

# Package ‘bodycompref’

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**Type** Package

**Title** Reference Values for CT-Assessed Body Composition

**Version** 2.0.1

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**Description** Get z-scores, percentiles, absolute values, and percent of predicted of a reference cohort. Functionality requires installing the data packages 'adiposerefdata' and 'musclerefdata'. For more information on the underlying research, please visit our website which also includes a graphical interface. The models and underlying data are described in Marquardt JP et al.(planned publication 2025; reserved doi 10.1097/RLI.0000000000001104), ``Subcutaneous and Visceral adipose tissue Reference Values from Framingham Heart Study Thoracic and Abdominal CT'', \*Investigative Radiology\* and Tonnesen PE et al. (2023), ``Muscle Reference Values from Thoracic and Abdominal CT for Sarcopenia Assessment [column] The Framingham Heart Study'', \*Investigative Radiology\*, <doi:10.1097/RLI.0000000000001012>.

**URL** <https://bodycomp-metrics.mgh.harvard.edu>,  
<https://github.com/p-mq/bodycompref>

**Depends** R (>= 4.0.0)

**Imports** assertthat, gamlss, stats, sae

**License** GPL (>= 3)

**Encoding** UTF-8

**RoxygenNote** 7.3.1

**Suggests** testthat (>= 3.0.0), usethis, adiposerefdata, musclerefdata,  
knitr, rmarkdown

**Config/testthat/edition** 3

**Additional\_repositories** <https://p-mq.github.io/drat>

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** CRAN

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.Get_lambda	<i>Get the lambda used to build a model</i>
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## Description

For each reference LMSP model, get the lambdas used before fitting

## Usage

```
.Get_lambda(metric, sex, level = NA)
```

## Arguments

metric	character, body composition metric
sex	character, "Female" or "Male"
level	character, used vertebral level

## Value

lambda (numeric, range [-2, 2], increments of 0.1)

## Author(s)

J Peter Marquardt

---

.Get\_percent\_predicted

*Get % of expected value*

---

### **Description**

For a given constellation of metric, sex, vertebral level, and age returns the ratio of actual and expected value (percentile 50) in percent

### **Usage**

```
.Get_percent_predicted(  
    metric,  
    sex,  
    level,  
    age,  
    measurement,  
    verbose = FALSE,  
    digits = 0  
)
```

### **Arguments**

metric	character, body composition metric
sex	character, "Female" or "Male"
level	character, used vertebral level
age	integer, age
measurement	numeric, raw value of measurement
verbose	logical, should messages be displayed
digits	integer, digits to round return value

### **Value**

numeric, corresponding percentile

### **Author(s)**

J. Peter Marquardt

---

`.Get_reference_model` *Get reference models*

---

**Description**

For a given combination of metric, sex, and level return the appropriate LMSP model. Imports the non-CRAN packages `musclerefdata` and `adiposerefdata`

**Usage**

```
.Get_reference_model(fitted_metric, sex, level)
```

**Arguments**

<code>fitted_metric</code>	string, name of fitted metric (abbreviation, includes a lowercase b prefix for metrics with box-cox-transformation)
<code>sex</code>	character, "Male" or "Female"
<code>level</code>	string, vertebral level, T5, T8, T10, or L3

**Value**

LMSP model

**Author(s)**

J.Peter Marquardt

---

`.Get_reference_percentile`  
*Get percentile for a given combination of model and measurement*

---

**Description**

For a given constellation of metric, sex, vertebral level, and age returns the corresponding percentile for a given measurement

**Usage**

```
.Get_reference_percentile(  
  metric,  
  sex,  
  level,  
  age,  
  measurement,  
  verbose = FALSE,  
  digits = 0  
)
```

### Arguments

metric	character, body composition metric
sex	character, "Female" or "Male"
level	character, used vertebral level
age	integer, age
measurement	numeric, raw value of measurement
verbose	logical, should messages be displayed
digits	integer, digits to round percentile to

### Value

numeric, corresponding percentile

### Author(s)

J. Peter Marquardt

---

.Get\_reference\_value *Get reference for a given combination of model and percentile/z-score*

---

### Description

For a given constellation of metric, sex, vertebral level, and age returns the corresponding measurement for a given percentile/z-score

### Usage

```
.Get_reference_value(  
  metric,  
  sex,  
  level,  
  age,  
  percentile = NULL,  
  z_score = NULL,  
  verbose = FALSE,  
  digits = 0  
)
```

### Arguments

metric	character, body composition metric
sex	character, "Female" or "Male"
level	character, used vertebral level
age	integer, age

percentile	numeric, percentile to return value for. If both percentile and z_score are given, only percentile is evaluated
z_score	numeric, z score to return value for. If both percentile and z_score are given, only percentile is evaluated
verbose	logical, should messages be displayed
digits	integer, digits to round reference value

**Value**

numeric, corresponding percentile

**Author(s)**

J. Peter Marquardt

---

*.Get\_reference\_z\_score*

*Get z-score for a given combination of model and measurement*

---

**Description**

For a given constellation of metric, sex, vertebral level, and age returns the corresponding z-score for a given measurement

**Usage**

```
.Get_reference_z_score(
    metric,
    sex,
    level,
    age,
    measurement,
    verbose = FALSE,
    digits = 2
)
```

**Arguments**

metric	character, body composition metric
sex	character, "Female" or "Male"
level	character, used vertebral level
age	integer, age
measurement	numeric, raw value of measurement
verbose	logical, should messages be displayed
digits	integer, digits to round percentile to

**Value**

numeric, corresponding z-score

**Author(s)**

J. Peter Marquardt

---

bodycomp\_reference      *Get body composition reference values*

---

**Description**

For a given constellation of metric, sex, vertebral level, and age returns either - the reference percentile - the reference z-score - the reference value - the percent of predicted value

**Usage**

```
bodycomp_reference(
  metric,
  sex,
  level,
  age,
  type,
  measurement = NULL,
  percentile = NULL,
  z_score = NULL,
  verbose = FALSE,
  digits = 2
)
```

**Arguments**

metric	character (vector), body composition metric.
sex	character (vector), "Female" or "Male"
level	character (vector), used vertebral level
age	integer (vector), age
type	character, type of value to return, either of "percentile", "z_score", "reference_value", "percent_predicted"
measurement	numeric (vector), raw value of measurement
percentile	numeric (vector), percentile to return value for. If both percentile and z_score are given, only percentile is evaluated
z_score	numeric (vector), z score to return value for. If both percentile and z_score are given, only percentile is evaluated
verbose	logical, should messages be displayed
digits	integer, digits to round return value to

## Details

Reference models are available for the following metrics: - CSMA: Cross-sectional muscle area [cm<sup>2</sup>] - SMI: Skeletal Muscle Index [cm<sup>2</sup>/m<sup>2</sup>] - SMRA: Skeletal Muscle Radioattenuation [Hounsfield Units (HU)] - SMG: Skeletal Muscle Gauge [cm<sup>2</sup> \* HU/ m<sup>2</sup>] - CSFA: Cross-sectional (subcutaneous) fat area [cm<sup>2</sup>] - SATI: Subcutaneous Adipose Tissue Index [cm<sup>2</sup>/m<sup>2</sup>] - SATRA: Subcutaneous Adipose Tissue Radioattenuation [HU] - SATG: Subcutaneous Adipose Tissue Gauge [cm<sup>2</sup> \* HU/ m<sup>2</sup>] - CSVFA: Cross-sectional Visceral Fat Area [cm<sup>2</sup>] - VATI: Visceral Adipose Tissue Index [cm<sup>2</sup>/m<sup>2</sup>] - VATRA: Visceral Adipose Tissue Radioattenuation [HU] - VATG: Visceral Adipose Tissue Gauge [cm<sup>2</sup> \* HU/ m<sup>2</sup>] - TAT: Cross-sectional Total Adipose Tissue Area [cm<sup>2</sup>] (SATA + VATA) - TATI: Total Adipose Tissue Index [cm<sup>2</sup>/m<sup>2</sup>] (SATI + VATI) - VAT\_SAT\_ratio: VAT/SAT ratio []

Measurement values must be  $\geq -124$  for SATRA and VATRA,  $\leq -1$  for SATG and VATG, and  $\geq 1$  for all other metrics.

The reference values are based on LMSP models constructed from the Framingham Heart Study published in the following publications: - Marquardt JP, Tonnesen PE, Mercaldo ND, Graur A, Allaire B, Bouxsein ML, Samelson EJ, Kiel DP, Fintelmann FJ. Subcutaneous and Visceral adipose tissue Reference Values from Framingham Heart Study Thoracic and Abdominal CT. Investigative Radiology, 2024. - Tonnesen PE, Mercaldo ND, Tahir I, Dietrich ASW, Amari W, Graur A, Allaire B, Bouxsein ML, Samelson EJ, Kiel DP, Fintelmann FJ. Muscle Reference Values from Thoracic and Abdominal CT for Sarcopenia Assessment: The Framingham Heart Study. Investigative Radiology, 2023.

## Value

numeric, corresponding percentile

## Author(s)

J. Peter Marquardt

## Examples

```
bodycomp_reference(metric=c("CSFA", "CSFA"), sex=c("Female", "Male"),
                  level=c("T5", "L3"), age=c(42,68), measurement=c(100,200),
                  type = "percentile")
```

---

percent_predicted	<i>Get % of expected value</i>
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---

## Description

For a given constellation of metric, sex, vertebral level, and age returns the ratio of actual and expected value (percentile 50) in percent

### Usage

```
percent_predicted(  
  metric,  
  sex,  
  level,  
  age,  
  measurement,  
  verbose = FALSE,  
  digits = 0  
)
```

### Arguments

<code>metric</code>	character (vector), body composition metric
<code>sex</code>	character (vector), ""Female" or "Male"
<code>level</code>	character (vector), used vertebral level
<code>age</code>	integer (vector), age
<code>measurement</code>	numeric (vector), raw value of measurement
<code>verbose</code>	logical, should messages be displayed
<code>digits</code>	integer, digits to round return value to

### Value

numeric, corresponding percentile

### Author(s)

J. Peter Marquardt

### See Also

[`bodycomp_reference()`]

### Examples

```
percent_predicted(metric=c("CSFA", "CSFA"), sex=c("Female", "Male"),  
  level=c("T5", "L3"), age=c(42,68), measurement=c(100,200))
```

---

reference\_percentiles *Get percentile(s) for a given combination of model and measurement*

---

### Description

For a given constellation of metric, sex, vertebral level, and age returns the corresponding percentiles for a given measurement

### Usage

```
reference_percentiles(  
  metric,  
  sex,  
  level,  
  age,  
  measurement,  
  verbose = FALSE,  
  digits = 0  
)
```

### Arguments

metric	character (vector), body composition metric
sex	character (vector), "Female" or "Male"
level	character (vector), used vertebral level
age	integer (vector), age
measurement	numeric (vector), raw value of measurement
verbose	logical, should messages be displayed
digits	integer, digits to round percentile to

### Value

numeric, corresponding percentile

### Author(s)

J. Peter Marquardt

### See Also

[bodycomp\_reference()]

### Examples

```
reference_percentiles(metric=c("CSFA", "CSFA"), sex=c("Female", "Male"),  
  level=c("T5", "L3"), age=c(42, 68), measurement=c(50, 50))
```

---

reference_values	<i>Get reference values for a given combination of model and percentile/z-score</i>
------------------	---

---

**Description**

For a given constellation of metric, sex, vertebral level, and age returns the corresponding measurements to a given percentile/z-score

**Usage**

```
reference_values(  
  metric,  
  sex,  
  level,  
  age,  
  percentile = NULL,  
  z_score = NULL,  
  verbose = FALSE,  
  digits = 0  
)
```

**Arguments**

metric	character (vector), body composition metric
sex	character (vector), ""Female" or "Male"
level	character (vector), used vertebral level
age	integer (vector), age
percentile	numeric (vector), percentile to return value for. If both percentile and z_score are given, only percentile is evaluated
z_score	numeric (vector), z score to return value for. If both percentile and z_score are given, only percentile is evaluated
verbose	logical, should messages be displayed
digits	integer, digits to round return value to

**Value**

numeric, corresponding percentile

**Author(s)**

J. Peter Marquardt

**See Also**

[bodycomp\_reference()]

**Examples**

```
reference_values(metric=c("CSFA", "CSFA"), sex=c("Female", "Male"),
                level=c("T5", "L3"), age=c(42, 68), percentile=c(50, 50))
```

---

reference\_z\_scores      *Get z-scores for a given combination of model and measurement*

---

**Description**

For a given constellation of metric, sex, vertebral level, and age returns the corresponding z-scores for a given set of measurements

**Usage**

```
reference_z_scores(  
  metric,  
  sex,  
  level,  
  age,  
  measurement,  
  verbose = FALSE,  
  digits = 2  
)
```

**Arguments**

metric	character (vector), body composition metric
sex	character (vector), "Female" or "Male"
level	character (vector), used vertebral level
age	integer (vector), age
measurement	numeric (vector), raw value of measurement
verbose	logical, should messages be displayed
digits	integer, digits to round percentile to

**Value**

numeric, corresponding z-score

**Author(s)**

J. Peter Marquardt

**See Also**

[`bodycomp_reference()`]

**Examples**

```
reference_z_scores(metric=c("CSFA", "CSFA"), sex=c("Female", "Male"),  
                  level=c("T5", "L3"), age=c(42,68), measurement=c(50,50))
```

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