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Normative Percent Differences between Inter-day and Inter-limb Upper Extremity Limb Volume in Healthy Adult Females

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Background

Current diagnostic thresholds vary, but a 5% volume difference between limbs is generally accepted to diagnose lymphedema. Newer research among women with breast cancer-related lymphedema established a 3% threshold for diagnosis of *preclinical* lymphedema. Understanding normal limb volume fluctuations and side to side differences is important to determine whether this 3% cut point for diagnosis of subclinical lymphedema should be made compared to same or contralateral limbs.

Purpose

Little research to date has established normative percent volume differences between limbs and between days in a healthy female population. Normal variability must be accounted for to determine abnormal volume changes, such as those seen in secondary lymphedema. Therefore, the purpose of this study is to establish normative inter-limb and inter-day percent volume differences among healthy women.

Hypothesis

The hypothesis is that there will be no significant difference between normative inter-day and inter-limb percent volume differences among healthy women.

Participants

34 healthy females ages 20-69 without breast cancer or lymphedema, current upper extremity pathology or medical condition affecting fluid retention were enrolled.

Methods

Circumferential measurements of bilateral limbs were taken at 10 cm intervals using a flexible tape measure. Participants were measured two times over seven days by four trained assessors with established reliability of ICC>0.90. Total limb volume was calculated using the truncated cone formula: $V = (1/3) \cdot \pi \cdot h(R^2 + r^2 + R \cdot r)$.



Statistical Analysis

Descriptive statistics were calculated for dominant and non-dominant limbs for both time points. Data were analyzed using paired samples t-tests for inter-day and inter-limb volume differences.

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Results

Mean body mass index was 30.68 (± 33.78). There was no significant difference between means of dominant limb volumes from day 1 to day 2 or non-dominant limb volumes from day 1 to day 2. Additionally, there was no significance between non-dominant and dominant limb volumes day 1. The non-dominant to dominant limb difference, and day 1-day 2 difference for both dominant nondominant limbs was <1%. The standard error of the measure for both dominant and nondominant limbs was <1%.

	Day 1	Day 2	p value
Dominant limb volume (ml)	1799 \pm 292	1797 \pm 286	.757
Nondominant limb volume (ml)	1782 \pm 277	1785 \pm 280	.808
p value	.087	.265	

Conclusion

The results show that contralateral limbs may be used with confidence to determine volume differences. Furthermore, with a standard error of the measure of <1%, the threshold of 3% can be confidently used to identify subclinical lymphedema.

Clinical Relevance

The standard error of the measure gives a percent of what typical limb volume fluctuation is. Slight fluctuations in limb volume do occur due to hydration, activity levels, etc. Since diagnosing someone with lymphedema requires > 3% limb difference, the SEM gives us a percentage that is < 3% for the healthy population.

This project completed in partial fulfillment of requirements for the Doctor of Physical Therapy degree.