Using `hhsurveydata` with `rdhs`

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This vignette illustrates use of `hhsurveydata` and `rdhs` to calculate fertility and mortality indicators for lots of DHS surveys in sub-Saharan Africa, and compare estimates to those produced for the DHS StatCompiler. It is currently a hastily developed analysis script, though may be further developed in the future.

Install and load packages

```
## install.packages("devtools")
## devtools::load_all("OJWatson/rdhs")
## devtools::load_all("mrc-ide/hhsurveydata")

library(rdhs)
library(hhsurveydata)
library(ggplot2)
library(data.table)
library(haven)

## a little nugget to return API requests as data.table rather than data.frame.
Sys.setenv(rdhs_DATA_TABLE = "TRUE")
```

Identify surveys and datasets

Identify all DHS surveys conducted in sub-Saharan Africa since the year 2005.

```
countries <- dhs_countries()
cc <- countries[RegionName == "Sub-Saharan Africa"]$DHS_CountryCode
surveys <- dhs_surveys(countryIds = cc, surveyYearStart=2005, surveyType = "DHS")
```

Identify individual recode (IR) and births recode (BR) datasets corresponding to these surveys.

```
ird <- dhs_datasets(fileType = "IR", fileFormat = "flat")[SurveyId %in% surveys$SurveyId]
brd <- dhs_datasets(fileType = "BR", fileFormat = "flat")[SurveyId %in% surveys$SurveyId]
```

Use `rdhs` to retreive datasets, downloading them from DHS website if not already in the `rdhs` cache.

```
ird$path <- unlist(get_datasets(ird$FileName))
brd$path <- unlist(get_datasets(brd$FileName))
```

Load all of the datasets into R as a list.

```
ir <- list()
for(survid in ird$SurveyId){
  print(survid)
  dat <- readRDS(ird[SurveyId == survid]$path)
  dat <- dat[grep("caseid|^v0|^v1|^b|^mm", names(dat))]
  ir[[survid]] <- dat
}
```

```
br <- list()
for(survid in brd$SurveyId){
  print(survid)
  dat <- readRDS(brd[SurveyId == survid]$path)
  dat <- dat[grep("caseid|^v0|^v1|^b", names(dat))]
  br[[survid]] <- dat
}

## Convert to factors (a bit inefficient)
ir <- lapply(ir, haven::as_factor)
br <- lapply(br, haven::as_factor)

## Add survey-level variables
ir <- Map(data.frame,
          SurveyId = surveys$SurveyId,
          CountryName = surveys$CountryName,
          SurveyYear = surveys$SurveyYear,
          ir)

br <- Map(data.frame,
          SurveyId = surveys$SurveyId,
          CountryName = surveys$CountryName,
          SurveyYear = surveys$SurveyYear,
          br)
```

Note that `rdhs` provides better tools to extract variables and pool datasets which haven't been fully embraced here.

Use `hhsurveydata` to analyse demographic rate indicators

Fertility

Calcualte TFR and 15-19 ASFR for 3 year period preceding survey (default argument `tips=c(0, 3)`).

```
tfr <- lapply(ir, calc_tfr, by=~SurveyId+CountryName+SurveyYear, strata=NULL)
tfr <- do.call(rbind, tfr)

asfr15to19 <- lapply(ir, calc_asfr, by=~SurveyId + CountryName + SurveyYear,
                     agegr = c(15, 20), strata=NULL)
asfr15to19 <- do.call(rbind, asfr15to19)
```

Adult mortality

Identify surveys that include sibling history model via querying the DHS API survery with "Maternal mortality" characteristic.

```
survchar <- dhs_surveyCharacteristics()
survchar[grepl("Maternal", SurveyCharacteristicName)]
```

```
##    SurveyCharacteristicID SurveyCharacteristicName
## 1:                      1       Maternal mortality
```

```
mm_surv <- dhs_surveys(surveyCharacteristicIds = 1)
has_mm <- surveys$SurveyId %in% mm_surv$SurveyId
```

Reshape IR datasets to one row per sibling episode, create a binary variable indicating sibling death, and calculate ${}_{35}q_{15}$ estimates by sexx.

```
sib <- lapply(ir[has_mm], reshape_sib_data,
              widevars = c("SurveyId", "CountryName", "SurveyYear", "v005", "v008", "v021"))
sib <- lapply(sib, function(x){x$death <- factor(x$mm2, c("dead", "alive")) == "dead"; x})
q3515 <- lapply(sib, calc_nqx, by=~SurveyId+CountryName+SurveyYear + mm1, strata = NULL,
                agegr=seq(15, 50, 5), tips=c(0, 7), dob="mm4", dod="mm8")
q3515 <- do.call(rbind, q3515)
```

Child mortality

`hhsurveydata` does not yet implement the exact child mortality calculation produced in DHS reports and DHS StatCompiler (see Rutstein and Rojas 2006. This is planned for future implementation.

The function `calc_nqx()` calculates piecewise constant mortality rates within age groups 0, 1-2, 3-4, 5-11, 12-24 months, and 2, 3, and 4-5 years (parameter `agegr = c(0, 1, 3, 5, 12, 24, 36, 48, 60)/12`). These are aggregated to a cumulative hazards over the age group 0-4 years and converted to probabilities to estimate ${}_5q_0$.

Add a binary indicator whether a death occurred and a date of death variable, placed 0.5 months in the month the death occurred.

```
br <- lapply(br, function(x){x$death <- x$b5 == "no"; x})
br <- lapply(br, function(x){x$dod <- x$b3 + x$b7 + 0.5; x})
```

Calculate ${}_5q_0$ for period 0-4, 5-9, and 10-14 years preceding the survey.

```
u5mr <- lapply(br, calc_nqx, by=~SurveyId+CountryName+SurveyYear, strata=NULL)
u5mr <- do.call(rbind, u5mr)
```

Merge DHS StatCompiler indicators

Identify the indicator IDs associated with TFR, ASFR 15-19, ${}_{35}q_{15}$, and ${}_5q_0$.

```
indic <- dhs_indicators()

indic[grepl("TFR 15-49", ShortName), .(IndicatorId, ShortName, Label)]
```

```
##      IndicatorId ShortName                      Label
## 1: FE_FRTR_W_TFR TFR 15-49 Total fertility rate 15-49
```

```
indic[grepl("ASFR 15-19", ShortName), .(IndicatorId, ShortName, Label)]
```

```
##      IndicatorId  ShortName
## 1: FE_FRTR_W_A15 ASFR 15-19
## 2: FE_FRTT_W_A15 ASFR 15-19
##                                                 Label
## 1:                     Age specific fertility rate: 15-19
## 2: Age specific fertility rate: 15-19 (five year periods)
```

```
indic[grepl("Probability of dying", ShortName), .(IndicatorId, Definition)]
```

```
##      IndicatorId
## 1: MM_AMPB_W_AMP
## 2: MM_AMPB_M_AMP
##                                                      Definition
```

```
## 1: Probability of dying between exact age 15 and 50 (35q15) for women
## 2:   Probability of dying between exact age 15 and 50 (35q15) for men
```

```
indic[grepl("Under-five mortality", ShortName), .(IndicatorId, Label)]
```

```
##      IndicatorId                     Label
## 1: CM_ECMR_C_U5M Under-five mortality rate
```

Query estimates from DHS API and merge with calculated estimates.

```
tfr_dhs <- dhs_data(indicatorIds = "FE_FRTR_W_TFR",
                    surveyId = tfr$SurveyId)
tfr <- merge(tfr, tfr_dhs[ , .(SurveyId, Value)])

asfr15to19_dhs <- dhs_data(indicatorIds = "FE_FRTR_W_A15",
                           surveyId = asfr15to19$SurveyId)
asfr15to19 <- merge(asfr15to19, asfr15to19_dhs[ , .(SurveyId, Value)])

q3515_dhs <- dhs_data(indicatorIds = c("MM_AMPB_W_AMP", "MM_AMPB_M_AMP"),
                      surveyId = q3515$SurveyId)
q3515_dhs$mm1 <- c(MM_AMPB_M_AMP = "male", MM_AMPB_W_AMP = "female")[q3515_dhs$IndicatorId]
q3515 <- merge(q3515, q3515_dhs[ , .(SurveyId, mm1, Value)])

u5mr_dhs <- dhs_data(indicatorIds = "CM_ECMT_C_U5M",
                     surveyYearStart = 2005,
                     breakdown = "all")[SurveyId %in% u5mr$SurveyId]
u5mr_dhs$tips <- u5mr_dhs$CharacteristicLabel
u5mr <- merge(u5mr, u5mr_dhs[, .(SurveyId, tips, Value)])
```

View estimates

Table 1: TFR

SurveyId	Value	CountryName	SurveyYear	tips	tfr	se_tfr
AO2015DHS	6	Angola	2015	0-2	6.216	0.14
BF2010DHS	6	Burkina Faso	2010	0-2	5.991	0.10
BJ2006DHS	6	Benin	2006	0-2	5.739	0.07
BJ2012DHS	5	Benin	2012	0-2	4.902	0.07
BU2010DHS	6	Burundi	2010	0-2	6.384	0.10
BU2016DHS	6	Burundi	2016	0-2	5.519	0.08

Table 2: ASFR 15-19

SurveyId	Value	CountryName	SurveyYear	agegr	tips	asfr	se_asfr
AO2015DHS	163	Angola	2015	15-19	0-2	0.1627	0
BF2010DHS	130	Burkina Faso	2010	15-19	0-2	0.1301	0
BJ2006DHS	112	Benin	2006	15-19	0-2	0.1123	0
BJ2012DHS	94	Benin	2012	15-19	0-2	0.0939	0
BU2010DHS	65	Burundi	2010	15-19	0-2	0.0652	0
BU2016DHS	58	Burundi	2016	15-19	0-2	0.0582	0

Table 3: 35q15

SurveyId	mm1	Value	CountryName	SurveyYear	tips	nqx	se	ci_l	ci_u
AO2015DHS	female	110	Angola	2015	0-6	0.110	0.010	0.090	0
AO2015DHS	male	182	Angola	2015	0-6	0.182	0.013	0.157	0
BF2010DHS	female	146	Burkina Faso	2010	0-6	0.146	0.008	0.131	0
BF2010DHS	male	145	Burkina Faso	2010	0-6	0.145	0.007	0.130	0
BJ2006DHS	female	127	Benin	2006	0-6	0.127	0.006	0.114	0
BJ2006DHS	male	162	Benin	2006	0-6	0.161	0.008	0.146	0

Table 4: 5q0

	SurveyId	tips	Value	CountryName	SurveyYear	nqx	se	ci_l	ci_u
1	AO2015DHS	0-4	68	Angola	2015	0.066	0.004	0.058	0
3	AO2015DHS	5-9	95	Angola	2015	0.093	0.005	0.082	0
2	AO2015DHS	10-14	145	Angola	2015	0.146	0.008	0.130	0
4	BF2010DHS	0-4	129	Burkina Faso	2010	0.121	0.004	0.113	0
6	BF2010DHS	5-9	168	Burkina Faso	2010	0.169	0.005	0.160	0
5	BF2010DHS	10-14	177	Burkina Faso	2010	0.180	0.006	0.169	0

Check that TFR, ASFR, and $_{35}q_{15}$ estimates exactly match

Estimates for fertility rates and adult mortality rates should exactly match those produced as standard DHS indicators.

```
## TFR matches exactly
with(tfr, table(round(tfr, 1) == Value))
```

```
##
## TRUE
##   66
```

```
## ASFR 15-19 matches exactly
with(asfr15to19, table(round(1000*asfr) == Value))
```

```
##
## TRUE
##   66
```

```
## 35q15 matches exactly for >80%
with(q3515, table(round(1000*nqx) == Value))
```

```
##
## FALSE  TRUE
##    23    87
```

```
with(q3515, table(round(1000*nqx) - Value))
```

```
##
## -8 -3 -1  0  1  5
##  1  1 16 87  4  1
```

```
subset(q3515, abs((round(1000*nqx) - Value)) > 1)
```

```
##     SurveyId    mm1 Value CountryName SurveyYear tips       nqx         se
```

```
## 57 MZ2011DHS female   199  Mozambique       2011  0-6 0.1914953 0.01021433
## 58 MZ2011DHS   male   241  Mozambique       2011  0-6 0.2383925 0.01186020
## 97 UG2011DHS female   201      Uganda       2011  0-6 0.2062956 0.01222652
##         ci_l      ci_u
## 57 0.1712256 0.2112692
## 58 0.2147886 0.2612869
## 97 0.1819667 0.2299010
```

Compare $_5q_0$ estimates

```
u5mr$tips <- factor(u5mr$tips, c("0-4", "5-9", "10-14"))
ggplot(u5mr, aes(1000*nqx, Value, color=tips)) +
  geom_abline(slope=1, color="grey") +
  geom_point() +
  coord_fixed() +
  xlab("hhsurveydata::calc_nqx()") +
  ylab("DHS StatCompiler") +
  ggtitle("5q0 comparison")
```