

Package ‘WHORiskCalculator’

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Title WHO Cardiovascular Disease Risk Calculator

Version 1.0.0

Description Implements the 2019 World Health Organization (WHO) cardiovascular disease (CVD) risk prediction models, as described in Kaptoge et al. (2019) [doi:10.1016/S2214-109X\(19\)30318-3](https://doi.org/10.1016/S2214-109X(19)30318-3). Provides two validated models for estimating 10-year risk of fatal and non-fatal cardiovascular events (myocardial infarction and stroke): a laboratory-based model using age, sex, systolic blood pressure, total cholesterol, smoking status, and diabetes history; and a non-laboratory-based model substituting body mass index (BMI) for cholesterol and diabetes, suitable for resource-limited settings. Risk estimates are recalibrated to 21 Global Burden of Disease regions using region-specific incidence rates and risk factor distributions derived from the Emerging Risk Factors Collaboration. Functions are fully vectorized for efficient batch calculations and support automatic country-to-region mapping via ISO 3166-1 alpha-3 country codes.

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Contents

calculate_who_risk	2
------------------------------	---

calculate_who_risk_nonlab	4
country_to_region	6
get_country_codes	6
get_regions	7

Index	8
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calculate_who_risk	<i>Calculate WHO 10-Year CVD Risk (Laboratory-Based Model)</i>
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Description

Calculates the 10-year risk of cardiovascular disease (fatal and non-fatal myocardial infarction and stroke) using the WHO laboratory-based model. This model requires total cholesterol measurement.

Usage

```
calculate_who_risk(
  age,
  sex,
  sbp,
  cholesterol,
  smoking,
  diabetes,
  region = NULL,
  country = NULL
)
```

Arguments

age	Numeric vector. Age in years (valid range: 40-80).
sex	Character vector. Sex: "male" or "female".
sbp	Numeric vector. Systolic blood pressure in mmHg.
cholesterol	Numeric vector. Total cholesterol in mmol/L. To convert from mg/dL to mmol/L, divide by 38.67.
smoking	Logical vector. Current smoking status (TRUE = current smoker).
diabetes	Logical vector. History of diabetes (TRUE = diabetic).
region	Character vector. WHO/GBD region name. One of the 21 global regions (see get_regions for valid values). If NULL and country is provided, region will be determined automatically.
country	Character vector. ISO 3166-1 alpha-3 country code (e.g., "USA", "GBR", "IND"). Used to determine region if region is NULL. See get_country_codes for valid values.

Details

The model uses Cox proportional hazards regression with the following predictors:

- Age (with interactions for all other predictors)
- Total cholesterol
- Systolic blood pressure
- Diabetes status
- Current smoking status

Risk is calculated separately for myocardial infarction/CHD death and stroke, then combined assuming independence of the two outcomes:

$$P_{CVD} = 1 - (1 - P_{MI}) \times (1 - P_{stroke})$$

The model is recalibrated to region-specific incidence rates and mean risk factor levels from the Global Burden of Disease study.

Value

Numeric vector of 10-year CVD risk as a proportion (0-1). Multiply by 100 to get percentage.

Centering Values

Variables are centered at:

- Age: 60 years
- Systolic blood pressure: 120 mmHg
- Total cholesterol: 6 mmol/L

See Also

[calculate_who_risk_nonlab](#) for the non-laboratory-based model, [get_regions](#) for available regions, [get_country_codes](#) for country code lookup.

Examples

```
# Single calculation
calculate_who_risk(
  age = 55,
  sex = "male",
  sbp = 140,
  cholesterol = 5.5,
  smoking = TRUE,
  diabetes = FALSE,
  region = "western_europe"
)

# Using country code instead of region
calculate_who_risk(
```

```

age = 60,
sex = "female",
sbp = 130,
cholesterol = 6.0,
smoking = FALSE,
diabetes = TRUE,
country = "ITA"
)

# Vectorized calculation
calculate_who_risk(
  age = c(45, 55, 65),
  sex = c("male", "female", "male"),
  sbp = c(120, 140, 160),
  cholesterol = c(5.0, 6.0, 7.0),
  smoking = c(FALSE, TRUE, FALSE),
  diabetes = c(FALSE, FALSE, TRUE),
  country = c("USA", "GBR", "IND")
)

```

```
calculate_who_risk_nonlab
```

Calculate WHO 10-Year CVD Risk (Non-Laboratory-Based Model)

Description

Calculates the 10-year risk of cardiovascular disease using the WHO non-laboratory-based model. This model uses BMI instead of cholesterol and does not require diabetes status, making it suitable for resource-limited settings where laboratory testing may not be available.

Usage

```

calculate_who_risk_nonlab(
  age,
  sex,
  sbp,
  bmi,
  smoking,
  region = NULL,
  country = NULL
)

```

Arguments

age	Numeric vector. Age in years (valid range: 40-80).
sex	Character vector. Sex: "male" or "female".
sbp	Numeric vector. Systolic blood pressure in mmHg.

bmi	Numeric vector. Body mass index in kg/m ² .
smoking	Logical vector. Current smoking status (TRUE = current smoker).
region	Character vector. WHO/GBD region name. One of the 21 global regions (see get_regions for valid values). If NULL and country is provided, region will be determined automatically.
country	Character vector. ISO 3166-1 alpha-3 country code.

Details

This model is designed for use in resource-limited settings where laboratory measurements (cholesterol, glucose) may not be readily available. It uses BMI as a proxy for metabolic risk.

Important limitations:

- The non-laboratory model tends to underestimate risk in people with diabetes because diabetes is a strong predictor not included in this model.
- For individuals identified as high risk (>10%) by this model, laboratory-based assessment is recommended.

Value

Numeric vector of 10-year CVD risk as a proportion (0-1).

Centering Values

Variables are centered at:

- Age: 60 years
- Systolic blood pressure: 120 mmHg
- BMI: 25 kg/m²

See Also

[calculate_who_risk](#) for the laboratory-based model.

Examples

```
# Single calculation
calculate_who_risk_nonlab(
  age = 55,
  sex = "male",
  sbp = 140,
  bmi = 28,
  smoking = TRUE,
  region = "south_asia"
)

# Using country code
calculate_who_risk_nonlab(
  age = 60,
```

```
sex = "female",
sbp = 135,
bmi = 26,
smoking = FALSE,
country = "KEN"
)
```

country_to_region *Map Country Code to Region*

Description

Utility function to map ISO 3166-1 alpha-3 country codes to WHO/GBD regions.

Usage

```
country_to_region(country)
```

Arguments

country Character vector of ISO 3166-1 alpha-3 country codes.

Value

Character vector of region names.

Examples

```
country_to_region(c("USA", "DEU", "JPN"))
```

get_country_codes *Get Country Code to Region Mapping*

Description

Returns a named vector mapping ISO 3166-1 alpha-3 country codes to their corresponding WHO/GBD regions.

Usage

```
get_country_codes(country = NULL)
```

Arguments

country Optional character vector of country codes to look up. If NULL (default), returns the complete mapping.

Value

If country is NULL, returns a named character vector where names are country codes and values are region names. If country is provided, returns the corresponding region(s).

Examples

```
# Get all mappings
head(get_country_codes())

# Look up specific countries
get_country_codes(c("USA", "GBR", "IND"))
```

get_regions

Get Available Region Names

Description

Returns a character vector of valid WHO/GBD region names that can be used with the risk calculation functions.

Usage

```
get_regions()
```

Value

Character vector of 21 GBD region names.

Examples

```
get_regions()
```

Index

`calculate_who_risk`, [2](#), [5](#)
`calculate_who_risk_nonlab`, [3](#), [4](#)
`country_to_region`, [6](#)

`get_country_codes`, [2](#), [3](#), [6](#)
`get_regions`, [2](#), [3](#), [5](#), [7](#)