesized that there would be groups who would lose or maintain weight and that these groups would cluster on measured characteristics.

Methods

This retrospective cohort study was conducted in the Pacific Northwest region of the United States using data from administrative Department of Veterans Affairs (VA) data sources. It was approved by the VA Puget Sound Institutional Review Board (no. 00039).

Participants

The study included male veterans identified in our previous study[15] who had an incident toe to transfemoral amputation between January 1, 1997, and December 31, 2008, and who had at least 1 plausible weight measurement during the 8 weeks before or after the index amputation and at least 1 additional weight measurement within the subsequent 39 months. Women were excluded from this study because they make up a very small proportion of amputations performed within the VA (<2%). A small number of individuals had 2 to 5 amputation procedures within 45 days of their first amputation. These may have been planned or they may have been necessitated by complications at the initial amputation site. We considered these to be part of the same amputation event and assigned the date of the last (most proximal) amputation as the index date. We excluded men who died or had a subsequent amputation within 18 months of the index amputation to limit the sample to a population for whom a weight management intervention might be indicated. Veterans were followed for up to 39 months or until December 31, 2010, whichever came first. Men who had another amputation 18 to 39 months after their index event were censored at the time of the subsequent amputation.

We identified a total of 1734 men who had a toe, foot, or leg amputated during the study period. Among those, 230 had a subsequent amputation between 45 days and 18 months after the index amputation, and 426 died within 18 months of their index amputation and were excluded. We excluded 256 men because they did not have a plausible baseline weight, 39 because they did not have at least 1 plausible follow-up weight, and 11 because they did not have a plausible height. We excluded an additional 13 men because they had prosthetics codes before the index amputation date that made us suspect they had a prior amputation, leaving 759 for analyses.

List of abbreviations:

BMI body mass index
DCG diagnostic cost group
LLA lower-limb amputation
VA Department of Veterans Affairs

Weight and height measures

We used body weight and height measurements collected during inpatient and outpatient clinical encounters to estimate weight trajectories. We excluded weights <34kg (75lb) and >272.1kg (600lb). We also excluded weight measurements that seemed implausible, operationalized as a change of >18.1kg (40lb) in a 30-day period or more than an average of 0.9kg (2lb) per week over periods >30 days for any veteran. We excluded height measurements of <4ft (<1.2m) or >7ft (>2.1m).

When available, we used a weight during the 2 to 8 weeks after the index amputation as the baseline weight for each veteran. If no weight was available, we estimated the baseline weight by subtracting the estimated weight of the amputated limb from the preamputation weight using published formulas.[16] We calculated the median recorded weight for each individual during each 3-month period until up to 39 months after amputation, for a maximum of 14 longitudinal weights per person. We used the most commonly recorded (mode) height from among included height measurements to calculate the BMI. We were not able to determine whether weight was measured with or without a prosthesis.

Covariate measures

We categorized BMI as underweight (<18.5kg/m^2), healthy weight (18.5−25.0kg/m^2), overweight (25.0−29.9kg/m^2), and obese (≥30.0kg/m^2). We used *International Classification of Diseases—9th Revision* surgery codes to classify the index amputation level as follows: toe or foot (84.11 or 84.12), ankle or transtibial (84.13−84.15), and knee disarticulation or transfemoral (84.16 or 84.17). We recorded the service connected disability rating, a measure of the extent of impairment in earning capacity that results from an illness, injury, or disability related to an individual's military service,[17] for each veteran. We categorized service connected disability as <50% or ≥50% because veterans with a service connected disability rating ≥50% are eligible for VA care at no cost. We used the predicted diagnostic cost group (DCG) score for the year after amputation to adjust for health status during follow-up. The DCG is calculated using an individual patient's past claims and medical history to predict current or future year patient costs and has been shown to predict hospitalization and death among veterans.[18] It is normalized to a mean score of 1 relative to the Medicare population.[19,20]

Statistical analysis

We used group-based trajectory modeling, which is a finite mixture modeling approach that estimates the mean trajectories for a given number of groups and for each individual provides a probability of membership to each latent class (group). Individuals are then assigned to the trajectory group for which they have the