

# Package ‘childsds’

October 12, 2022

**Title** Data and Methods Around Reference Values in Pediatrics

**Version** 0.8.0

**Description** Calculation of standard deviation scores and percentiles adduced from different standards (WHO, UK, Germany, Italy, China, etc). Also, references for laboratory values in children and adults are available, e.g., serum lipids, iron-related blood parameters, IGF, liver enzymes. See package documentation for full list.

**Depends** R (>= 3.5.0)

**Imports** gamlss, gamlss.dist, dplyr, magrittr, methods, tidyr, boot, class, tibble, reshape2, purrr, purrrlyr, utils, VGAM

**Suggests** ggplot2

**BugReports** <https://git.sc.uni-leipzig.de/my221hepi/chilsds/-/issues>

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 7.1.2

**NeedsCompilation** no

**Author** Mandy Vogel [aut, cre]

**Maintainer** Mandy Vogel <mandy.vogel@googlemail.com>

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<i>aga_15.ref</i>	<i>Parameters from recommendations of the German Adiposity Association (2015, AGA)</i>
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---

**Description**

Parameters from recommendations of the German Adiposity Association (2015, AGA)

**Usage**

`aga_15.ref`

**Source**

"Kromeyer-Hauschild K, Moss A, Wabitsch M. Referenzwerte fuer den Body-Mass-Index fuer Kinder, Jugendliche und Erwachsene in Deutschland. Adipositas - Ursachen, Folgeerkrankungen, Therapie. 2015;09(3):123-7."

---

<code>aggregate_lms</code>	<i>aggregate lms parameters</i>
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**Description**

aggregate lms parameters

**Usage**

`aggregate_lms(lms.list)`

**Arguments**

`lms.list` list of parameter tables as returned by `do_iterations()`

**Details**

function takes the `lms` part of the result from the `do_iterations()` function and returns the mean parameters

**Value**

list of dataframes containing the aggregated parameters, each for every level of sex

**Author(s)**

Mandy Vogel

---

`belgium.ref` *Parameters derived from Flandern population*

---

**Description**

Parameters derived from Flandern population

**Usage**

`belgium.ref`

**Source**

Roelants M, Hauspie R, Hoppenbrouwers K. References for growth and pubertal development from birth to 21 years in Flanders, Belgium. *Annals of Human Biology*. 2009 December;36(6):680-94.

---

`bone.ref` *Parameters for different bone parameters*

---

**Description**

Parameters for different bone parameters

**Usage**

`bone.ref`

**Source**

"Geserick M, Vogel M, Eckelt F, et al. Children and adolescents with obesity have reduced serum bone turnover markers and 25-hydroxyvitamin D but increased parathyroid hormone concentrations – Results derived from new pediatric reference ranges. Bone 2020;132:115124 and Weber et al. unpublished for VitD binding protein"

---

bp_wuehl_age.ref	<i>Parameters from Wuehl et al. blood pressure reference values Germany according to age, from version 0.7.3 unplausible values are replaced by interpolated ones. For the original values check out earlier versions</i>
------------------	---

---

**Description**

Parameters from Wuehl et al. blood pressure reference values Germany according to age, from version 0.7.3 unplausible values are replaced by interpolated ones. For the original values check out earlier versions

**Usage**

bp\_wuehl\_age.ref

**Source**

"Wuehl E, Witte K, Soergel M, Mehls O, Schaefer F, Hypertension for the GWG on P. Distribution of 24-h ambulatory blood pressure in children: normalized reference values and role of body dimensions. Journal of Hypertension. 2002 Oct;20(10):1995.", implausible values were replaced by interpolated ones from package version 0.7.4

---

bp_wuehl_height.ref	<i>Parameters from Wuehl et al. blood pressure reference values Germany according to height from version 0.7.3 unplausible values are replaced by interpolated ones. For the original values check out earlier versions</i>
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---

**Description**

Parameters from Wuehl et al. blood pressure reference values Germany according to height from version 0.7.3 unplausible values are replaced by interpolated ones. For the original values check out earlier versions

**Usage**

bp\_wuehl\_height.ref

**Source**

"Wuehl E, Witte K, Soergel M, Mehls O, Schaefer F, Hypertension for the GWG on P. Distribution of 24-h ambulatory blood pressure in children: normalized reference values and role of body dimensions. Journal of Hypertension. 2002 Oct;20(10):1995.", implausible values were replaced by interpolated ones from package version 0.7.4

---

`calc_confints`*Calculate confidence intervals*

---

**Description**

Calculate confidence intervals

**Usage**

```
calc_confints(  
  lms.list,  
  perc = c(2.5, 5, 50, 95, 97.5),  
  level = 0.95,  
  type = c("point")  
)
```

**Arguments**

<code>lms.list</code>	lms part of the returned list of <a href="#">do_iterations</a>
<code>perc</code>	percentiles for which the confidence bands are calculated
<code>level</code>	confidence level
<code>type</code>	for now only point is a valid value

**Details**

The function takes a lms list as returned by [do\\_iterations](#) and calculates the confidence bands for a given set of percentiles using [envelope](#) from the boot package

**Value**

list containing the respective confidence envelopes

**Author(s)**

mandy

---

cdc.ref	<i>LMS Parameters for the Centers for Disease Control and Prevention 2000 Growth Charts, contains bmi, height, head circumference, weight, weight for length,</i>
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---

**Description**

LMS Parameters for the Centers for Disease Control and Prevention 2000 Growth Charts, contains bmi, height, head circumference, weight, weight for length,

**Usage**

cdc.ref

**Source**

National health statistics reports 63.

---

cn.ref	<i>Parameters for height of normal weight and obese children from the CrescNet database dependent on height</i>
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---

**Description**

Parameters for height of normal weight and obese children from the CrescNet database dependent on height

**Usage**

cn.ref

**Source**

"Kempf et al. In progress"

---

colombia_sf.ref	<i>Parameters of skinfold measures derived from Colombian population</i>
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---

**Description**

Parameters of skinfold measures derived from Colombian population

**Usage**

colombia\_sf.ref

**Source**

Ramirez-Velez, R. et al. Triceps and Subscapular Skinfold Thickness Percentiles and Cut-Offs for Overweight and Obesity in a Population-Based Sample of Schoolchildren and Adolescents in Bogota, Colombia. *Nutrients* 8, (2016).

---

doyon_age.ref	<i>Parameters for different carotid artery intima-media thickness and distensibility dependent on age</i>
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---

**Description**

Parameters for different carotid artery intima-media thickness and distensibility dependent on age

**Usage**

doyon\_age.ref

**Source**

"Doyon A, Kracht D, Bayazit AK, et al. Carotid artery intima-media thickness and distensibility in children and adolescents: reference values and role of body dimensions. *Hypertension* 2013;62(3):550-6"



---

doyon_height.ref	<i>Parameters for different carotid artery intima-media thickness and distensibility dependent on height</i>
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---

**Description**

Parameters for different carotid artery intima-media thickness and distensibility dependent on height

**Usage**

doyon\_height.ref

**Source**

"Doyon A, Kracht D, Bayazit AK, et al. Carotid artery intima-media thickness and distensibility in children and adolescents: reference values and role of body dimensions. Hypertension 2013;62(3):550-6"

---

do_iterations	<i>do lms iterations</i>
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---

**Description**

Do lms iterations

**Usage**

```
do_iterations(
  data.list,
  n = 10,
  max.it = 1000,
  method = "gamlss",
  prop.fam = 0.75,
  prop.subject = 1,
  age.min = 0,
  age.max = 18,
  age.int = 1/12,
  keep.models = F,
  dist = "BCCGo",
  mu.df = 4,
  sigma.df = 3,
  nu.df = 2,
  tau.df = 2,
  verbose = F,
  formula = NULL,
```

```

sigma.formula = ~1,
nu.formula = ~1,
tau.formula = ~1,
method.pb = "ML",
trans.x = F,
lim.trans = c(0, 1.5)
)

```

### Arguments

data.list	list of dataframes as returned by prepare_data
n	number of desired fits
max.it	maximum number of iterations that will be run
method	use vgam or gamlss
prop.fam	proportion of families to be sampled
prop.subject	proportion of subject to be sampled
age.min	lower bound of age
age.max	upper bound of age
age.int	stepwidth of the age variable
keep.models	indicator whether or not models in each iteration should be kept
dist	distribution used for the fitting process, has to be one of BCCGo, BCPEo, BCTo as they are accepted by lms()
mu.df	degree of freedom location parameter
sigma.df	degree of freedom spread parameter
nu.df	degree of freedom skewness parameter
tau.df	degree of freedom kurtosis parameter
verbose	whether or not information about sampling will be printed during while iterate
formula	formula for the location parameter
sigma.formula	formula for the sigma parameter
nu.formula	formula for the nu parameter
tau.formula	formula for the tau parameter
method.pb	GAIC or ML
trans.x	indicator wether age should be transformed or not
lim.trans	limits for the exponent of transformation of age

### Details

function samples families, samples measurements (and subjects), fits the model for a given number of iterations

### Value

list of lists for models and fitted parameters

**Author(s)**

Mandy Vogel

---

duran\_bf.ref*Parameters for bodyfat ( for Whites, Blacks, and Mexican-Americans)*

---

**Description**

Parameters for bodyfat ( for Whites, Blacks, and Mexican-Americans)

**Usage**

duran\_bf.ref

**Source**

"Duran I, Martakis K, Rehberg M, Stark C, Schafmeyer L, Schoenau E. Reference Centiles for the Evaluation of Nutritional Status in Children using Body Fat Percentage, Fat Mass and Lean Body Mass Index. Journal of Clinical Densitometry [Internet] 2019 [cited 2019 Mar 19];Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1094695018302622>"

---

ethiop.ref*Parameters derived Ethiopian children*

---

**Description**

Parameters derived Ethiopian children

**Usage**

ethiop.ref

**Source**

Amare, E. B. et al. Reference Ranges for Head Circumference in Ethiopian Children 0–2 Years of Age. World Neurosurgery 84, 1566–1571.e2 (2015).

---

 fit\_gamlss

*fit lms*


---

## Description

fit\_gamlss

## Usage

```
fit_gamlss(
  data,
  age.min = 0.25,
  age.max = 18,
  age.int = 1/12,
  keep.models = F,
  dist = "BCCGo",
  mu.df = 4,
  sigma.df = 3,
  nu.df = 2,
  tau.df = 2,
  trans.x = F,
  lim.trans = c(0, 1.5),
  value,
  tmpdata
)
```

## Arguments

data	dataframe as return by select_meas()
age.min	lower bound of age
age.max	upper bound of age
age.int	stepwidth of the age variable
keep.models	indicator whether or not models in each iteration should be kept
dist	distribution used for the fitting process, has to be one of BCCGo, BCPEo, BCTo as they are accepted by lms()
mu.df	degree of freedom location parameter
sigma.df	degree of freedom spread parameter
nu.df	degree of freedom skewness parameter
tau.df	degree of freedom kurtosis parameter
trans.x	indicator whether age should be transformed or not
lim.trans	limits for the exponent of transformation of age
value	names of the value variable (character) if different from value, ignored
tmpdata	ignored

**Details**

wrapper around the `lms` function in the `gamlss` package returns the fitted `lms`-parameter at given age points the function is called inside `do_iterations` and may not called directly

**Value**

list containing a dataframe of the fitted `lms` parameter at the given age points and the fitted model

**Author(s)**

Mandy Vogel

---

<code>fit_gamlss1</code>	<i>fit_gamlss1</i>
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---

**Description**

`fit_gamlss`

**Usage**

```
fit_gamlss1(
  data,
  age.min = 0,
  age.max = 80,
  age.int = 1/12,
  keep.models = F,
  dist = "BCCGo",
  formula = NULL,
  sigma.formula = ~1,
  nu.formula = ~1,
  tau.formula = ~1,
  method.pb = "ML"
)
```

**Arguments**

<code>data</code>	dataframe as return by <code>select_meas()</code>
<code>age.min</code>	lower bound of age
<code>age.max</code>	upper bound of age
<code>age.int</code>	stepwidth of the age variable
<code>keep.models</code>	indicator whether or not models in each iteration should be kept
<code>dist</code>	distribution used for the fitting process, has to be one of <code>BCCGo</code> , <code>BCPEo</code> , <code>BCTo</code> as they are accepted by <code>lms()</code>
<code>formula</code>	formula for the location parameter

sigma.formula	formula for the sigma parameter
nu.formula	formula for the nu parameter
tau.formula	formula for the tau parameter
method.pb	GAIC or ML

**Details**

wrapper around the `gamlss` function from the `gamlss` package returns the fitted lms-parameter at given age points the function is called inside `do_iterations` and may not be called directly

**Value**

list containing a dataframe of the fitted lms parameter at the given age points and the fitted model

**Author(s)**

Mandy Vogel

---

fit_vgam	<i>fit lms parameters via VGAM</i>
----------	------------------------------------

---

**Description**

fit gamlss

**Usage**

```
fit_vgam(
  data,
  age.min = 0.25,
  age.max = 18,
  age.int = 1/12,
  keep.models = F,
  dist = "BCN",
  mu.df = 4,
  sigma.df = 3,
  nu.df = 2,
  value
)
```

**Arguments**

data	dataframe as return by <code>select_meas()</code>
age.min	lower bound of age
age.max	upper bound of age
age.int	stepwidth of the age variable

keep.models	indicator whether or not models in each iteration should be kept
dist	distribution used for the fitting process, has to be one of BCCGo, BCPEo, BCTo as they are accepted by lms()
mu.df	degree of freedom location parameter
sigma.df	degree of freedom spread parameter
nu.df	degree of freedom skewness parameter
value	names of the value variable (character) if different from value, ignored

### Details

wrapper around the `vgam` function in the VGAM package returns the fitted lms-parameter at given age points the function is called inside `do_iterations` and may not called directly

### Value

list containing a dataframe of the fitted lms parameter at the given age points and the fitted model

### Author(s)

mandy

---

fredriks05.ref

*Parameters derived from Dutch children (additional to nl4.ref)*

---

### Description

Parameters derived from Dutch children (additional to nl4.ref)

### Usage

fredriks05.ref

### Source

Fredriks, A. M. et al. Nationwide age references for sitting height, leg length, and sitting height/height ratio, and their diagnostic value for disproportionate growth disorders. *Archives of Disease in Childhood* 90, 807–812 (2005)

---

international\_lab.ref *International Laboratory Parameters Tables*

---

**Description**

International Laboratory Parameters Tables

**Usage**

international\_lab.ref

**Source**

Bidlingmaier, M., Friedrich, N., Emeny, R.T., Spranger, J., Wolthers, O.D., Roswall, J., Koerner, A., Obermayer-Pietsch, B., Huebener, C., Dahlgren, J., others, 2014. Reference intervals for insulin-like growth factor-1 (IGF-I) from birth to senescence: results from a multicenter study using a new automated chemiluminescence IGF-I immunoassay conforming to recent international recommendations. *The Journal of Clinical Endocrinology & Metabolism* 99, 1712-1721.

Friedrich, N., Wolthers, O.D., Arafat, A.M., Emeny, R.T., Spranger, J., Roswall, J., Kratzsch, J., Grabe, H.J., Huebener, C., Pfeiffer, A.F.H., Doering, A., Bielohuby, M., Dahlgren, J., Frystyk, J., Wallaschofski, H., Bidlingmaier, M., 2014. Age- and Sex-Specific Reference Intervals Across Life Span for Insulin-Like Growth Factor Binding Protein 3 (IGFBP-3) and the IGF-I to IGFBP-3 Ratio Measured by New Automated Chemiluminescence Assays. *The Journal of Clinical Endocrinology & Metabolism* 99, 1675-1686. doi:10.1210/jc.2013-3060

---

iron.ref

*Parameters for iron-related blood parameters in children*

---

**Description**

Parameters for iron-related blood parameters in children

**Usage**

iron.ref

**Source**

Rieger, K. et al. Reference intervals for iron-related blood parameters: results from a population-based cohort study (LIFE Child). *LaboratoriumsMedizin* 40, (2016).



---

italian.ref

*Parameters derived from Italian children*

---

**Description**

Parameters derived from Italian children

**Usage**

italian.ref

**Source**

Cacciari E, Milani S, Balsamo A, Spada E, Bona G, Cavallo L, et al. Italian cross-sectional growth charts for height, weight and BMI (2 to 20 yr). *J Endocrinol Invest.* 2006 Jul 1;29(7):581–93.

---

japanese.ref

*Parameters derived from Japanese children*

---

**Description**

Parameters derived from Japanese children

**Usage**

japanese.ref

**Source**

Inokuchi, M., Matsuo, N., Anzo, M., Takayama, J. I. & Hasegawa, T. Age-dependent percentile for waist circumference for Japanese children based on the 1992–1994 cross-sectional national survey data. *Eur J Pediatr* 166, 655–661 (2007)

---

japan\_lab.ref

*Parameters of serum insulin-like growth factor-I (IGF-I)*

---

**Description**

Parameters of serum insulin-like growth factor-I (IGF-I)

**Usage**

japan\_lab.ref

**Source**

Isojima, T., Shimatsu, A., Yokoya, S., Chihara, K., Tanaka, T., Hizuka, N., Teramoto, A., Tatsumi, K., Tachibana, K., Katsumata, N., Horikawa, R., 2012. Standardized centile curves and reference intervals of serum insulin-like growth factor-I (IGF-I) levels in a normal Japanese population using the LMS method. *Endocrine Journal* 59, 771-780. doi:10.1507/endocrj.EJ12-0110

---

kawel\_boehm.ref

*Parameters for Cardiovascular Magnetic Resonance*

---

**Description**

Parameters for Cardiovascular Magnetic Resonance

**Usage**

kawel\_boehm.ref

**Source**

"Kawel-Boehm N, Hetzel SJ, Ambale-Venkatesh B, et al. Reference ranges ("normal values") for cardiovascular magnetic resonance (CMR) in adults and children: 2020 update. *Journal of Cardiovascular Magnetic Resonance* 2020;22(1):87."

---

kiggs.ref	<i>LMS Parameters for German reference data (KiGGS, 2003-2006) for height, weight, bmi, hip, whr, whtr; bodyfat, skinfold sum, triceps skinfold, subscapular skinfold, and waist circumference</i>
-----------	--

---

**Description**

LMS Parameters for German reference data (KiGGS, 2003-2006) for height, weight, bmi, hip, whr, whtr, bodyfat, skinfold sum, triceps skinfold, subscapular skinfold, and waist circumference

**Usage**

kiggs.ref

**Source**

Referenzperzentile fuer anthropometrische Masszahlen und Blutdruck aus KiGGS 2003-2006, Robert Koch Institut, Germany

---

kiggs_bp.ref	<i>Parameters derived from the German KiGGS cohort</i>
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---

**Description**

Parameters derived from the German KiGGS cohort

**Usage**

kiggs\_bp.ref

**Details**

contains 2-dimensional reference grid. Do not use with `sds` but `sds_2d`

**Source**

Neuhauser, H. K., Thamm, M., Ellert, U., Hense, H. W. & Rosario, A. S. Blood Pressure Percentiles by Age and Height from Nonoverweight Children and Adolescents in Germany. *Pediatrics* peds.2010-1290 (2011). doi:10.1542/peds.2010-1290.

---

kro.ref	<i>LMS Parameters for German reference data (Kromeyer Hauschild, 2001) for height, weight, bmi, and waist circumference, including preterm correction (Voigt)</i>
---------	---

---

**Description**

LMS Parameters for German reference data (Kromeyer Hauschild, 2001) for height, weight, bmi, and waist circumference, including preterm correction (Voigt)

**Usage**

kro.ref

**Source**

Perzentile fuer den Body-mass-Index fuer das Kindes- und Jugendalter unter Heranziehung verschiedener deutscher Stichproben, Monatsschrift Kinderheilkunde August 2001, Volume 149, Issue 8, pp 807-818; Fruehgeborenenkorrektur nach Voigt

---

life_circ.ref	<i>Parameters for different circumferences and whr and whtr</i>
---------------	---

---

**Description**

Parameters for different circumferences and whr and whtr

**Usage**

life\_circ.ref

**Source**

"Roennecke E, Vogel M, Bussler S, Grafe N, Jurkutat A, Schlingmann M, Koerner A, Kiess W. Age- and sex-related percentiles of skinfold thickness, waist and hip circumference, Waist-to- Hip Ratio and Waist-to-Height Ratio: Results from a population-based paediatric cohort in Germany (LIFE Child). Obesity Facts. 2019."

---

life_cysc.ref	<i>Parameters for different metabolom parameters from the LIFE Child cohort</i>
---------------	---

---

**Description**

Parameters for different metabolom parameters from the LIFE Child cohort

**Usage**

life\_cysc.ref

**Source**

"Ziegelasch N, Vogel M, Müller E, et al. Cystatin C Serum Levels in Healthy Children Are Related to Age, Gender, and Pubertal Stage. *Pediatr Nephrol* 2019; 34: 449–57."

---

life_fibroscan.ref	<i>Parameters for fibroscan from the LIFE Child cohort</i>
--------------------	--

---

**Description**

Parameters for fibroscan from the LIFE Child cohort

**Usage**

life\_fibroscan.ref

**Source**

"preliminary reference values cap med and e med from fibroscan in the life child study. Publication (Puasa et al) in preparation."

---

life_heart.ref	<i>hs-Troponin T and NT-proBNP from the LIFE Child cohort</i>
----------------	---

---

**Description**

hs-Troponin T and NT-proBNP from the LIFE Child cohort

**Usage**

life\_heart.ref

**Source**

"Kiess A, Green J, Willenberg A, et al. Age-dependent reference values for hs-Troponin T and NT-proBNP and determining factors in a cohort of healthy children (The LIFE child study). *Pediatric Cardiology* 2022. Accepted"

---

life_igf.ref	<i>IGF-I and IGF-BP3 from the LIFE Child cohort</i>
--------------	---

---

**Description**

IGF-I and IGF-BP3 from the LIFE Child cohort

**Usage**

life\_igf.ref

**Source**

"Hoerenz C, Vogel M, Wirkner K. BMI and contraceptives affect new age-, sex-, and puberty-adjusted IGF-I and IGFBP-3 reference ranges across life span. *JCEM* 2022 (in (minor) revision)."

---

life_liver.ref	<i>Parameters for serum liver enzymes</i>
----------------	---

---

**Description**

Parameters for serum liver enzymes

**Usage**

life\_liver.ref

**Source**

Bussler et al, New pediatric percentiles of liver enzyme serum levels (ALT, AST, GGT): effects of age, sex, BMI and pubertal stage, Hepatology 2017

---

life_skinfold.ref	<i>Parameters for different skinfolds</i>
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---

**Description**

Parameters for different skinfolds

**Usage**

life\_skinfold.ref

**Source**

"Roennecke E, Vogel M, Bussler S, Grafe N, Jurkutat A, Schlingmann M, Koerner A, Kiess W. Age- and sex-related percentiles of skinfold thickness, waist and hip circumference, Waist-to- Hip Ratio and Waist-to-Height Ratio: Results from a population-based paediatric cohort in Germany (LIFE Child). Obesity Facts. 2019."

---

life_thyr.ref	<i>Parameters for TSH, FT3, FT4 from the LIFE Child cohort</i>
---------------	--

---

**Description**

Parameters for TSH, FT3, FT4 from the LIFE Child cohort

**Usage**

life\_thyr.ref

**Source**

"Surup H., Vogel M., Koerner A., Hiemisch A., Oelkers L., Willenberg A., Kiess W., Kratzsch J. (2021). BMI and puberty have to be included into the interpretation of TSH, FT3 and FT4 measurements by new pediatric reference intervals. THYROID."

---

lipids.ref	<i>Parameters for serum lipids in children</i>
------------	--

---

**Description**

Parameters for serum lipids in children

**Usage**

lipids.ref

**Source**

Dathan-Stumpf, A. et al. Pediatric reference data of serum lipids and prevalence of dyslipidemia: Results from a population-based cohort in Germany. *Clinical Biochemistry* 49, 740–749 (2016).



---

make\_percentile\_tab    *calculate raw values*

---

### Description

Calculate raw values for percentile curve

### Usage

```
make_percentile_tab(  
  ref,  
  item,  
  perc = c(2.5, 5, 50, 95, 97.5),  
  stack = F,  
  age = NULL,  
  include.pars = T,  
  digits = 4,  
  sex  
)
```

### Arguments

ref	Refgroup object
item	name of the measurement item
perc	vector of percentiles to be calculated
stack	wether or not the data should be stacked, stacked data would most possibly be used in ggplot2
age	desired values of age
include.pars	indicator whether or not parameters should be included
digits	specification of number of decimal places
sex	name of the sex variable (character) if different from sex, not functional in this version and therefore ignored

### Details

calculates quantile values for given RefGroup and given percentiles

### Value

data frame either with the different percentiles as columns or, if stacked, as data frame with four columns: age, sex, variable, value

### Author(s)

Mandy Vogel

**Examples**

```
ptab <- make_percentile_tab(ref = kro.ref,
                           item = "height",
                           perc = c(2.5,10,50,90,97.5),
                           stack = TRUE)

ggplot2::ggplot(ptab, ggplot2::aes(x = age, y = value, colour = variable)) +
  ggplot2::geom_line() +
  ggplot2::facet_wrap(~ sex, nrow = 2)
```

---

metabolom.ref	<i>Parameters for different metabolom parameters from the LIFE Child cohort</i>
---------------	---

---

**Description**

Parameters for different metabolom parameters from the LIFE Child cohort

**Usage**

```
metabolom.ref
```

**Source**

"Hirschel, J., Vogel, M., Baber, R., Garten, A., Beuchel, C., Dietz, Y., Dittrich, J., Körner, A., Kiess, W., & Ceglarek, U. (2020). Relation of Whole Blood Amino Acid and Acylcarnitine Metabolome to Age, Sex, BMI, Puberty, and Metabolic Markers in Children and Adolescents. *Metabolites*, 10(4), 149. <https://doi.org/10.3390/metabo10040149>"

---

mock_df	<i>Mock a data frame</i>
---------	--------------------------

---

**Description**

mock values for a given reference

**Usage**

```
mock_df(ref, item, n = 1000)
```

**Arguments**

ref	a valid RefGroup object
item	a valid imte present in ref
n	how many values should be created

**Details**

mock values for a given reference

**Value**

data frame containing a age, sex, and value column

**Author(s)**

mandy

---

mock_value	<i>Mock Value</i>
------------	-------------------

---

**Description**

mock a value for a given reference

**Usage**

```
mock_value(ref, item, sex = c("male", "female"), age)
```

**Arguments**

- ref            a valid RefGroup object
- item          a valid item present in ref
- sex           character male or female
- age           numeric age value

**Details**

the function creates a random value for a given age and sex value and a given reference

**Value**

a random value from the conditional distribution (conditionally on age and sex)

**Author(s)**

mandy

---

mock_values	<i>Mock Values</i>
-------------	--------------------

---

**Description**

mock values for a given reference, given age and given sex

**Usage**

```
mock_values(df, sex, age, ref, item)
```

**Arguments**

df	data frame containing the age and sex
sex	name of the sex variable
age	name of the age variable
ref	a valid RefGroup object
item	a valid imte present in ref

**Details**

the function creates random values for given age and sex values and a given reference

**Value**

data frame containing the additional column with random numbers

**Author(s)**

mandy

---

momo.ref	<i>Parameters for the German MoMo study (sports test)</i>
----------	---

---

**Description**

Parameters for the German MoMo study (sports test)

**Usage**

```
momo.ref
```

**Source**

"Niessner C, Utesch T, Oriwol D, et al. Representative Percentile Curves of Physical Fitness From Early Childhood to Early Adulthood: The MoMo Study. *Front Public Health* 2020;8. Available from: <https://www.frontiersin.org/articles/10.3389/fpubh.2020.00458/full?report=reader>"

---

`motor.ref`*Parameters for 5 subtests of the KiGGS Motorik Module*

---

**Description**

Parameters for 5 subtests of the KiGGS Motorik Module

**Usage**`motor.ref`**Source**

"Sobek et al. In progress"

---

`n13.ref`*Parameters of skinfold measures derived from Colombian population*

---

**Description**

Parameters of skinfold measures derived from Colombian population

**Usage**`n13.ref`**Source**

Fredriks, A. M. et al. Continuing positive secular growth change in The Netherlands 1955-1997. *Pediatric research* 47, 316-323 (2000).

Fredriks, A.M., van Buuren, S., Wit, J.M., Verloove-Vanhorick, S.P., 2000. Body index measurements in 1996-7 compared with 1980. *Archives of disease in childhood* 82, 107-112.

<https://cran.r-project.org/package=AGD>

---

`n14.ref`*Parameters derived from the 4th Dutch growth study*

---

**Description**

Parameters derived from the 4th Dutch growth study

**Usage**`n14.ref`**Source**

Fredriks, A. M. et al. Nationwide age references for sitting height, leg length, and sitting height/height ratio, and their diagnostic value for disproportionate growth disorders. *Archives of Disease in Childhood* 90, 807–812 (2005); Fredriks, A. M. et al. Height, weight, body mass index and pubertal development references for children of Moroccan origin in The Netherlands. *Acta Paediatr.* 93, 817–824 (2004); Fredriks, A. M. et al. Continuing positive secular growth change in The Netherlands 1955–1997. *Pediatric research* 47, 316–323 (2000); Fredriks, A. M. et al. Height, weight, body mass index and pubertal development reference values for children of Turkish origin in the Netherlands. *Eur. J. Pediatr.* 162, 788–793 (2003); Fredriks, A. M., van Buuren, S., Wit, J. M. & Verloove-Vanhorick, S. P. Body index measurements in 1996–7 compared with 1980. *Archives of disease in childhood* 82, 107–112 (2000); R package: AGD, Stef van Buuren, <http://www.stefvanbuuren.nl/>

---

`one_iteration`*one iteration*

---

**Description**

one iteration

**Usage**

```
one_iteration(  
  data.list,  
  method,  
  prop.fam = 0.75,  
  prop.subject = 1,  
  age.min = 0,  
  age.max = 18,  
  age.int = 1/12,  
  keep.models = F,  
  dist = "BCCGo",  
  formula = NULL,  
  sigma.df = 3,
```

```

    nu.df = 2,
    mu.df = 4,
    tau.df = 2,
    sigma.formula = ~1,
    nu.formula = ~1,
    tau.formula = ~1,
    verbose = F,
    trans.x = F,
    lim.trans = c(0, 1.5),
    method.pb = "ML"
  )

```

### Arguments

data.list	list of dataframes as returned by prepare_data
method	use vgam or gamlss
prop.fam	proportion of families to be sampled
prop.subject	proportion of subject to be sampled
age.min	lower bound of age
age.max	upper bound of age
age.int	stepwidth of the age variable
keep.models	indicator whether or not models in each iteration should be kept
dist	distribution used for the fitting process, has to be one of BCCGo, BCPEo, BCTo as they are accepted by lms()
formula	formula for the location parameter
sigma.df	degree of freedom spread parameter
nu.df	degree of freedom skewness parameter
mu.df	degree of freedom location parameter
tau.df	degree of freedom kurtosis parameter
sigma.formula	formula for the sigma parameter
nu.formula	formula for the nu parameter
tau.formula	formula for the tau parameter
verbose	whether or not information about sampling will be printed during while iterate
trans.x	indicator whether age should be transformed or not
lim.trans	limits for the exponent of transformation of age
method.pb	GAIC or ML

### Details

function samples families then measurements and fits the model the function is called inside [do\\_iterations](#) and may not called directly

**Value**

list of lists each containing a dataframe of the fitted lms parameter at the given age points and the fitted model

**Author(s)**

Mandy Vogel

---

ParTab-class	<i>Table of references</i>
--------------	----------------------------

---

**Description**

Reference tables

**Slots**

`item` identifier of the item

`dist` named list which contains the distribution which was used in fitting the references. One entry for male and one for female

---

portug.ref	<i>Parameters derived from Portuguese children</i>
------------	--

---

**Description**

Parameters derived from Portuguese children

**Usage**

portug.ref

**Source**

Chaves, R., Baxter-Jones, A., Souza, M., Santos, D. & Maia, J. Height, weight, body composition, and waist circumference references for 7-to 17-year-old children from rural Portugal. *HOMO-Journal of Comparative Human Biology* 66, 264–277 (2015).



---

prepare_data	<i>prepare data for iteration process</i>
--------------	---

---

**Description**

prepare data for repeated iteration process

**Usage**

```
prepare_data(
  data,
  group = NULL,
  subject = "SIC",
  sex = NULL,
  value = "value",
  age = "age",
  lb = -Inf,
  ub = Inf
)
```

**Arguments**

data	dataframe containing measurement values, age, sex, and subject identifier
group	optional variable indicating groups of subjects within the data frame in most cases (families)
subject	subject identifier
sex	column containing the sex (or any other stratum), ideally of type character, iteration process will run on each of the levels separately
value	numeric column containing the measurement values
age	numeric column containing the age
lb	optional - lower bound for age
ub	optional - upper bound for age

**Details**

given a dataframe, the column name of the subject identifier, sex, age, value and group columns, the function creates a dataframe containing only these five columns with the standard column names group, subject, sex, age, value. lines containing missing values are removed.

**Value**

list of dataframes containing the columns group, subject, sex, age, value; one dataframe for every level of sex

**Author(s)**

Mandy Vogel

---

```
preterm.ref           Parameters Preterm and Intrauterine
```

---

**Description**

Parameters Preterm and Intrauterine

**Usage**

```
preterm.ref
```

**Source**

Olsen, I.E., Lawson, M.L., Ferguson, A.N., Cantrell, R., Grabich, S.C., Zemel, B.S., Clark, R.H., 2015. BMI Curves for Preterm Infants. *PEDIATRICS* 135, e572-e581. doi:10.1542/peds.2014-2777

Olsen, I.E., Groveman, S.A., Lawson, M.L., Clark, R.H., Zemel, B.S., 2010. New intrauterine growth curves based on United States data. *Pediatrics* 125, e214-224. doi:10.1542/peds.2009-0913

---

```
RefGroup-class       Class of references
```

---

**Description**

Container for reference tables

**Slots**

`name` name of the reference group

`refs` List of references, each reference refers to one item and contains independent variable age, and the parameter values for both genders

`citations` information about the sources of the references

`info` additional infos regarding the references

**Author(s)**

Mandy Vogel

**Examples**

```
data(kiggs.ref)
print(kiggs.ref)
data(ukwho.ref)
print(ukwho.ref)
data(who.ref)
print(who.ref)
```

saudi.ref

*Parameters derived from Saudi children***Description**

Parameters derived from Saudi children

**Usage**

saudi.ref

**Source**

Mouzan, M. I. E., Salloum, A. A. A., Alqurashi, M. M., Herbish, A. S. A. & Omar, A. A. The LMS and Z scale growth reference for Saudi school-age children and adolescents. Saudi Journal of Gastroenterology 22, 331 (2016)

Shaik, S.A., El Mouzan, M.I., AlSalloum, A.A., AlHerbish, A.S., 2016. Growth reference for Saudi preschool children: LMS parameters and percentiles. Ann Saudi Med 36, 2-6. doi:10.5144/0256-4947.2016.2

sds

*Calculate SDS Values***Description**

Calculate SDS values

**Usage**

```
sds(value, age, sex, item, ref, type = "SDS", male = "male", female = "female")
```

**Arguments**

value	vector of measurement values
age	vector of age values
sex	vector of sex
item	name of the item e.g. "height"
ref	RefGroup object
type	"SDS" or "perc"
male	coding of sex for male
female	coding of sex for female

**Details**

The function takes a vector of measurement values, and of age and of sex and a RefGroup object as arguments. It calculates the sds or percentile values.

**Value**

vector containing SDS or percentile values

**Author(s)**

Mandy Vogel

**Examples**

```
anthro <- data.frame(age = c(11.61,12.49,9.5,10.42,8.42,10.75,9.57,10.48),
  height = c(148.2,154.4,141.6,145.3,146,140.9,145.5,150),
  sex = sample(c("male","female"), size = 8, replace = TRUE),
  weight = c(69.5,72.65,47.3,51.6,45.6,48.9,53.5,58.5))
anthro$height_sds <- sds(anthro$height,
  age = anthro$age,
  sex = anthro$sex, male = "male", female = "female",
  ref = kro.ref,
  item = "height",
  type = "SDS")

anthro$bmi <- anthro$weight/(anthro$height**2) * 10000
anthro$bmi_perc <- sds(anthro$bmi,
  age = anthro$age,
  sex = anthro$sex, male = "male", female = "female",
  ref = kro.ref,
  item = "bmi",
  type = "perc")

data(who.ref)
x <- data.frame(height=c(50,100,60,54),
  sex=c("m","f","f","m"),
  age=c(0,2.9,0.6,0.2))
sds(value = x$height, age = x$age, sex = x$sex, male = "m", female = "f",
  ref = who.ref, item = "height")
```

---

sdsold

*Calculate SDS Values*

---

**Description**

Calculate SDS values - old version for comparison

**Usage**

```
sdsold(
  value,
  age,
  sex,
  item,
  ref,
  type = "SDS",
  male = "male",
  female = "female"
)
```

**Arguments**

value	vector of measurement values
age	vector of age values
sex	vector of sex
item	name of the item e.g. "height"
ref	RefGroup object
type	"SDS" or "perc"
male	coding of sex for male
female	coding of sex for female

**Details**

The function takes a vector of measurement values, and of age and of sex and a RefGroup object as arguments. It calculates the sds or percentile values.

**Value**

vector containing SDS or percentile values

**Author(s)**

Mandy Vogel

**Examples**

```
anthro <- data.frame(age = c(11.61,12.49,9.5,10.42,8.42,10.75,9.57,10.48),
  height = c(148.2,154.4,141.6,145.3,146,140.9,145.5,150),
  sex = sample(c("male","female"), size = 8, replace = TRUE),
  weight = c(69.5,72.65,47.3,51.6,45.6,48.9,53.5,58.5))
anthro$height_sds <- sds(anthro$height,
  age = anthro$age,
  sex = anthro$sex, male = "male", female = "female",
  ref = kro.ref,
  item = "height",
  type = "SDS")
```

```

anthro$bmi <- anthro$weight/(anthro$height**2) * 10000
anthro$bmi_perc <- sds(anthro$bmi,
                      age = anthro$age,
                      sex = anthro$sex, male = "male", female = "female",
                      ref = kro.ref,
                      item = "bmi",
                      type = "perc")

data(who.ref)
x <- data.frame(height=c(50,100,60,54),
                sex=c("m","f","f","m"),
                age=c(0,2.9,0.6,0.2))
sds(value = x$height, age = x$age, sex = x$sex, male = "m", female = "f",
    ref = who.ref, item = "height")

```

sds\_2d

*Calculate SDS Values for 2-dimensional matrix of covariates***Description**

Calculate SDS values for 2-dimensional matrix of covariates

**Usage**

```

sds_2d(
  value,
  age,
  x2,
  sex,
  item,
  ref,
  type = "SDS",
  male = "male",
  female = "female"
)

```

**Arguments**

value	vector of measurement values
age	vector of age values
x2	second vector of covariates
sex	vector of sex
item	name of the item e.g. "height"
ref	RefGroup object
type	"SDS" or "perc"
male	coding of sex for male
female	coding of sex for male

**Details**

The function takes a vector of measurement values, and of age and a second covariate (like age and height for blood pressure) of sex and a RefGroup object as arguments. It calculates the sds or percentile values. This function is beta.

the function searches for the nearest given point in the reference grid. From there, the SDS/percentile value will be calculated. Different from [sds](#), no interpolation will be applied. The procedure is according to Neuhauser et al. Blood Pressure Percentiles by Age and Height from Nonoverweight Children and Adolescents in Germany. 2011.

**Value**

vector containing SDS or percentile values

**Author(s)**

Mandy Vogel

---

select_fams	<i>select families</i>
-------------	------------------------

---

**Description**

Select groups (families)

**Usage**

```
select_fams(data, prop = 0.75, group, verbose = F)
```

**Arguments**

data	dataframe as returned by prepare data
prop	proportion of families to be sampled
group	name of the group variable (character) if not "group", ignored
verbose	if TRUE information about sample size is printed out

**Details**

function selects a given proportion of groups/families from the data if no grouping variable is given the original data set is returned function is called inside [do\\_iterations](#) and may not called directly

**Value**

dataframe containing only prop.fam percent the families in data

**Author(s)**

Mandy Vogel

select\_meas                    *choose one measurement per subject*

---

**Description**

Choose one measurement per subject

**Usage**

```
select_meas(data, subject = "subject", prop = 1, verbose = F)
```

**Arguments**

data	dataframe as returned by prepare data
subject	name of the column containing the subject identifier
prop	optional - proportion of measurements to sample
verbose	if TRUE information about sample size is printed out

**Details**

function samples one measurement per subject, if prop < 1 additional a prop\*100 percent will be sampled from the measurements the function is called inside [do\\_iterations](#) and may not called directly

**Value**

dataframe containing the sampled rows

**Author(s)**

Mandy Vogel

---

show,ParTab-method            *class ParTab*

---

**Description**

show method for ParTab

**Usage**

```
## S4 method for signature 'ParTab'  
show(object)
```



**Arguments**

object            object of class ParTab

**Details**

show method for ParTab

**Value**

print information about the respective reference table

**Author(s)**

Mandy Vogel

---

show,RefGroup-method    *class RefGroup*

---

**Description**

show method for RefGroup

**Usage**

```
## S4 method for signature 'RefGroup'  
show(object)
```

**Arguments**

object            object of class RefGroup

**Details**

show method for RefGroup

**Value**

prints information about age range, citations, etc.

**Author(s)**

Mandy Vogel

---

turkish.ref

*Parameters derived from Turkish children*

---

**Description**

Parameters derived from Turkish children

**Usage**

turkish.ref

**Source**

Hatipoglu, N. et al. Waist circumference percentiles for 7- to 17-year-old Turkish children and adolescents. *Eur J Pediatr* 167, 383–389 (2008); Bundak, R. et al. Body mass index references for Turkish children. *Acta Paediatrica* 95, 194–198 (2006).

Neyzi, O., Furman, A., Bundak, R., Gunoz, H., Darendeliler, F., Bas, F., 2006. Growth references for Turkish children aged 6 to 18 years. *Acta Paediatrica* 95, 1635-1641. doi:10.1080/08035250600652013

Bundak, R. et al. Body mass index references for Turkish children. *Acta Paediatrica* 95, 194-198 (2006).

---

uk1990.ref

*Parameters from the 1990 UK growth study*

---

**Description**

Parameters from the 1990 UK growth study

**Usage**

uk1990.ref

**Source**

Cole, T.J., Freeman, J.V., Preece, M.A., 1998. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. *Statistics in medicine* 17, 407-429.

Cole, T.J., Freeman, J.V., Preece, M.A., 1995. Body mass index reference curves for the UK, 1990. *Archives of disease in childhood* 73, 25-29.

---

ukwho.ref	<i>LMS Parameters for UK-WHO growth charts for height, weight, bmi, head circumference</i>
-----------	--

---

**Description**

LMS Parameters for UK-WHO growth charts for height, weight, bmi, head circumference

**Usage**

ukwho.ref

**Source**

Wright, Charlotte M., et al, Practice pointer: Using the new UK-WHO growth charts. British Medical Journal 340.c1140 (2010): 647-650. Preterm British 1990, 0-4 WHO2006, 4-18 British1990

---

us.ref	<i>Parameters derived from US children (additional to the cdc.ref)</i>
--------	--

---

**Description**

Parameters derived from US children (additional to the cdc.ref)

**Usage**

us.ref

**Source**

Sharma, A. K., Metzger, D. L., Daymont, C., Hadjiyannakis, S. & Rodd, C. J. LMS tables for waist-circumference and waist-height ratio Z-scores in children aged 5-19 y in NHANES III: association with cardio-metabolic risks. Pediatric research (2015)

---

who.ref	<i>LMS Parameters for UK-WHO growth charts for height, weight, bmi, head circumference, arm mid upper arm circumference, subscapular and triceps skinfold, weight for height</i>
---------	--

---

**Description**

LMS Parameters for UK-WHO growth charts for height, weight, bmi, head circumference, arm mid upper arm circumference, subscapular and triceps skinfold, weight for height

**Usage**

who.ref

**Source**

de Onis, M., Onyango, A., Borghi, E., Siyam, A., Blossner, M., & Lutter, C. (2012). Worldwide implementation of the WHO child growth standards. *Public Health Nutr*, 12, 1-8.

---

who2007.ref	<i>Parameters of skinfold measures derived from Colombian population</i>
-------------	--

---

**Description**

Parameters of skinfold measures derived from Colombian population

**Usage**

who2007.ref

**Source**

Onis, M. de, Onyango, A.W., Borghi, E., Siyam, A., Nishida, C., Siekmann, J., 2007. Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization* 85, 660-667.

---

`wormplot_gg`*Worm Plot ggplot version*

---

**Description**

Worm plot ggplot version

**Usage**

```
wormplot_gg(  
  m = NULL,  
  residuals = NULL,  
  age = NA,  
  n.inter = 1,  
  y.limits = c(-1, 1)  
)
```

**Arguments**

<code>m</code>	a gamlss model
<code>residuals</code>	normalized quantile residuals
<code>age</code>	numeric vector of ages
<code>n.inter</code>	number of age intervals or cut points
<code>y.limits</code>	limits of the y-axis

**Details**

creates a wormplot for a gamlss model or a given vector of normalized quantile residuals, either for all residuals or grouped by age intervals

**Value**

ggplot object

---

`zong13.ref`*Parameters derived from Chinese children (additional to nl4.ref)*

---

**Description**

Parameters derived from Chinese children (additional to nl4.ref)

**Usage**

```
zong13.ref
```

**Source**

Zong, X.-N., Li, H. Construction of a New Growth References for China Based on Urban Chinese Children: Comparison with the WHO Growth Standards. PLOS ONE 8, e59569 (2013).

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