# Package: WHORiskCalculator (via r-universe)

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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>. 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



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`calculate_who_risk` *Calculate WHO 10-Year CVD Risk (Laboratory-Based Model)*

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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")
)
```

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`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/m². |
| 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"
)
```

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`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()
```

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