Package 'physiology'

October 14, 2022

Title Calculate physiologic characteristics of awake and anesthetized adults, children and infants

Version 1.2.1

Description A variety of formulae are provided for estimation of physiologic characteristics of infants, children, and adults. Calculations include: body surface area, ideal weight, airway dead-space, the alveolar gas equation, and GFR. Each formula is referenced to the original publication. Future functions will cover more material with a focus on anaesthesia, critical care and peri-operative medicine.

License GPL-3

URL https://jackwasey.github.io/physiology/

BugReports https://github.com/jackwasey/physiology/issues

Depends R (>= 3.4)

Imports Rcpp

Suggests childsds, dplyr, ggplot2, lintr, magrittr, rmarkdown, testthat, knitr, spelling, tidyr, utils

LinkingTo Rcpp

VignetteBuilder knitr

Encoding UTF-8

Language en-US

LazyData true

LazyDataCompression xz

RoxygenNote 6.1.1

NeedsCompilation yes

Author Jack O. Wasey [aut, cre, cph] (<https://orcid.org/0000-0003-3738-4637>), Bill Denney [ctb] (<https://orcid.org/0000-0002-5759-428X>)

Maintainer Jack O. Wasey <jack@jackwasey.com>

Repository CRAN

Date/Publication 2018-11-28 22:51:22 UTC

R topics documented:

`physiology-package` *physiology*

Description

A variety of formulae are provided for estimation of physiologic characteristics of infants, children, and adults. Calculations include: body surface area, ideal weight, airway dead-space, the alveolar gas equation, and GFR. Each formula is referenced to the original publication. Future functions will cover more material with a focus on anaesthesia, critical care and peri-operative medicine.

Author(s)

Maintainer: Jack O. Wasey <jack@jackwasey.com> (0000-0003-3738-4637) [copyright holder]

Other contributors:

- Bill Denney <wdenney@humanpredictions.com> (0000-0002-5759-428X) [contributor]

See Also

Useful links:

- https://jackwasey.github.io/physiology/
- Report bugs at https://github.com/jackwasey/physiology/issues

---

`adj_weight_adult` *adjusted body weight*

Description

returns ideal weight + 40 actual weights. Ideal weight is calculated using default algorithm. TODO: is downward adjustment valid?

Usage

```
adj_weight_adult(height_m, weight_kg, male, ...)
```

Arguments

`height_m`	single numeric, height in meters
`weight_kg`	weight in kg, may be a vector
`male`	logical value(s) whether patient is male. TRUE or FALSE.
`...`	passed to validation

Examples

```
adj_weight_adult(1.6, 120, male = FALSE)
```

`age_from_dates` *age from birth and reference dates*

Description

Calculate age at time of reference date, based on birth date, rounded to the given unit. These are designed for physiologic estimations, not for accuracy. The dates can be given as anything which can be coerced into a `Date`.

Usage

```
age_from_dates(birth_date, ref_date = Sys.Date(), unit = c("year",
  "month", "day"))
```

Arguments

birth_date	Date of birth, either as a Date or something which will be converted to a Date
ref_date	Date at which to calculate age, defaults to current date, either as a Date or something which will be converted to a Date
unit	character of length, one of "year" or "day".

Value

integer vector

References

https://stackoverflow.com/questions/31126726

Examples

```
age_from_dates("2014-11-08", "2014-12-31", unit = "day")
age_from_dates("2014-11-08", "2014-12-31", unit = "day")
age_from_dates("1981-07-09", "2014-06-29", unit = "year")
# age must be zero or positive, may be in future, or error is thrown
## Not run:
age_from_dates("2120-10-10", "2119-01-01")

## End(Not run)
# leap days work: we are just using internal R date manipulation
age_from_dates("2000-02-28", "2000-03-01", unit = "day")
age_from_dates("2004-02-28", "2004-03-01", unit = "day")
age_from_dates("1900-02-28", "1900-03-01", unit = "day")
age_from_dates("1901-02-28", "1901-03-01", unit = "day")
```

---

age_m_to_y *Calculate age in years from other units*

Description

Calculate age in years from other units

Usage

```
age_m_to_y(age_m)

age_d_to_y(age_d)

age_d_to_m(age_d)
```

Arguments

age_m	Months
age_d	Days

Examples

```
age_m_to_y(12)
age_m_to_y(1)
```

`alveolar_PAO2_mmHg` *alveolar gas equation*

Description

Estimate PAO2 in alveolus based on atmospheric pressure, fraction of oxygen in inspired air, partial pressure of carbon dioxide in the alveolus, and the respiratory quotient

Usage

```
alveolar_PAO2_mmHg(fi_o2 = 0.209, rq = 0.8, PACO2_mmHg = 40,
  Patm_mmHg = 760, PAH2O_mmHg = 47)
```

Arguments

`fi_o2`	fraction of oxygen in inspired gas, from 0 to 1, default reflects (dry) room air
`rq`	respiratory quotient, i.e., the ratio of CO2 produced to oxygen consumed, usually between around 0.7 and 1.0, but can legitimately be greater than 1.0. Default it 0.8.
`PACO2_mmHg`	partial pressure of CO2 in alveolus, which can be roughly approximated as the end-tidal pCO2
`Patm_mmHg`	atmospheric pressure in kPa
`PAH2O_mmHg`	partial pressure of water vapor at sea level, defaults to 6.25 kPa (47 mmHg) which is appropriate for body temperature

See Also

Other respiratory: `deadspace_total`

Examples

```
# vary RQ
rq <- seq(0.6, 1.4, 0.05)
plot(rq, alveolar_PAO2_mmHg(rq = rq))

# 100% fi_o2 at typical atmospheric pressure
alveolar_PAO2_mmHg(fi_o2 = 1)

# hyperbaric oxygen at 100%, 2 atmospheres
alveolar_PAO2_mmHg(fi_o2 = 1, Patm_mmHg = 1520)
```

`blood_vol_Nadler` *Estimate Blood Volume*

Description

estimate blood volume according to the classic 1960s paper by Nadler. Surgery. 1962 Feb;51(2):224-32. Prediction of blood volume in normal human adults. Nadler SB, Hidalgo JH, Bloch T.

This effectively reverses engineers an ideal weight from BMI of 22, then use the square root of its ratio to actual body weight to adjust the 70ml per kg of an ideal weight person. Age-dependent regression equations for indexed blood volume `InBV` at ideal body weight. (No adjustment made in obesity by Lemmens.) `InBV = 90-0.4 X age` (males) `InBV = 85-0.4 X age` (females).

applies to slim adults, but note that the age-related decline is not seen if high degree of physical activity is maintained. TODO: check BMI not elevated

Usage

```
blood_vol_Nadler(height_m, weight_kg, male, ...)

blood_vol_Lemmens_sedentary(height_m, weight_kg, ...)

blood_vol_Lemmens_indexed(height_m, weight_kg, ...)

blood_vol_Lemmens_non_obese(weight_kg, age_y, male, ...)
```

Arguments

`height_m`	single numeric, height in meters
`weight_kg`	numeric vector of weight(s) in kg
`male`	logical
`...`	arguments passed to downstream functions, e.g. `warn = TRUE`
`age_y`	numeric vector, age(s) in years. Extremely exact age is not required, so for age in days or months, simplest just to divide. This is not used in the calculation itself, so may be missing.

Value

numeric vector

References

'Davy KP, Seals DR. Total blood volume in healthy young and older men. J Appl Physiol 1994; 76: 2059-62'

'Parker-Jones P, Davy KP, DeSouza CA et al. Absence of age-related decline in total blood volume in physically active females. Am J Physiol 1997; 272: H2534-40'

Examples

```
blood_vol_Nadler(1.8, 80, male = TRUE)
blood_vol_Nadler(1.8, 160, male = TRUE)
blood_vol_Nadler(1.8, 80, male = FALSE)
blood_vol_Lemmens_sedentary(1.8, 80)
blood_vol_Lemmens_sedentary(1.8, 160)
blood_vol_Lemmens_indexed(1.8, 80)
blood_vol_Lemmens_indexed(1.8, 160)
  blood_vol_Lemmens_non_obese(80, age_y = 25, male = TRUE)
  blood_vol_Lemmens_non_obese(80, age_y = 75, male = TRUE)
```

---

bmi_adult *Body Mass Index (BMI) for adults*

Description

Calculate body mass index using weight in kg / (height in meters ^ 2)

Usage

```
bmi_adult(height_m, weight_kg, ...)

bmi_adult_ins_lbs(heightin, weightlb, ...)
```

Arguments

height_m	single numeric, height in meters
weight_kg	numeric vector of weight(s) in kg
...	passed to validation
heightin	height in inches
weightlb	weight in pounds

Examples

```
bmi_adult(1.6, 120)
bmi_adult(2, 75)
bmi_adult_ins_lbs(72, 200)
```

bsa *Estimate body surface area*

Description

Estimate body surface area (BSA)

Usage

```
bsa_adult(height_m, weight_kg, ...)

bsa_dubois_dubois(height_m, weight_kg, ...)

bsa_mosteller(height_m, weight_kg, ...)

bsa_haycock(height_m, weight_kg, ...)

bsa_gehan_george(height_m, weight_kg, ...)

bsa_boyd(height_m, weight_kg, ...)

bsa_fujimoto(height_m, weight_kg, ...)

bsa_takahira(height_m, weight_kg, ...)

bsa_shuter_aslani(height_m, weight_kg, ...)

bsa_schlich(height_m, weight_kg, male, ...)
```

Arguments

height_m	height(s) in meters
weight_kg	numeric vector of weight(s) in kg
...	passed to validation
male	logical value(s) whether patient is male. TRUE or FALSE.

Details

1.73 m^2 is commonly used as an average adult BSA.

Value

numeric vector of body surface areas in m^2.

Functions

- `bsa_adult`: Uses ‘bsa_mosteller()‘
- `bsa_dubois_dubois`: Du Bois and Du Bois formula (usually the preferred formula for adults and children)
- `bsa_mosteller`: Mosteller formula
- `bsa_haycock`: Haycock formula
- `bsa_gehan_george`: Gehan and George formula
- `bsa_boyd`: Boyd formula
- `bsa_fujimoto`: Fujimoto formula (often used for Japanese individuals)
- `bsa_takahira`: Takahira formula (a variant of Du Bois that could be used for Japanese individuals; Fujimoto may be preferred)
- `bsa_shuter_aslani`: Shuter and Aslani formula
- `bsa_schlich`: Schlich formula

References

Du Bois D, Du Bois EF (Jun 1916). "A formula to estimate the approximate surface area if height and weight be known". Archives of Internal Medicine. 17 (6): 863–71.

Mosteller, RD (1987). "Simplified calculation of body-surface area". N Engl J Med. 317 (17): 1098. https://www.ncbi.nlm.nih.gov/pubmed/3657876

Haycock, GB, Schwartz, GJ, Wisotsky, DH (1978). Geometric method for measuring body surface area: A height-weight formula validated in infants, children and adults. J Pediatr. 93: 62–66.

Gehan EA, George SL, Cancer Chemother Rep 1970, 54:225-235

Boyd, Edith (1935). The Growth of the Surface Area of the Human Body. University of Minnesota. The Institute of Child Welfare, Monograph Series, No. x. London: Oxford University Press.

Fujimoto S, Watanabe T, Sakamoto A, Yukawa K, Morimoto K. Studies on the physical surface area of Japanese. 18. Calculation formulae in three stages over all ages. Nippon Eiseigaku Zasshi 1968;5:443–50.

Fujimoto S, Watanabe T, Sakamoto A, Yukawa K, Morimoto K. Studies on the physical surface area of Japanese. 18. Calculation formulae in three stages over all ages. Nippon Eiseigaku Zasshi 1968;5:443–50.

Shuter, B; Aslani, A (2000). "Body surface area: Du Bois and Du Bois revisited". European Journal of Applied Physiology. 82 (3): 250–254.

Schlich, E; Schumm, M; Schlich, M (2010). "3-D-Body-Scan als anthropometrisches Verfahren zur Bestimmung der spezifischen Körperoberfläche". Ernährungs Umschau. 57: 178–183.

Examples

```
bsa_dubois_dubois(2, 80)
bsa_dubois_dubois(1.5, 80)
stopifnot(
  identical(
    bsa_mosteller(1.5, 80),
    bsa_adult(1.5, 80)))
```

creatinine_mgdl_to_uM *Convert serum creatinine from mg/dL to umol/L*

Description

Convert serum creatinine from mg/dL to umol/L

Usage

```
creatinine_mgdl_to_uM(scr_mgdl, ...)
```

Arguments

scr_mgdl	Serum creatinine in mg/dL units
...	passed to validation

Details

Validation is performed after unit conversion. The result is more precise than the typical conversion used of `1 mg/dL = 88.4 umol/L`.

Value

Serum creatinine in umol/L units

References

Molecular weight is 113.12 g/mol from https://pubchem.ncbi.nlm.nih.gov/compound/creatinine

See Also

egfr

Other renal: egfr

deadspace_equipment_ml *Calculate equipment deadspace in ventilator breathing circuit*

Description

There are minor brand variations between these airway devices. For the purposes of rough physiologic calculations, this function gives values based on real, widely-used equipment.

Usage

```
deadspace_equipment_ml(humidifier = c("adult", "infant", "none"),
  elbow = TRUE, flexible = c("none", "compressed", "extended"),
  min = 0)
```

Arguments

humidifier	Single value, if TRUE, the default, then we assume the adult humidifier. If humidifier is set to the character string "adult", the results is the same as for TRUE. Alternatively, "infant" refers to the lower volume, higher resistance device.
elbow	Single logical value, default is TRUE
flexible	Single logical value or character string. If FALSE, the default, no additional flexible tubing is added. If TRUE, the volume of typical extended flexible tubing is added. If "compressed" or "extended" are given, the volume of flexible tubing in the given state is used.
min	numeric, giving the minimum number of obligatory milliliters of deadspace. The default is zero to allow calculation of additional airway elements.

See Also

deadspace_things_ml

Examples

```
deadspace_equipment_ml()
deadspace_equipment_ml(humidifier = FALSE)
deadspace_equipment_ml(humidifier = "infant", elbow = TRUE)
deadspace_equipment_ml(flexible = "extended", elbow = FALSE)
deadspace_equipment_ml(flexible = "extended", elbow = TRUE)
```

---

deadspace_total *Estimate ventilation dead-space*

Description

Estimate ventilation dead-space

Usage

```
deadspace_total(ideal_weight_kg, age_y = NULL, elbow_ml = 10,
  humidifier_ml = 7, ett_diameter_mm = NULL)

deadspace_anatomic(ideal_weight_kg, age_y = NULL)

deadspace_anatomic_adult(ideal_weight_kg = NULL)
```

```
deadspace_anatomic_child(ideal_weight_kg, age_y = NULL)

deadspace_intrathoracic_ml(ideal_weight_kg)
```

Arguments

ideal_weight_kg	Ideal weight in kilograms. May be calculated using ideal_weight_adult or ideal_weight_child
age_y	Age in years, optional for estimating ETT and HME sizes automatically
elbow_ml	Numeric volume of elbow of breathing circuit in ml
humidifier_ml	Numeric volume of humidifier of breathing circuit in ml
ett_diameter_mm	Numeric internal diameter of endotracheal tube. Default is NULL which would estimate this from the age of patient

Details

'Mean intrathoracic anatomic dead space was 1.03 ml/kg and was not related to age.' Numa, 1985

Value

estimate of anatomic dead-space in ml

Functions

- deadspace_anatomic: Estimate anatomic dead-space
- deadspace_anatomic_adult: Estimate anatomic dead-space in an adult
- deadspace_anatomic_child: Estimate anatomic dead-space in an infant or child
- deadspace_intrathoracic_ml: intrathoracic component of dead-space is age independent

References

http://www.atsjournals.org/doi/abs/10.1164/arrd.1971.104.2.215 http://rc.rcjournal.com/content/53/7/885.short https://www.ncbi.nlm.nih.gov/pubmed/8727530

See Also

Other respiratory: alveolar_PAO2_mmHg

Other airway equipment: deadspace_things_ml, ett_size_by_age, ett_vol_ml

Examples

```
  height <- seq(1, 2, 0.05)
  male <- rep(FALSE, length(height))
  iw <- ideal_weight_adult(height_m = height, male = male)
  ## Not run:
  plot(iw, deadspace_anatomic_adult(ideal_weight_kg = height))

## End(Not run)

  # discontinuity at age 6 is driven by ideal weight more than the
  # lograithmic calculation
  iw <- c(seq(12, 18, 0.2), seq(18.5, 24, 0.5))
  youngest = 3
  oldest = 9
  ages <- seq(youngest, oldest, (oldest - youngest) / (length(iw) - 1))
  ## Not run:
  plot(iw, deadspace_anatomic_child(ideal_weight_kg = iw, age_y = ages),
       type = "l")

## End(Not run)
```

---

egfr *Automatically select the best equation to use for estimated glomerular filtration rate (eGFR) calculation.*

Description

Automatically select the best equation to use for estimated glomerular filtration rate (eGFR) calculation.

Usage

```
egfr(scr_uM, age_y, height_m, male, black, ...)

egfr_cockcroft_gault(scr_uM, age_y, weight_kg, male, idms_assay = TRUE,
  ...)

egfr_mdrd(scr_uM, age_y, male, black, idms_assay = TRUE, ...,
  warn_ckdepi_preferred = TRUE)

egfr_ckdepi(scr_uM, age_y, male, black, idms_assay = TRUE, ...,
  warn_mdrd_preferred = TRUE)

egfr_bedside_schwartz(scr_uM, height_m, idms_assay = TRUE, ...)
```

Arguments

scr_uM	Serum creatinine (in micromoles/L, or 'uM').
age_y	Age in years
height_m	Height in meters
male	Logical, TRUE (male) or FALSE (female)
black	Logical, TRUE (race is Black (African-American in USA) or FALSE
...	passed to subsequent GFR methods (for egfr) or validation (for other functions)
weight_kg	numeric vector of weight(s) in kg
idms_assay	Was an isotope dilution mass spectrometry (IDMS) calibrated assay used for serum creatinine measurement?
warn_ckdepi_preferred	When calculating eGFR > 60, should a warning be generated suggesting CKD-EPI is preferred?
warn_mdrd_preferred	When calculating eGFR < 60, should a warning be generated suggesting MDRD is preferred?

Details

GFR estimation is not recommended or validated for individuals with unstable creatinine concentration (including pregnancy, serious comorbid conditions, hospitalized patients, patients with acute renal failure) or extremes in muscle mass and diet (including amputees, paraplegics, bodybuilders, or obese patients; or vegetarians or when taking creatine dietary supplements). For more details, please refer to the NIDDK summary on estimating GFR: https://www.niddk.nih.gov/health.

The main function (egfr) automatically selects the best method for eGFR calculation based on the following metrics:

* If age_y < 18, use the Bedside Schwartz equation. * If age_y >= 18: * Estimate eGFR by the MDRD and CKD-EPI methods * If eGFR,MDRD is estimated < 60 mL/min/1.73 m^2 and eGFR,CKD-EPI < 60, return eGFR,MDRD. * If eGFR,MDRD is estimated >= 60 mL/min/1.73 m^2 and eGFR,CKD-EPI >= 60, return eGFR,CKD-EPI. * Otherwise, return the average of eGFR,MDRD and eGFR,CKD-EPI.

If an IDMS - calibrated assay is used (idms_assay = TRUE), the MDRD equation will be corrected for the assay by approximately 6 equation is only validated for use with IDMS - calibrated assays, and the Cockcroft - Gault is not calibrated for use with an IDMS - calibrated assay. Most labs follow the National Kidney Disease Education Program (NKDEP) recommendation to use an IDMS - calibrated assay, so by default idms_assay = TRUE.

Value

A vector of estimated glomerular filtration rates with units of mL/min/1.73 m^2 (except that the units are mL/min for egfr_cockcroft_gault.

Functions

- `egfr_cockcroft_gault`: The Cockcroft - Gault equation for eGFR (not preferred).
- `egfr_mdrd`: The MDRD equation for eGFR (preferred for adults with eGFR < 60).
- `egfr_ckdepi`: The CKD-EPI equation for eGFR (preferred for adults with eGFR >= 60).
- `egfr_bedside_schwartz`: The Bedside Schwartz equation for eGFR (for children, age less than 18 years).

References

Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, 3rd, Feldman HI, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150(9):604-12.

Levey AS, Coresh J, Greene T, Stevens LA, Zhang YL, Hendriksen S, Kusek JW, Van Lente F; Chronic Kidney Disease Epidemiology Collaboration. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. Ann Intern Med. 2006 Aug 15;145(4):247-54.

Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. Nephron. 1976;16(1):31-41.

https://www.niddk.nih.gov/health

Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, 3rd, Feldman HI, et al. A new equation to estimate glomerular filtration rate. Ann Intern Med. 2009;150(9):604-12.

Levey AS, Coresh J, Greene T, Stevens LA, Zhang YL, Hendriksen S, Kusek JW, Van Lente F; Chronic Kidney Disease Epidemiology Collaboration. Using standardized serum creatinine values in the modification of diet in renal disease study equation for estimating glomerular filtration rate. Ann Intern Med. 2006 Aug 15;145(4):247-54.

https://www.niddk.nih.gov/health

Schwartz GJ, et al. New equations to estimate GFR in children with CKD. J Am Soc Nephrol. 2009;20:629-637.

Schwartz GJ and Work DF. Measurement and estimation of GFR in children and adolescents. Clin J Am Soc Nephrol. 2009;4(11):1832-43.

See Also

`creatinine_mgdl_to_uM`

Other renal: `creatinine_mgdl_to_uM`

Other renal: `creatinine_mgdl_to_uM`

Other renal: `creatinine_mgdl_to_uM`

Other renal: `creatinine_mgdl_to_uM`

Other renal: `creatinine_mgdl_to_uM`

ett_size_by_age *Estimate appropriate size of endotracheal tube for infants and children*

Description

ett_size_cole uses the classic Cole formula for uncuffed tubes, Motoyama formula for cuffed tubes with age over two years, and the Khine formula for cuffed tubes with age under two years. All of these, as any anesthesiologist will tell, give poor estimates at any extreme of age, or height. These formulae are for use in pediatric practice only.

Usage

```
ett_size_by_age(age_y, cuffed = TRUE)
```

Arguments

age_y	numeric vector
cuffed	logical vector, single value, or a vector of the same length as the given age vector, defining whether the desired tube is to be cuffed. If not specified, then it is assumed that a cuffed tube is used.

Value

ETT size, internal diameter in mm, rounded to nearest half-mm size up to 6mm, then the nearest integer.

References

http://anesthesiology.pubs.asahq.org/Article.aspx?articleid=1933172

See Also

Other airway equipment: deadspace_things_ml, deadspace_total, ett_vol_ml

Examples

```
teenagers <- ett_size_by_age(13:18)
plot(13:18, teenagers,
  main = "This formula for ETT tube size overestimates tube
  sizes of teenagers, and takes no account of gender")
lines(13:18, teenagers)
ages <- c(1/12, 1, 2, 4, 7, 11)
neonate_to_child <- ett_size_by_age(age = ages)
names(neonate_to_child) <- ages
print(neonate_to_child)
plot(ages, neonate_to_child)
lines(ages, neonate_to_child)
plot(ages, neonate_to_child, log = "x")
lines(ages, neonate_to_child)
```

ett_vol_ml *Estimate volume inside an endotracheal tube*

Description

Calculations are based on standard endotracheal tubes. The volume is estimated as the cylinder of the given diameter and typical length of a tube of given size.

Usage

```
ett_vol_ml(diameter_mm)
```

Arguments

diameter_mm	The internal diameter of the endotracheal tube in millimeters. Sizes between 2.0 and 8 are offered. Half sizes between 2.5 and 6 are accepted.

Value

Volumes of each given ETT in cubic millimeters

See Also

Other airway equipment: deadspace_things_ml, deadspace_total, ett_size_by_age

Examples

```
ett_vol_ml(2:8)
plot(2:8, ett_vol_ml(2:8))
lines(2:8, ett_vol_ml(2:8),
  xlab = "ETT internal diameter, mm",
  ylab = "ETT internal volume, mm^3")
(vols_cm3 <- ett_vol_ml(seq(2, 6, 0.5)) / 1000)

# Ages through to ETT internal volume
ett_vol_ml(ett_size_by_age(1:10))
```

french_to_diameter_mm *French to diameter*

Description

Convert French size of a catheter to diameter in mm. Currently accepts or returns non-integer French values

Usage

```
french_to_diameter_mm(x)

diameter_mm_to_french(x)
```

Arguments

x	Size in French units, or mm

`henderson_hasselbalch` *pH by Henderson Hasselbalch equation*

Description

Calculate the pH based on bicarbonate and partial pressure of CO2

Usage

```
henderson_hasselbalch(bicarbonate, pp_co2)
```

Arguments

bicarbonate	mmol/L
pp_co2	partial pressure of carbon dioxide in mmHg

Examples

```
bicarbonate <- seq(10, 50, 5)
pp_co2 <- seq(20, 70, 10)
bc <- rep(bicarbonate, length(pp_co2))
pp <- rep(pp_co2, each = length(bicarbonate))
acidbase <- matrix(henderson_hasselbalch(bc, pp), nrow = 9, ncol = 6)
rownames(acidbase) <- paste("bicarb", bicarbonate)
colnames(acidbase) <- paste("PaCO2", pp_co2)
acidbase
```

`ideal_weight` *ideal weight for adults*

Description

`ideal_weight_adult` gives the ideal weight using default adult algorithm, Devine. If an age is specified and less than 18 years, the Traub function will be used.

Devine method is the default and most widely used. Normally stated in inches. Male: 50kg + 2.3kg * inches over 5ft. Female: 45.5kg + 2.3kg * inches over 5ft. (from 1974 genatamicin paper - see Lemmens for ref.)

Robinson's method for ideal weight: different linear relationship. (Robinson JD, Lupkiewicz SM, Palenik L et al. Determination of ideal body weight for drug dosage calculations. Am J Hosp Pharm 1983; 40: 1016-9.)

Miller's method for ideal weight: different linear relationship. (Miller DR, Carlson JD, Loyd BJ et al. Determining ideal body weight. (Letter). Am J Hosp Pharm 1983; 40: 1622.)

Calculate ideal weight based on Broca (1871) Height in cm -100 for women, -105 for men Broca PP. Memoires d'anthropologie. Paris 1871 / 1877.

Lemmens method assumes BMI 22 as ideal (Obesity Surgery 2005)

Usage

```
ideal_weight(height_m, ..., age_y = NULL, male = NULL)

ideal_weight_adult(height_m, male, ...)

ideal_weight_child(height_m, age_y = NULL, ...)

ideal_weight_Devine(height_m, male, ...)

ideal_weight_Robinson(height_m, male, ...)

ideal_weight_Miller(height_m, male, ...)

ideal_weight_Broca(height_m, male, ...)

ideal_weight_Lemmens(height_m, ...)
```

Arguments

`height_m`	single numeric, height in meters
`...`	arguments passed to downstream functions, e.g. `warn = TRUE`
`age_y`	numeric vector, age(s) in years. Extremely exact age is not required, so for age in days or months, simplest just to divide. This is not used in the calculation itself, so may be missing.
`male`	logical value(s) whether patient is male. TRUE or FALSE.

Functions

- `ideal_weight_adult`: Ideal weight of an adult
- `ideal_weight_child`: Ideal weight of a child, age >= 1 and age < 18 years

Examples

```
ideal_weight_adult(1.7, male = TRUE)
ideal_weight_adult(1.7, male = FALSE)
ideal_weight_adult(6 * 12 * 2.54 / 100, male = TRUE) # 6ft
suppressWarnings(ideal_weight_adult(5, male = FALSE))
```

`ideal_weight_Traub` *ideal weight for child per Traub*

Description

`2.396e0.01863(height)`, where height is in cm. There is an argument for using another package to capture durations, of which age is a special case. However, I am resisting bringing in external dependencies, and for almost all use-cases I can imagine, the age will be captured as a single number of one type, not a mix of types. Note that gender does not appear to be important in this relationship.

See package AGD for CDC growth chart data.

Usage

```
ideal_weight_Traub(height_m, age_y = NULL, ...)
```

Arguments

`height_m`	single numeric, height in meters
`age_y`	numeric vector, age(s) in years. Extremely exact age is not required, so for age in days or months, simplest just to divide. This is not used in the calculation itself, so may be missing.
`...`	arguments passed to downstream functions, e.g. `warn = TRUE`

Source

http://www.ncbi.nlm.nih.gov/pubmed/6823980

Examples

```
# will warn if given age is not in validate range from publication:
## Not run:
  ideal_weight_child(height_m = 0.5, age_y = 0, do_warn = TRUE)
  ideal_weight_child(0.8, age_y = 11 / 12, do_warn = TRUE)
  ideal_weight_child(0.5, age_y = 25/365, do_warn = TRUE)

## End(Not run)
  ideal_weight_child(0.5, age_y = 25 / 365, do_warn = FALSE)
  ideal_weight_child(1, age_y = 2)
```

is_adult *Is age >= 18 years*

Description

Is age >= 18 years

Usage

```
is_adult(age_y)
```

Arguments

age_y	Numeric vector of age in years. Bear in mind that age is not handled with extreme precision, since it is only used for approximating physiologic characteristics.

Pa_to_torr *Conversion factor from Pa to torr (mmHg)*

Description

The conversion is exactly 760 / 101325

Usage

```
Pa_to_torr
```

Format

An object of class `numeric` of length 1.

See Also

Other physics: `pres_atm_kPa`, `svp_sea_level`, `temp_c_to_k`

pres_atm_kPa *Get mean atmospheric pressure at given altitude in kPa*

Description

Get mean atmospheric pressure at given altitude in kPa

Usage

```
pres_atm_kPa(altitude_m)

pres_atm_frac(altitude_m)
```

Arguments

altitude_m	Altitude above mean sea level in meters

Value

Pressure in pascals

Functions

- pres_atm_frac: Get fraction of mean atomspheric pressure at sea level

References

Below 51 km: Practical Meteorology by Roland Stull, pg 12. Above 51 km: http://www.braeunig.us/space/atmmodel.htm Validation data: https://www.avs.org/AVS/files/c7/c7edaedb-95b2-438f-adfb-36de54f8pdf

See Also

Other physics: Pa_to_torr, svp_sea_level, temp_c_to_k

Examples

```
pres_atm_kPa(-430.5) # Dead Sea
pres_atm_kPa(0)
pres_atm_kPa(3440) # Namche Bazaar
pres_atm_kPa(4260) # Dingboche
pres_atm_kPa(5364) # Everest Base Camp
pres_atm_kPa(6000) # Camp 1
pres_atm_kPa(6400) # Camp 2
pres_atm_kPa(7200) # Camp 3
pres_atm_kPa(7950) # Camp 4
pres_atm_kPa(8850) # Everest summit
pres_atm_frac(8850) # fraction of sea level pressure on Everest
```

svp_sea_level *Saturation vapor pressure of water at sea level*

Description

Saturation vapor pressure of water at sea level

Usage

```
svp_sea_level(temp_k)
```

Arguments

temp_k	Temperature in Kelvin

See Also

Other physics: Pa_to_torr, pres_atm_kPa, temp_c_to_k

temp_c_to_k *Temperature in Kelvin from Celsius*

Description

Temperature in Kelvin from Celsius

Usage

```
temp_c_to_k(temp_c)
```

Arguments

temp_c	Temperature in Celsius

See Also

Other physics: Pa_to_torr, pres_atm_kPa, svp_sea_level

valid_height *Validate physiologic input parameters*

Description

User may generate warnings for unreasonable or obviously erroneous heights.

Usage

```
valid_height(height_m, ht_min = 0.1, ht_max = 2.5,
  ht_min_hard = 0.001, ht_max_hard = 3, extra_msg = "",
  do_warn = TRUE, do_stop = FALSE, equal_ok = FALSE)

valid_height_adult(height_m, ht_min = 0.5, ht_max = 2.5,
  ht_min_hard = 0.001, ht_max_hard = 3, extra_msg = "",
  do_warn = TRUE, do_stop = FALSE, equal_ok = FALSE)

valid_weight(weight_kg, wt_min = 0.1, wt_max = 300, wt_min_hard = 0,
  wt_max_hard = 600, extra_msg = "", do_warn = TRUE,
  do_stop = FALSE, equal_ok = FALSE)

valid_weight_adult(weight_kg, wt_min = 5, wt_max = 300,
  wt_min_hard = 0, wt_max_hard = 600, extra_msg = "",
  do_warn = TRUE, do_stop = FALSE, equal_ok = FALSE)

valid_age(age_y, age_min = 0, age_max = 150, age_min_hard = 1e-05,
  age_max_hard = 150, extra_msg = "", do_warn = TRUE,
  do_stop = FALSE, equal_ok = FALSE)

valid_age_adult(age_y, age_min = 18, age_max = 150,
  age_min_hard = 17, age_max_hard = 150, extra_msg = "",
  do_warn = TRUE, do_stop = FALSE, equal_ok = FALSE)

valid_creatinine(scr_uM, scr_min = 8, scr_max = 1000,
  scr_min_hard = 0, scr_max_hard = 4000, extra_msg = "",
  do_warn = TRUE, do_stop = FALSE, equal_ok = FALSE)
```

Arguments

height_m	single numeric, height in meters
ht_min	minimum height below which to warn if warn = TRUE
ht_max	maximum height above which to warn if warn = TRUE
ht_min_hard	minimum height below which to warn regardless of warn
ht_max_hard	maximum height above which to warn if warn
extra_msg	single character string with additional message to append, default is ""

do_warn	single logical, if TRUE, will give warnings outside of soft limits
do_stop	single logical, stop instead of warning if any values outside hard limits
equal_ok	logical, if true, then being equal to a limit does not trigger a warning or error
weight_kg	numeric vector of weight(s) in kg
wt_min	minimum height below which to warn if warn = TRUE
wt_max	maximum height above which to warn if warn = TRUE
wt_min_hard	minimum height below which to warn regardless of warn
wt_max_hard	maximum height above which to warn if warn
age_y	numeric years
age_min	minimum age below which to warn if warn = TRUE
age_max	maximum age above which to warn if warn = TRUE
age_min_hard	minimum age below which to warn regardless of warn
age_max_hard	maximum age above which to warn if warn
scr_uM	numeric serum creatinine (umol/L)
scr_min	minimum serum creatinine below which to warn if warn = TRUE
scr_max	maximum serum creatinine above which to warn if warn = TRUE
scr_min_hard	minimum serum creatinine below which to warn regardless of warn
scr_max_hard	maximum serum creatinine above which to warn if warn

Index