Package 'mapnhanespa'

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Title Map Quantiles for Physical Activity from 'NHANES'

Version 0.4.0

Description Maps physical activity from the National Health and Nutrition Examination Survey ('NHANES') study into population-based quantiles, using the NHANES 2011-2014 step count and physical activity summaries described in Koffman, Crainiceanu, and Muschelli (2025) <doi:10.1249/MSS.0000000000003616>, with minute-level data from Koffman and Muschelli (2025) <doi:10.13026/9n0r-tv02>.

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Encoding UTF-8

Depends R (>= 4.1.0)

LazyData true

LazyDataCompression xz

URL https://github.com/jhuwit/mapnhanespa

BugReports https://github.com/jhuwit/mapnhanespa/issues

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VignetteBuilder knitr

Imports dplyr, purrr, survey

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`map_nhanes_pa_quantiles` *Map physical activity values to NHANES population quantiles*

Description

`map_nhanes_pa_quantiles()` adds a population-level quantile column and the NHANES age category used for each row to a participant-level data frame. Quantiles are evaluated from NHANES accelerometer cumulative distribution functions stratified by age category, sex/gender, measure, and optionally survey wave. Accepted measure names and their CDF summaries are listed by `nhanes_pa_measure_map()`. Unmapped names return missing quantiles and are listed in a warning.

Usage

```
map_nhanes_pa_quantiles(
  data,
  id = NULL,
  age = "age",
  sex = "sex",
  measure = "measure",
  value = "value",
  wave = NULL,
  age_category = NULL,
  quantile_col = "nhanes_quantile",
  min_wear_minutes = 1368,
  min_valid_days = 3
)
```

Arguments

`data`	A data frame with one row per participant-measure observation.
`id`	Optional participant identifier column name. The column is checked when supplied, but otherwise left unchanged.

`age`, `sex`, `measure`, `value`
: Column names in `data` containing age in years, sex/gender, physical activity measure, and observed value. Set `age = NULL` to use the age-overall CDFs. Set `sex = NULL` to use the sex/gender-overall CDFs. Setting both to `NULL` uses the overall CDF across both dimensions.

`wave`
: Optional NHANES wave column name or scalar value. Supported values are `7`, `8`, `"2011-2012"`, and `"2013-2014"`. If `NULL`, the combined wave CDFs are used.

`age_category`
: Optional column name containing NHANES age categories such as `"[20,30)"` or `"Overall"`. When supplied, it is used instead of `age`.

`quantile_col`
: Name of the output quantile column.

`min_wear_minutes`, `min_valid_days`
: Accelerometer wear-time inclusion criterion for the NHANES reference population: the minimum minutes of wear for a valid day (`600`, `960`, `1296`, `1368`, or `1440`) and the minimum number of valid days (`1`, `3`, or `4`). The defaults (`1368` minutes, `3` days) use nhanes_measure_data and give the same results as earlier versions of the package. Other values use the matching criterion in nhanes_measure_data_wear_criteria, with survey weights adjusted for that criterion. Choose the criterion that matches the inclusion rules applied to `data`. See `nhanes_pa_wear_criteria()`.

Value

`data` with an added quantile column and `age_category_pa_map`, the NHANES age category used to select the CDF. The category is `"Overall"` when `age = NULL` and is taken directly from `age_category` when supplied.

Examples

```
example_data <- data.frame(
  id = 1:2,
  age = c(25, 62),
  sex = c("Female", "Male"),
  measure = c("mims", "ssl_steps"),
  value = c(15000, 7500)
)

map_nhanes_pa_quantiles(example_data)

map_nhanes_pa_quantiles(example_data, sex = NULL)

map_nhanes_pa_quantiles(example_data, age = NULL, wave = "2011-2012")
map_nhanes_pa_quantiles(example_data, age = NULL, sex = NULL)

# NHANES reference built with a 10-hour, 4-day wear criterion
map_nhanes_pa_quantiles(example_data, min_wear_minutes = 600,
                        min_valid_days = 4)
```

`nhanes_measure_data` *NHANES PA data*

Description

NHANES PA data

Usage

```
nhanes_measure_data
```

Format

A data frame with 87619 rows and 9 variables:

SEQN ID variable

data_release_cycle wave/data release cycle

cat_age age category

gender sex/gender designation

wtmec4yr_adj_norm normalized weight for surveys

masked_variance_pseudo_psu PSU - sampling unit

masked_variance_pseudo_stratum sampling stratum

num_valid_days number of valid days of wear (e.g. 1368 minutes, see Details)

measure measure that was calculated

value value for the measure

Details

Valid days are defined as in Koffman, Crainiceanu, and Muschelli (2025). A day is valid if (1) at least 1,368 minutes (95% of a full day) were classified as wake wear, sleep wear, or unknown and had no data quality flags; (2) at least 420 minutes were classified as wake wear; and (3) at least 420 minutes had non-zero MIMS. Only participants with at least 3 valid days are included.

Source

NHANES 2011-2012 and 2013-2014 accelerometer data.

References

Koffman L, Crainiceanu C, Muschelli J (2025). Comparing Step Counting Algorithms for High-Resolution Wrist Accelerometry Data in NHANES 2011-2014. *Medicine & Science in Sports & Exercise*, 57(4), 746-755. doi:10.1249/MSS.0000000000003616. PMID: 39589008.

nhanes_measure_data_wear_criteria *NHANES PA data under alternative wear-time inclusion criteria*

Description

Participant-level NHANES 2011-2014 physical activity summaries computed under 15 accelerometer wear-time inclusion criteria: every combination of a minimum of 600, 960, 1296, 1368, or 1440 wear minutes per valid day and a minimum of 1, 3, or 4 valid days. Use `nhanes_pa_wear_criteria()` to list the criteria and select one with the `min_wear_minutes` and `min_valid_days` arguments of the mapping functions.

Usage

```
nhanes_measure_data_wear_criteria
```

Format

A data frame with 193114 rows and 18 variables:

SEQN ID variable

criterion wear-time criterion, `"wear{min}_days{d}"`, e.g. `"wear1368_days3"`. See `nhanes_pa_wear_criteria()`.

data_release_cycle wave/data release cycle

cat_age age category

gender sex/gender designation

wtmec4yr_adj_norm normalized survey weight, adjusted separately within each criterion

masked_variance_pseudo_psu PSU - sampling unit

masked_variance_pseudo_stratum sampling stratum

num_valid_days number of valid days under the criterion

AC, log10AC, PAXMTSM, log10PAXMTSM, oaksteps, scrfsteps, scsslsteps, vsrevsteps, vssteps values for each summary, as in the `measure` and `value` columns of nhanes_measure_data

Details

The data are stored wide, with one row per participant and criterion and one column per summary, to keep the package small.

A day is valid if (1) at least `min_wear_minutes` minutes were classified as wake wear, sleep wear, or unknown and had no data quality flags; (2) at least 420 minutes were classified as wake wear; and (3) at least 420 minutes had non-zero MIMS. A participant is included under a criterion if they have at least `min_valid_days` valid days. Survey weights were re-adjusted for each criterion, so rows from different criteria should never be combined.

The `"wear1368_days3"` criterion matches nhanes_measure_data up to floating-point rounding (relative differences of about 1e-16 in some `log10AC` and `log10PAXMTSM` values), except for two participants (SEQN 69762 and 80584) who each differ by one valid day. This is because the PhysioNet

PAXFLGSM quality-flag file omits some flags present in the original NHANES data. The package default (min_wear_minutes = 1368, min_valid_days = 3) therefore continues to use nhanes_measure_data, so earlier results are unchanged.

Source

NHANES 2011-2012 and 2013-2014 accelerometer data, via PhysioNet.

References

Koffman L, Crainiceanu C, Muschelli J (2025). Comparing Step Counting Algorithms for High-Resolution Wrist Accelerometry Data in NHANES 2011-2014. *Medicine & Science in Sports & Exercise*, 57(4), 746-755. doi:10.1249/MSS.0000000000003616.

Koffman L, Muschelli J (2025). Minute Level Step Counts and Physical Activity Data from the National Health and Nutrition Examination Survey (NHANES) 2011-2014 (version 1.0.1). *PhysioNet*. doi:10.13026/9n0rtv02.

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nhanes_pa_age_category

Convert ages to NHANES physical activity CDF age categories

Description

Ages are grouped into 10-year bins from [0,10) through [70,80). Ages greater than or equal to 80 are assigned to the oldest available CDF category, "[80,85)". Ages greater than 85 also map to "[80,85)", with a warning by default.

Usage

```
nhanes_pa_age_category(age, warn = TRUE)
```

Arguments

age	Numeric age in years.
warn	Logical. If TRUE, warn when non-missing ages greater than 85 are mapped into the "[80,85)" category.

Value

A character vector of NHANES age category labels.

Examples

```
nhanes_pa_age_category(c(8, 25, 84, 90))
```

nhanes_pa_measure_cdf *Select the NHANES CDF for a measure*

Description

Uses the explicit aliases in nhanes_pa_measure_map() to select the CDF calculated from the corresponding summary in nhanes_measure_data, or in nhanes_measure_data_wear_criteria for a non-default wear-time criterion.

Usage

```
nhanes_pa_measure_cdf(
  measure,
  age = NULL,
  sex = NULL,
  wave = NULL,
  age_category = NULL,
  min_wear_minutes = 1368,
  min_valid_days = 3
)
```

Arguments

measure	A single supported measure name.
age	Age in years, or NULL for the overall age CDF.
sex	Sex/gender, or NULL for the overall sex/gender CDF.
wave	Optional NHANES wave (7, 8, "2011-2012", or "2013-2014").
age_category	Optional NHANES age category, used instead of age.
min_wear_minutes, min_valid_days	Accelerometer wear-time inclusion criterion for the NHANES reference population: the minimum minutes of wear for a valid day (600, 960, 1296, 1368, or 1440) and the minimum number of valid days (1, 3, or 4). The defaults (1368 minutes, 3 days) use nhanes_measure_data and give the same results as earlier versions of the package. Other values use the matching criterion in nhanes_measure_data_wear_criteria, with survey weights adjusted for that criterion. Choose the criterion that matches the inclusion rules applied to data. See nhanes_pa_wear_criteria().

Value

A CDF function, or NA_real_ if no CDF is available.

nhanes_pa_measure_map *Supported physical activity measure names*

Description

Returns every accepted measure name and the NHANES summary used to build its CDF. Matching ignores case, spaces, underscores, and punctuation. Measures absent from this table have no supported CDF.

Usage

```
nhanes_pa_measure_map()
```

Value

A data frame with `measure` (accepted name) and `summary` (the measure in `nhanes_measure_data` used for its CDF).

nhanes_pa_quantile *Evaluate a single NHANES physical activity quantile*

Description

Evaluate a single NHANES physical activity quantile

Usage

```
nhanes_pa_quantile(
  value,
  age = NULL,
  sex = NULL,
  measure,
  wave = NULL,
  age_category = NULL,
  min_wear_minutes = 1368,
  min_valid_days = 3
)
```

Arguments

`value`	Observed physical activity value.
`age`	Age in years. Set to `NULL` to use the age-overall CDFs. Ignored when `age_category` is supplied.
`sex`	Sex/gender. Common values such as `"M"`, `"male"`, `"F"`, and `"female"` are normalized. Set to `NULL` to use the sex/gender-overall CDFs.

`measure` Physical activity measure. See `nhanes_pa_measure_map()` for every supported name and its CDF summary.

`wave` Optional NHANES wave. Supported values are `7`, `8`, `"2011-2012"`, and `"2013-2014"`.

`age_category` Optional NHANES age category such as `"[20,30)"` or `"Overall"`.

`min_wear_minutes, min_valid_days`
Accelerometer wear-time inclusion criterion for the NHANES reference population: the minimum minutes of wear for a valid day (`600`, `960`, `1296`, `1368`, or `1440`) and the minimum number of valid days (`1`, `3`, or `4`). The defaults (`1368` minutes, `3` days) use nhanes_measure_data and give the same results as earlier versions of the package. Other values use the matching criterion in nhanes_measure_data_wear_criteria, with survey weights adjusted for that criterion. Choose the criterion that matches the inclusion rules applied to `data`. See `nhanes_pa_wear_criteria()`.

Value

A numeric quantile in `[0, 1]`, or `NA_real_` when no matching CDF is available.

Examples

```
nhanes_pa_quantile(
  value = 15000,
  age = 25,
  sex = "Female",
  measure = "mims"
)

nhanes_pa_quantile(
  value = 15000,
  age = 25,
  sex = NULL,
  measure = "mims",
  wave = "2013-2014"
)

# Same value against a complete-wear (24 h), 1-day reference
nhanes_pa_quantile(
  value = 15000,
  age = 25,
  sex = "Female",
  measure = "mims",
  min_wear_minutes = 1440,
  min_valid_days = 1
)
```

nhanes_pa_wear_criteria *Available accelerometer wear-time inclusion criteria*

Description

Lists the wear-time inclusion criteria that can be selected with the `min_wear_minutes` and `min_valid_days` arguments of `map_nhanes_pa_quantiles()`, `nhanes_pa_quantile()`, `nhanes_pa_measure_cdf()`, and `precompute_nhanes_pa_cdfs()`. Choose the criterion that matches the inclusion rules used for your own data.

Usage

```
nhanes_pa_wear_criteria()
```

Details

A day is valid if it has at least `min_wear_minutes` minutes of non-flagged wear (wake wear, sleep wear, or unknown), at least 420 minutes of wake wear, and at least 420 minutes with non-zero MIMS. A participant is included if they have at least `min_valid_days` valid days. Survey weights were re-adjusted separately for each criterion.

The default criterion (1,368 minutes, 3 days) uses nhanes_measure_data, the primary analysis of Koffman, Crainiceanu, and Muschelli (2025). Every other criterion uses the matching subset of nhanes_measure_data_wear_criteria.

Value

A data frame with one row per criterion and columns:

criterion criterion label, `"wear{min}_days{d}"`

min_wear_minutes minimum minutes of wear for a valid day

min_wear_hours `min_wear_minutes` in hours

pct_of_day `min_wear_minutes` as a percentage of 1,440 minutes

min_valid_days minimum number of valid days

default `TRUE` for the package default criterion

note short note on where the wear threshold is used

References

Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise*, 40(1), 181-188. doi:10.1249/mss.0b013e31815a51b3.

Saint-Maurice PF, Troiano RP, Bassett DR, et al. (2020). Association of daily step count and step intensity with mortality among US adults. *JAMA*, 323(12), 1151-1160. doi:10.1001/jama.2020.1382.

Koffman L, Crainiceanu C, Muschelli J (2025). Comparing Step Counting Algorithms for High-Resolution Wrist Accelerometry Data in NHANES 2011-2014. *Medicine & Science in Sports & Exercise*, 57(4), 746-755. doi:10.1249/MSS.0000000000003616.

Examples

```
nhanes_pa_wear_criteria()
```

`precompute_nhanes_pa_cdfs` *Precompute and cache NHANES PA CDFs*

Description

Builds every supported CDF combination and stores the result in the internal cache. This covers combined and by-wave CDFs, age-specific and age-overall strata, sex/gender-specific and sex/gender-overall strata, and the overall-overall combination for each supported measure. CDFs are cached separately for each wear-time criterion.

Usage

```
precompute_nhanes_pa_cdfs(min_wear_minutes = 1368, min_valid_days = 3)
```

Arguments

`min_wear_minutes`, `min_valid_days`
: Accelerometer wear-time inclusion criterion for the NHANES reference population: the minimum minutes of wear for a valid day (`600`, `960`, `1296`, `1368`, or `1440`) and the minimum number of valid days (`1`, `3`, or `4`). The defaults (`1368` minutes, `3` days) use nhanes_measure_data and give the same results as earlier versions of the package. Other values use the matching criterion in nhanes_measure_data_wear_criteria, with survey weights adjusted for that criterion. Choose the criterion that matches the inclusion rules applied to `data`. See `nhanes_pa_wear_criteria()`.

Value

Invisibly returns a list with the cached combined and by-wave tables.

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