



WHO 2007 SAS macro package

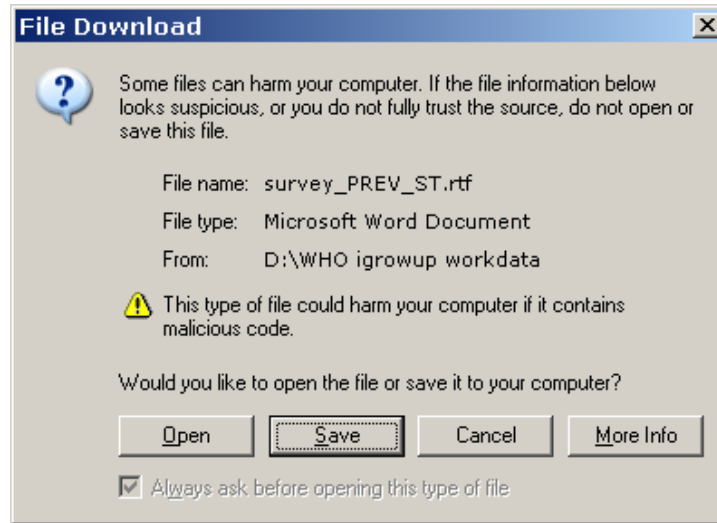
The package, **WHO2007_SAS.zip**, contains:

1. The source codes, WHO2007.sas, of the SAS macro, %WHO2007,
2. Three permanent SAS data sets containing the WHO 2007 references:
wfawho2007.sas7bdat, hfawho2007.sas7bdat and bfawho2007.sas7bdat,
3. Readme.pdf, and
4. An example survey data, survey_who2007.sas7bdat, and its related SAS output files:

survey_who2007_z.sas7bdat,
survey_who2007_z.csv,
survey_who2007_prev.rtf,
survey_who2007_prev.xls,

Pre-requisites

1. Users are advised to read this readme file carefully, especially the **macro parameters** section. Users should also try the example provided in the end of this document before running their own analyses.
2. This macro requires SAS Version 8.2 or higher to run since it creates a rich text format (RTF) file in MS Word. In creating the RTF in Word without opening the **SAS Results Viewer** window, the following dialogue may be displayed for security reasons.



To proceed, choose either “Open” or “Cancel”. If you choose “Save”, an error message may be displayed even though the correct RTF is still exported. If users have SAS version 7, the macro section for exporting the RTF should be suppressed. And, if users have a SAS version lower than 7, the section for exporting the Excel file should also be suppressed.

Precautions:

- Avoid any temporary SAS data sets with names starting with underscore “_”; otherwise they may be replaced by the temporary ones created by the macro.
- Avoid any variable names starting with underscore “_” in the input SAS data set; otherwise they may be replaced by the derived ones created by the macro.
- Avoid any temporary format names starting with underscore “_”; otherwise they may be replaced by the temporary ones created by the macro.
- Avoid any SAS global macro variable names starting with underscore “_”, except those defined by the system.

Contact for reporting bugs/comments:

Should you encounter any problem with this macro, please send an e-mail with a clear description of the identified problem to "anthro2005@who.int", specifying in the subject line that it concerns the **who2007** package and also indicate which version of SAS you are using. Thank you.

Setup and run

1. Create a package directory, and reserve this directory only for the files downloaded/extracted in the following steps 2 and 3.
2. Download the package zip file to the package directory.
3. Extract the following files: Readme.pdf, who2007.sas, wfawho2007.sas7bdat, hfawho2007.sas7bdat and bfawho2007.sas7bdat to the package directory.
4. Create a working directory, and extract to it the example survey (survey_who2007.sas7bdat) and its pertinent output files from the package.
5. To compile the SAS macros, copy the following commend lines in your SAS program,

```
%include "<path for the package directory>\who2007.sas";
```

6. Replace *<path for the package directory>* with the actual pathname. Users must use the backslash "\" inside the path but not at the end of it.

References

de Onis, M, Onyango, A, Borghi, E, Siyam, A, Nishida, C, Siekmann, J. Development of a WHO growth reference for school-aged children and adolescents. Bulletin of the World Health Organization 2007; 85: 661-668.

Description

1. The macro, %who2007, calculates z-scores for the **three** anthropometric indicators, weight-for-age, height-for-age, and BMI-for-age for children aged 5 to 19 years old.
2. The macro produces indicator-, sex- and age-specific prevalence estimates including 95% confidence intervals of under/over nutrition and summary statistics (mean and SD) of the z-scores (non-missing and non-flagged); if required, the analysis may be further stratified by a grouping variable such as urban/rural or regions. For oedema cases with non-missing age, weight-related z-scores (weight-for-age and BMI-for-age) are not calculated, but they are treated as being < -3 SD in their prevalence estimations
3. Extreme (i.e. biologically implausible) z-scores are flagged for each indicator according to the following system:

Weight-for-age z-score (ZWFA)	ZWFA<-6 or ZWFA> 5
Height-for-age z-score (ZHFA)	ZHFA<-6 or ZHFA> 6
BMI-for-age z-score (ZBFA)	ZBFA<-5 or ZBFA> 5

4. The macro requires three permanent SAS data sets containing the WHO 2007 references. They must be stored in a user defined directory (referred to here as the package directory). The names of these SAS data sets must be:

Standards	SAS names
Weight-for-age	wfawho2007
Height-for-age	hfawho2007
BMI-for-age	bfawho2007

5. The macro requires a permanent SAS data set containing age, sex and the raw measurements of weight in kg and height in cm. It must be stored in another user defined directory (referred to here as the working directory). The variables for weight and height are compulsory to run the macro. If either of those is not available in the data set, the user must create a corresponding numeric variable and set its values to missing.

Macro parameters

Except for the macro parameter LABEL, all other parameters should be specified without any quotation marks. The values of the parameters are not case sensitive. They are divided into two categories:

1. Compulsory parameters:

The following parameters must be specified; otherwise the macro will not run properly.

- **LABEL:** to specify the characteristics of the survey, e.g. country, survey year and selection criteria etc; it will appear in the header section of the output Word file. It must be specified in double quotes.
- **REF_LIB:** to specify the package directory where the three SAS data sets containing the WHO 2007 references are stored. Users must use the backslash "\" inside the path but not at the end of it, for example, "D:\WHO2007\ref_sas".
- **DATA_LIB:** to specify the working directory where the input SAS data set containing anthropometric measurements is stored. Users must use the backslash "\" inside the path but not at the end of it, for example, "D:\WHO2007\workdata_sas".
- **DATA_IN:** to specify the name of the input SAS data set; it must be a permanent SAS data set stored in the working directory defined by DATA_LIB.
- **SEX:** to specify the name of a variable containing sex information. If it is a numeric variable, its values must be, 1 for males and 2 for females. And if it is a character variable, it must be, "m" or "M" for males and "f" or "F" for females. Users must code any missing values as "." (for numeric variable) or "" (for character variable), in which case no z-scores will be calculated.
- **AGE:** to specify the name of a numeric variable containing age information. Age can be in days, months or years. An accurate age without any rounding or truncating is strongly recommended; ideally it should be derived from date of birth (DOB) and date of measurement (DOM), i.e. DOM-DOB. Users must code any missing values as ".", in which case none of the three age-related z-scores can be calculated.
- **AGE_UNIT:** to specify the age unit of the age variable. It must be specified as DAYS, MONTHS or YEARS. The macro converts age in

days or years to months, dividing it by 30.4375 days or multiplying it by 12 months, respectively.

- **WEIGHT:** to specify the name of a numeric variable containing body weight information; it must be in kilograms, and users must code any missing values as ".", in which case the weight-related z-scores are not calculated.
- **HEIGHT:** to specify the name of a numeric variable containing height information; it must be in centimeters, and users must code any missing values as ".", in which case the height-related z-scores are not calculated.

2. Optional parameters:

The following parameters can be left unspecified, and the default analysis will be performed.

- **OEDEMA:** to specify the name of the character variable containing oedema information. The values of this variable must be "n" or "N" for non-oedema, and "y" or "Y" for oedema. Users must code any missing values as " ", and the macro assumes those are non-oedema. By default, i.e. if this parameter is not specified, the macro assumes all cases as non-oedema. For oedema cases, weight-related z-scores (weight-for-age and BMI-for-age) are not calculated, but they are treated as being < -3 SD in their prevalence estimations.
- **SW:** to specify the name of a numeric variable containing the sampling weights (SW). By default, i.e. if this parameter is not specified, the un-weighted analysis is performed. Where specified, negative values in the sampling weights are not allowed; otherwise an error message will be given in the log file, indicating the presence of negative SW, and the macro will stop execution.
- **Group:** to specify the name of a character variable containing the grouping information for the stratified analysis. Only one stratifying variable can be specified. Users must code any missing values as " ", and the macro will treat that as a separate group.

Exported files

1. The macro creates, in the working directory, a permanent SAS data set. The name of the data set is *dataname_z.sas7bdat*, where *dataname* is the value of the macro parameter **DATA_IN** (see the **macro parameter** section). This data set retains all the records and variables from the input SAS data set and adds the following 8 variables derived by the macro:

Variable names	Variable labels
_AGEMONS	calculated age in months for deriving z-score
_CBMI	calculated BMI=weight / squared (height)
_ZWFA	Weight-for-age z-score
_ZHFA	Height-for-age z-score
_ZBFA	BMI-for-age z-score
_FWFA	Flag for _ZWFA<-6 or _ZWFA>5
_FHFA	Flag for _ZHFA<-6 or _ZHFA>6
_FBFA	Flag for _ZBFA<-5 or _ZBFA>5

- It creates, in the working directory, a data set in CSV format that has the same data structure as the one in SAS format. The name of the data set is *dataname_z.csv*, where *dataname* is the value of the macro parameter DATA_IN.
- It creates, in the working directory, a summary report in MS Word RTF format. Its name is *dataname_PREV.rtf*, where *dataname* is the value of the macro parameter DATA_IN. It contains the indicator-specific prevalence estimates including 95% confidence intervals of under/over nutrition and summary statistics (mean and standard deviation) of z-scores. If the GROUP parameter is specified, the analysis is further stratified by the grouping variable. In this summary analysis, only children aged between 61 to 228 completed months are included. The age groups in yearly and monthly intervals are shown below:

Age		Indicator		
Years	Months	Weight	Height	BMI
5	61-71	✓	✓	✓
6	72-83	✓	✓	✓
7	84-95	✓	✓	✓
8	96-107	✓	✓	✓
9	108-119	✓	✓	✓
10	120-131	✓*	✓	✓
11	132-143		✓	✓
12	144-155		✓	✓
13	156-167		✓	✓
14	168-179		✓	✓
15	180-191		✓	✓
16	192-203		✓	✓
17	204-215		✓	✓
18	216-227		✓	✓
19	228		✓	✓

* For Weight-for-age, age group 10 yrs covers up to age 120 completed months.

4. It creates, in the working directory, an Excel file containing the same age/sex specific estimates as those provided in the RTF file. Its name is *dataname_PREV.xls*, where *dataname* is the value of the macro parameter *DATA_IN*. If the *GROUP* parameter is specified, an additional stratified analysis by the grouping variable will also be provided.

An example

An example survey, *survey_WHO2007.sas7bdat*, is included in the package zip file. Users are advised to run this example as an exercise by following the steps below:

1. Follow the steps in the **setup and run** section above,
2. Copy the following SAS codes,

```
%WHO2007
(LABEL="An example survey for WHO 2007",
 REF_LIB= <path for the package directory>,
 DATA_LIB= <path for the working directory>,
 DATA_IN=survey_WHO2007,
 SEX=sex,
 AGE=agemons,
 AGE_UNIT=months,
 WEIGHT=weight,
 HEIGHT=height,
 OEDEMA=oedema,
 SW=sw,
 GROUP=region);
```

3. Replace *<path for the package directory>* and *<path for the working directory>* with their actual paths, and use the backslash "\" inside path but not at the end of it.
4. Run the SAS codes. Without error messages, the outputs should match exactly with the ones provided in the package.