# Package 'zscorer'

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**Type** Package

**Title** Child Anthropometry z-Score Calculator

**Version** 0.3.1

**Description** A tool for calculating z-scores and centiles for weight-for-age, length/height-for-age, weight-for-length/height, BMI-for-age, head circumference-for-age, age circumference-for-age, subscapular skinfold-for-age, triceps skinfold-for-age based on the WHO Child Growth Standards.

**Depends** R (>= 2.10)

**Imports** shiny

**Suggests** testthat, knitr, rmarkdown, shinythemes, covr

**License** AGPL-3

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**URL** https://github.com/nutriverse/zscorer

**BugReports** https://github.com/nutriverse/zscorer/issues

**VignetteBuilder** knitr

**NeedsCompilation** no

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**Repository** CRAN

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# Contents



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`addWGSR` *Add the WHO Growth Reference z-scores to a data frame of anthropometric data for weight, height or length, MUAC, head circumference, sub-scapular skinfold and triceps skinfold.*

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## Description

Add the WHO Growth Reference z-scores to a data frame of anthropometric data for weight, height or length, MUAC, head circumference, sub-scapular skinfold and triceps skinfold.

## Usage

```
addWGSR(data, sex, firstPart, secondPart, thirdPart = NA, index = NA,
  standing = NULL, output = paste(index, "z", sep = ""), digits = 2)
```

## Arguments

| | |
|---|---|
| `data` | A survey dataset as a data.frame object |
| `sex` | Name of variable specifying the sex of the subject. This must be coded as `1 = male` and `2 = female`. Give a quoted variable name as in (e.g.) `"sex"`. |
| `firstPart` | Name of variable specifying:<br>• Weight (kg) for BMI/A, W/A, W/H, or W/L<br>• Head circumference (cm) for HC/A<br>• Height (cm) for BMI/A for H/A<br>• Length (cm) for L/A<br>• MUAC (cm) for MUAC/A<br>• Sub-scapular skinfold (mm) for SSF/A<br>• Triceps skinfold (mm) for TSF/A<br>Give a quoted variable name as in (e.g.) `"weight"`. Be careful with units (weight in kg; height, length, head circumference, and MUAC in cm, skinfolds in mm). |

`secondPart` Name of variable specifying:

- Age (days) for H/A, HC/A, L/A, MUAC/A, SSF/A, or TSF/A
- Height (cm) BMI/A or W/H
- Length (cm) for W/L

Give a quoted variable name as in (e.g.) `"age"`. Be careful with units (age in days; height and length in cm).

`thirdPart` Name of variable specifying age (in days) for BMI/A. Give a quoted variable name as in (e.g.) `"age"`. Be careful with units (age in days).

`index` The index to be calculated and added to `data`. One of:

`bfa` BMI for age
`hca` Head circumference for age
`hfa` Height for age
`lfa` Length for age
`mfa` MUAC for age
`ssa` Sub-scapular skinfold for age
`tsa` Triceps skinfold for age
`wfa` Weight for age
`wfh` Weight for height
`wfl` Weight for length

Give a quoted index name as in (e.g.) `"wfh"`.

`standing` Variable specifying how stature was measured. If NULL then age (for `"hfa"` or `"lfa"`) or height rules (for `"wfh"` or `"wfl"`) will be applied. This must be coded as `1 = Standing`; `2 = Supine`; `3 = Unknown`. All other values will be recoded to `3 = Unknown`. Give a quoted variable name as in (e.g.) `"measured"` or a single value (e.g.`"measured = 1"`). If no value (or NULL) is specified then height and age rules will be applied.

`output` The name of the column containing the specified index to be added to the dataset. This is an optional parameter. If you do not specify a value for output then the added column will take the name of the specified index with a `"z"` appended.

`digits` The number of decimal places for `output`. Defaults to 2 d.p.

## Value

A data.frame of the survey dataset with the calculated z-scores added.

## Examples

```
# Calculate weight-for-height (wfh) for the anthro3 dataset
addWGSR(data = anthro3,
        sex = "sex",
        firstPart = "weight",
        secondPart = "height",
        index = "wfh")

# Calculate weight-for-age (wfa) for the anthro3 dataset
```

```
addWGSR(data = anthro3,
        sex = "sex",
        firstPart = "weight",
        secondPart = "age",
        index = "wfa")

# Calculate height-for-age (hfa) for the anthro3 dataset
addWGSR(data = anthro3,
        sex = "sex",
        firstPart = "height",
        secondPart = "age",
        index = "hfa")

# Calculate MUAC-for-age (mfa) for the anthro4 dataset

## Convert age in anthro4 from months to days
testData <- anthro4
testData$age <- testData$agemons * (365.25 / 12)

addWGSR(data = testData,
        sex = "sex",
        firstPart = "muac",
        secondPart = "age",
        index = "mfa")
```

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anthro1 *Anthropometric data from a SMART survey in Kabul, Afghanistan.*

---

## Description

Anthropometric data from a SMART survey in Kabul, Afghanistan.

## Usage

```
anthro1
```

## Format

A data frame with 873 observations and 11 variables

`psu` Primary sampling unit

`age` Age of child (months)

`sex` Gender of child

`weight` Weight of child (kgs)

`height` Height of child (cm)

`muac` Mid-upper arm circumference (mm)

`oedema` Presence or absence of oedema

`haz` Height-for-age z-score

`waz` Weight-for-age z-score

`whz` Weight-for-height z-score

`flag` Data quality flag

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`anthro2` *Anthropometric data from a single state from a Demographic and Health Survey (DHS) of a West African country.*

---

## Description

Anthropometric data from a single state from a Demographic and Health Survey (DHS) of a West African country.

## Usage

```
anthro2
```

## Format

A data frame with 796 observations and 6 variables

`psu` Primary sampling unit

`age` Age (months)

`sex` Gender

`wt` Weight (kg)

`ht` height (cm)

`oedema` Presence or absence of oedema

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`anthro3` *Anthropometric data from a Rapid Assessment Method (RAM) survey from Burundi.*

---

## Description

Anthropometric data from a Rapid Assessment Method (RAM) survey from Burundi.

## Usage

```
anthro3
```

## Format

A data frame with 221 observations and 7 variables

`psu` Primary sampling unit

`age` Age (months)

`sex` Gender

`weight` Weight (kg)

`height` Height (cm)

`muac` Mid-upper arm circumference (cm)

`oedema` Presence or absence of oedema

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`anthro4` *A subset of mid-upper arm circumference data from study conducted to create MUAC-for-age z-scores*

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## Description

A subset of mid-upper arm circumference data from study conducted to create MUAC-for-age z-scores

## Usage

```
anthro4
```

## Format

A data.frame with 257 observations and 4 variables

`pk_serial` Unique identifier

`muac` Mid-upper arm circumference in centimetres

`agemons` Age in months

`sex` Sex; 1 = Male; 2 = Female

## Source

Mramba Lazarus, Ngari Moses, Mwangome Martha, Muchai Lilian, Bauni Evasius, Walker A Sarah et al. A growth reference for mid upper arm circumference for age among school age children and adolescents, and validation for mortality: growth curve construction and longitudinal cohort study BMJ 2017; 358 :j3423 https://doi.org/10.1136/bmj.j3423

getAllWGS *Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a single child data.*

## Description

Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a single child data.

## Usage

```
getAllWGS(data = NULL, sex, weight, height, age, index)
```

## Arguments

| | |
|---|---|
| data | Data frame containing corresponding data on sex, weight, height, and age of children. Default is NULL. If specified, parameters for sex, weight, height and age should be provided as character values of the names of variables in data corresponding to the parameters required. |
| sex | Either numeric values (1 = male; 2 = female) indicating sex of child (default) or character value (if data is specified) indicating variable name in data containing information on sex of child/children (1 = male; 2 = female). |
| weight | Either numeric values for weight in kg with at least 1 decimal place (default) or character value (if data is specified) indicating variable name in data containing information on weight of child/children. |
| height | Either numeric values for height in cm with at least 1 decimal place (default) or character value (if data is specified) indicating variable name in data containing information on height of child/children. |
| age | Either numeric values for age in whole months (default) or character value (if data is specified) indicating variable name in data containing information on age of child/children. |
| index | One of "wfh", "hfa", "wfa" (specifies the required index) or "all" to calculate all three indices |

## Value

Either a single numeric value for z-score of the anthropometric index selected if data is for single child or a data frame of numeric values for z-scores of each anthropometric index if data is for multiple children and more than one anthropometric index selected.

The function fails messily when secondPart is outside of the range given in the WGS reference (i.e. 45 to 120 cm for height and 0 to 60 months for age). It is up to you to check the ranges of your data.

The reference data for W/H assumes supine length is used for children with a standing height below 85cm

Heights should be specified in cm to the nearest mm (i.e. to 1 d.p.)

Ages should be specified in whole months

Weights should be specified in kg to available precision

The function requires reference data `wgsData` included in this package

## Examples

```
# apply \code{getAllWGS()} to a make believe 52 month old male child with weight of
# 14.6 kg and height of 98.0 cm
waz <- getAllWGS(sex = 1,          # 1 = Male / 2 = Female
                 weight = 14.6,    # Weight in kilograms
                 height = 98,      # Height in centimetres
                 age = 52,         # Age in whole months
                 index = "wfa")    # Anthropometric index (weight-for-age)
waz

haz <- getAllWGS(sex = 1,
                 weight = 14.6,
                 height = 98,      # Height in centimetres
                 age = 52,
                 index = "hfa")    # Anthropometric index (height-for-age)
haz

whz <- getAllWGS(sex = 1,
                 weight = 14.6,
                 height = 98,
                 age = 52,
                 index = "wfh")    # Anthropometric index (weight-for-height)
whz

# apply \code{getAllWGS()} to \code{anthro1} dataset
waz <- getAllWGS(data = anthro1,
                 sex = "sex",
                 weight = "weight",
                 height = "height",
                 age = "age",
                 index = "wfa")
waz

haz <- getAllWGS(sex = anthro1$sex,
                 weight = anthro1$weight,
                 height = anthro1$height,
                 age = anthro1$age,
                 index = "hfa")
haz

all <- getAllWGS(data = anthro1,
                 sex = "sex",
                 weight = "weight",
                 height = "height",
                 age = "age",
                 index = "all")
all
```

getCohortWGS *Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a cohort or sample of children.*

## Description

Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a cohort or sample of children.

## Usage

```
getCohortWGS(data, FUN = getWGS, sexObserved, firstPart, secondPart,
  index)
```

## Arguments

| | |
|---|---|
| data | Data frame containing the variables needed for calculation |
| FUN | Function to apply; default to getWGS() |
| sexObserved | Sex of child (1 = Male; 2 = Female) |
| firstPart | Weight (kg; for WHZ and WAZ) or height (cm; for HAZ) |
| secondPart | Age (months; for HAZ and WAZ) or height (cm; for WHZ) |
| index | One of "wfh", "hfa", "wfa" (specifies the required index) |

## Value

Numeric vector of z-scores of the anthropometric index selected

The function fails messily when secondPart is outside of the range given in the WGS reference (i.e. 45 to 120 cm for height and 0 to 60 months for age). It is up to you to check the ranges of your data.

The reference data for W/H assumes supine length is used for children with a standing height below 85cm

Heights should be specified in cm to the nearest mm (i.e. to 1 d.p.)

Ages should be specified in whole months

Weights should be specified in kg to available precision

The function requires reference data wgsData included in this package

## Examples

```
# apply getWGS to first child in sample data anthro1
wazAll <- getCohortWGS(data = anthro1,
                       sexObserved = "sex",
                       firstPart = "weight",
                       secondPart = "age",
                       index = "wfa")
wazAll

hazAll <- getCohortWGS(data = anthro1,
                       sexObserved = "sex",
                       firstPart = "height",
                       secondPart = "age",
                       index = "hfa")
hazAll

whzAll <- getCohortWGS(data = anthro1,
                       sexObserved = "sex",
                       firstPart = "weight",
                       secondPart = "height",
                       index = "wfh")
whzAll
```

---

# getWGS *Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a single child data.*

---

## Description

Calculate z-scores for WHZ, HAZ, WAZ using the WHO Growth Reference (2006) for a single child data.

## Usage

```
getWGS(sexObserved, firstPart, secondPart, index)
```

## Arguments

| | |
|---|---|
| sexObserved | Sex of child (1 = Male; 2 = Female) |
| firstPart | Weight (in kg for WHZ and WAZ) or height (in cm for HAZ) |
| secondPart | Age (in months for HAZ and WAZ) or height (in cm for WHZ) |
| index | One of "wfh", "hfa", "wfa" (specifies the required index) |

## Value

z-score of the anthropometric index selected

## Warning

The function fails messily when `secondPart` is outside of the range given in the WGS reference (i.e. 45 to 120 cm for height and 0 to 60 months for age). It is up to you to check the ranges of your data.

## Reminders

The reference data for W/H assumes supine length is used for children with a standing height below 85cm

Heights should be specified in cm to the nearest mm (i.e. to 1 d.p.)

Ages should be specified in whole months

Weights should be specified in kg to available precision

The function requires reference data `wgsData` included in this package

## Note

This is a legacy function from the first CRAN release of `zscorer` which focused mainly on the calculation of z-scores for weight-for-age, weight-for-height and height-for-age. This function has been kept in the package to ensure that existing analysis workflows implemented using the function continue to work.

## Examples

```
# apply \code{getWGS()} to a make believe 52 month old male child with weight of
# 14.6 kg and height of 98.0 cm
waz <- getWGS(sexObserved = 1,     # 1 = Male / 2 = Female
              firstPart = 14.6,    # Weight in kilograms
              secondPart = 52,     # Age in whole months
              index = "wfa")       # Anthropometric index (weight-for-age)
waz

haz <- getWGS(sexObserved = 1,
              firstPart = 98,      # Height in centimetres
              secondPart = 52,
              index = "hfa")       # Anthropometric index (height-for-age)
haz

whz <- getWGS(sexObserved = 1,
              firstPart = 14.6,
              secondPart = 98,
              index = "wfh")       # Anthropometric index (weight-for-height)
whz
```

getWGSR *Calculate WHO Growth Reference z-score for a given anthropometric measurement.*

## Description

This function is usually called by the addWGSR() function but could be used as a stand-alone calculator for getting z-score for a given anthropometric measurement.

## Usage

```
getWGSR(sex, firstPart, secondPart, index = NA, standing = NA,
  thirdPart = NA)
```

## Arguments

| | |
|---|---|
| sex | Sex of the subject. This must be coded as 1 = male and 2 = female. |
| firstPart | Name of variable specifying:<br>• Weight (kg) for BMI/A, W/A, W/H, or W/L<br>• Head circumference (cm) for HC/A<br>• Height (cm) for BMI/A for H/A<br>• Length (cm) for L/A<br>• MUAC (cm) for MUAC/A<br>• Sub-scapular skinfold (mm) for SSF/A<br>• Triceps skinfold (mm) for TSF/A<br>Give a quoted variable name as in (e.g.) "weight". Be careful with units (weight in kg; height, length, head circumference, and MUAC in cm, skinfolds in mm). |
| secondPart | Name of variable specifying:<br>• Age (days) for H/A, HC/A, L/A, MUAC/A, SSF/A, or TSF/A<br>• Height (cm) BMI/A or W/H<br>• Length (cm) for W/L<br>Give a quoted variable name as in (e.g.) "age". Be careful with units (age in days; height and length in cm). |
| index | The index to be calculated and added to data. One of:<br>bfa BMI for age<br>hca Head circumference for age<br>hfa Height for age<br>lfa Length for age<br>mfa MUAC for age<br>ssa Sub-scapular skinfold for age<br>tsa Triceps skinfold for age<br>wfa Weight for age |

wfh Weight for height

wfl Weight for length

Give a quoted index name as in (e.g.) "wfh".

standing Variable specifying how stature was measured. If NULL then age (for "hfa" or "lfa") or height rules (for "wfh" or "wfl") will be applied. This must be coded as 1 = Standing; 2 = Supine; 3 = Unknown. All other values will be recoded to 3 = Unknown. Give a quoted variable name as in (e.g.) "measured" or a single value (e.g."measured = 1"). If no value (or NULL) is specified then height and age rules will be applied. zz

thirdPart Name of variable specifying age (in days) for BMI/A. Give a quoted variable name as in (e.g.) "age". Be careful with units (age in days).

## Value

A numeric value or vector of z-scores for the specified index.

## Examples

```
# Given a male child 10 months old with a weight of 5.7 kgs, height of 64.2
# cms, and MUAC of 125 mm:
#
# Calculate weight-for-height
getWGSR(sex = 1,
        firstPart = 5.7,
        secondPart = 64.2,
        index = "wfh",
        standing = 3)

# calculate weight-for-age
getWGSR(sex = 1,
        firstPart = 5.7,
        secondPart = 10,
        index = "wfa",
        standing = 3)

# calculate height-for-age
getWGSR(sex = 1,
        firstPart = 64.2,
        secondPart = 10,
        index = "hfa",
        standing = 3)

# Calculate MUAC-for-age z-score for a girl
getWGSR(sex = 1,
        firstPart = 20,
        secondPart = 62 * (365.25 / 12),
        index = "mfa")
```

## run_zscorer *Initialise built-in Shiny application*

### Description

Initialise built-in Shiny application

### Usage

```
run_zscorer()
```

### Examples

```
if(interactive()) run_zscorer()
```

## wgsData *World Health Organization (WHO) Growth Reference (2006) data*

### Description

World Health Organization (WHO) Growth Reference (2006) data

### Usage

```
wgsData
```

### Format

A data frame with 6 columns and 2338 rows.

`indicator` One of weight-for-age (`waz`), height-for-age (`haz`), or weight-for-height (`whz`) anthropometric indicators

`sex` Sex of child (1 = Male; 2 = Female)

`given` Variable to which standardisation is to be made. For `waz` and `haz`, `given` is age in months. For `whz`, `given` is height in cm

`l` `L` component of the LMS method for normalising growth centile standards. `L` is the trend in the optimal power to obtain normality

`m` `M` component of the LMS method for normalising growth centile standards. `M` is the trend in the mean

`s` `S` component of the LMS method for normalising growth centile standards. `S` is the trend in the coefficient of variation

## Source

World Health Organization. WHO Child Growth Standards: Length/Height-for-age, Weight-for-age, Weight-for-length, Weight-for-height, and Body Mass Index-for age: Methods and Development. 1st ed. World Health Organization; 2006.

# Index