Re-calculation of ORs in the Philippines measles paper

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This R-Markdown is used to re-calculate the Odd Ratios presented in Table 1 of the paper "Measles outbreak in the Philippines: epidemiological and clinical characteristics of hospitalized children, 2016-2019", published on The Lancet Regional Health - Western Pacific.

First of all, the required library, `epitools` is installed. The OR will be calculated using the command `oddsratio` with Wald (unconditional maximum likelihood estimation) method, while the p-value is calculated using mid-p method.

```
# install.packages('epitools')
library(epitools)
```

Retrieve the citation of R and epitools

```
citation()
```

```
##
## To cite R in publications use:
##
##   R Core Team (2022). R: A language and environment for statistical
##   computing. R Foundation for Statistical Computing, Vienna, Austria.
##   URL https://www.R-project.org/.
##
## A BibTeX entry for LaTeX users is
##
##   @Manual{,
##     title = {R: A Language and Environment for Statistical Computing},
##     author = {{R Core Team}},
##     organization = {R Foundation for Statistical Computing},
##     address = {Vienna, Austria},
##     year = {2022},
##     url = {https://www.R-project.org/},
##   }
##
## We have invested a lot of time and effort in creating R, please cite it
## when using it for data analysis. See also 'citation("pkgname")' for
## citing R packages.
```

```
citation("epitools")
```

```
##
## To cite package 'epitools' in publications use:
##
##   Tomas J. Aragon (2020). epitools: Epidemiology Tools. R package
##   version 0.5-10.1. https://CRAN.R-project.org/package=epitools
```

```
##
## A BibTeX entry for LaTeX users is
##
##   @Manual{,
##     title = {epitools: Epidemiology Tools},
##     author = {Tomas J. Aragon},
##     year = {2020},
##     note = {R package version 0.5-10.1},
##     url = {https://CRAN.R-project.org/package=epitools},
##   }
```

Calculation of the ORs for age groups (months)

```
# create matrix for age groups
age_group <- c('>24', '<3', '3-5', '6-8', '9-11', '12-24')
outcome <- c('Alive', 'Dead')
data_age_group <- matrix(c(1642-40, 40, 94-2, 2, 715-31, 31, 1280-40, 40, 765-21, 21, 1066-44, 44),
                         nrow=6, ncol=2, byrow=TRUE)
dimnames(data_age_group) <- list('Age group (months)'=age_group, 'Outcome'=outcome)

#view matrix
data_age_group
```

```
##                   Outcome
## Age group (months) Alive Dead
##              >24    1602   40
##              <3       92    2
##              3-5     684   31
##              6-8    1240   40
##              9-11    744   21
##              12-24  1022   44
```

```
# calculate odds ratio for this data
oddsratio(data_age_group, method="wald")
```

```
## Warning in chisq.test(xx, correct = correction): Chi-squared approximation may
## be incorrect
```

```
## $data
##                   Outcome
## Age group (months) Alive Dead Total
##              >24    1602   40  1642
##              <3       92    2    94
##              3-5     684   31   715
##              6-8    1240   40  1280
##              9-11    744   21   765
##              12-24  1022   44  1066
##              Total  5384  178  5562
##
## $measure
##                   odds ratio with 95% C.I.
## Age group (months)  estimate     lower    upper
##              >24   1.0000000        NA       NA
##              <3    0.8706522 0.2071934 3.658588
##              3-5   1.8151316 1.1260291 2.925948
```

```
##              6-8   1.2919355 0.8283283 2.015019
##              9-11  1.1304435 0.6618810 1.930714
##              12-24 1.7242661 1.1157052 2.664766
##
## $p.value
##                   two-sided
## Age group (months) midp.exact fisher.exact chi.square
##              >24           NA           NA         NA
##              <3    0.92515518   1.00000000 0.84989207
##              3-5   0.01645876   0.01768217 0.01312456
##              6-8   0.26095522   0.30379552 0.25750990
##              9-11  0.64764406   0.67678265 0.65328171
##              12-24 0.01470839   0.01675060 0.01311826
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_age_group[,2] / (data_age_group[,1] + data_age_group[,2])*100
```

```
##      >24       <3      3-5      6-8     9-11    12-24
## 2.436054 2.127660 4.335664 3.125000 2.745098 4.127580
```

Calculation of the OR for sex

```
# create matrix for sex
sex <- c('Male', 'Female')
outcome <- c('Alive', 'Dead')
data_sex <- matrix(c(3062-100, 100, 2500-78, 78),
                   nrow=2, ncol=2, byrow=TRUE)
dimnames(data_sex) <- list('Sex'=sex, 'Outcome'=outcome)

#view matrix
data_sex
```

```
##         Outcome
## Sex      Alive Dead
##   Male    2962  100
##   Female  2422   78
```

```
# calculate odds ratio for this data
oddsratio(data_sex, method="wald")
```

```
## $data
##         Outcome
## Sex      Alive Dead Total
##   Male    2962  100  3062
##   Female  2422   78  2500
##   Total   5384  178  5562
##
## $measure
##         odds ratio with 95% C.I.
## Sex       estimate     lower    upper
```

```
##   Male   1.0000000        NA       NA
##   Female 0.9539059 0.7060278 1.288811
##
## $p.value
##         two-sided
## Sex      midp.exact fisher.exact chi.square
##   Male           NA           NA         NA
##   Female  0.7609744    0.8183828  0.7585409
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_sex[,2] / (data_sex[,1] + data_sex[,2])*100
```

```
##     Male   Female
## 3.265839 3.120000
```

Calculation of the OR for region of residence

```
# create matrix for region of residence
region_of_residence <- c('In NCR', 'Outside NCR')
outcome <- c('Alive', 'Dead')
data_region_of_residence <- matrix(c(4706-140, 140, 670-30, 30),
                                   nrow=2, ncol=2, byrow=TRUE)
dimnames(data_region_of_residence) <- list('Region of residence'=region_of_residence, 'Outcome'=outcome)

#view matrix
data_region_of_residence
```

```
##                     Outcome
## Region of residence Alive Dead
##         In NCR       4566  140
##         Outside NCR   640   30
```

```
# calculate odds ratio for this data
oddsratio(data_region_of_residence, method="wald")
```

```
## $data
##                     Outcome
## Region of residence Alive Dead Total
##         In NCR       4566  140  4706
##         Outside NCR   640   30   670
##         Total        5206  170  5376
##
## $measure
##                     odds ratio with 95% C.I.
## Region of residence estimate    lower    upper
##         In NCR      1.000000       NA       NA
##         Outside NCR 1.528795 1.021811 2.287325
##
## $p.value
##                     two-sided
```

```
## Region of residence midp.exact fisher.exact chi.square
##         In NCR              NA           NA         NA
##         Outside NCR 0.04638871   0.04427124 0.03756005
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_region_of_residence[,2] / (data_region_of_residence[,1] + data_region_of_residence[,2])*100
```

```
##      In NCR Outside NCR
##    2.974926    4.477612
```

Calculation of the OR for admission timing

```
# create matrix for admission timing
admission_timing <- c('Non-epidemic', 'Epidemic')
outcome <- c('Alive', 'Dead')
data_admission_timing <- matrix(c(356-3, 3, 5206-175, 175),
                                nrow=2, ncol=2, byrow=TRUE)
dimnames(data_admission_timing) <- list('Admission timing'=admission_timing, 'Outcome'=outcome)

#view matrix
data_admission_timing
```

```
##                 Outcome
## Admission timing Alive Dead
##     Non-epidemic   353    3
##     Epidemic      5031  175
```

```
# calculate odds ratio for this data
oddsratio(data_admission_timing, method="wald")
```

```
## $data
##                 Outcome
## Admission timing Alive Dead Total
##     Non-epidemic   353    3   356
##     Epidemic      5031  175  5206
##     Total         5384  178  5562
##
## $measure
##                 odds ratio with 95% C.I.
## Admission timing estimate    lower    upper
##     Non-epidemic 1.000000       NA       NA
##     Epidemic     4.092957 1.300739 12.87906
##
## $p.value
##                 two-sided
## Admission timing  midp.exact fisher.exact  chi.square
##     Non-epidemic          NA           NA          NA
##     Epidemic     0.003219249  0.004674627 0.008993167
##
## $correction
```

```
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_admission_timing[,2] / (data_admission_timing[,1] + data_admission_timing[,2])*100
```

```
## Non-epidemic     Epidemic
##    0.8426966    3.3615060
```

Calculation of the OR for vaccine status

```
# create matrix for vaccine status
vaccine_status <- c('Vaccinated (>=1 dose)', 'Non-vaccinated')
outcome <- c('Alive', 'Dead')
data_vaccine_status <- matrix(c(847-16, 16, 4600-154, 154),
                              nrow=2, ncol=2, byrow=TRUE)
dimnames(data_vaccine_status) <- list('Vacination status'=vaccine_status, 'Outcome'=outcome)

#view matrix
data_vaccine_status
```

```
##                         Outcome
## Vacination status       Alive Dead
##   Vaccinated (>=1 dose)   831   16
##   Non-vaccinated         4446  154
```

```
# calculate odds ratio for this data
oddsratio(data_vaccine_status, method="wald")
```

```
## $data
##                         Outcome
## Vacination status       Alive Dead Total
##   Vaccinated (>=1 dose)   831   16   847
##   Non-vaccinated         4446  154  4600
##   Total                  5277  170  5447
##
## $measure
##                         odds ratio with 95% C.I.
## Vacination status       estimate    lower    upper
##   Vaccinated (>=1 dose) 1.000000       NA       NA
##   Non-vaccinated        1.799005 1.069419 3.026332
##
## $p.value
##                         two-sided
## Vacination status       midp.exact fisher.exact chi.square
##   Vaccinated (>=1 dose)         NA           NA         NA
##   Non-vaccinated          0.019067   0.02359792 0.02484703
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```r
# verify percentages of dead children
data_vaccine_status[,2] / (data_vaccine_status[,1] + data_vaccine_status[,2])*100
```

```
## Vaccinated (>=1 dose)        Non-vaccinated
##              1.889020              3.347826
```

Calculation of the OR for duration between fever onset and admission

```r
# create matrix for duration between fever onset and admission
onset_admission_duration_fever <- c('0-3d', '4-6d', '7-14d', '>14d')
outcome <- c('Alive', 'Dead')
data_admission_duration_fever <- matrix(c(2071-48, 48, 2746-91, 91, 676-37, 37, 35-1, 1),
                                        nrow=4, ncol=2, byrow=TRUE)
dimnames(data_admission_duration_fever) <- list('Duration between fever onset and admission'=onset_admi

#view matrix
data_admission_duration_fever
```

```
##                                           Outcome
## Duration between fever onset and admission Alive Dead
##                                       0-3d   2023   48
##                                       4-6d   2655   91
##                                       7-14d   639   37
##                                       >14d     34    1
```

```r
# calculate odds ratio for this data
oddsratio(data_admission_duration_fever, method="wald")
```

```
## Warning in chisq.test(xx, correct = correction): Chi-squared approximation may
## be incorrect
```

```
## $data
##                                           Outcome
## Duration between fever onset and admission Alive Dead Total
##                                       0-3d   2023   48  2071
##                                       4-6d   2655   91  2746
##                                       7-14d   639   37   676
##                                       >14d     34    1    35
##                                       Total  5351  177  5528
##
## $measure
##                                           odds ratio with 95% C.I.
## Duration between fever onset and admission estimate     lower    upper
##                                       0-3d  1.000000        NA       NA
##                                       4-6d  1.444546 1.0134989 2.058921
##                                       7-14d 2.440369 1.5749766 3.781263
##                                       >14d  1.239583 0.1662443 9.242827
##
## $p.value
##                                           two-sided
## Duration between fever onset and admission   midp.exact fisher.exact
##                                       0-3d           NA           NA
##                                       4-6d  0.0400652027 0.0453418621
##                                       7-14d 0.0001122345 0.0001011061
##                                       >14d  0.7591941956 0.5642856896
```

```
##                                          two-sided
## Duration between fever onset and admission   chi.square
##                                      0-3d            NA
##                                      4-6d  0.0408826723
##                                      7-14d 0.0000388797
##                                      >14d  0.8337252585
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_admission_duration_fever[,2] / (data_admission_duration_fever[,1] + data_admission_duration_fever[
```

```
##     0-3d     4-6d    7-14d     >14d
## 2.317721 3.313911 5.473373 2.857143
```

Calculation of the OR for duration between rash onset and admission

```
# create matrix for duration between rash onset and admission
onset_admission_duration_rash <- c('0-3d', '4-6d', '7-14d', '>14d')
outcome <- c('Alive', 'Dead')
data_admission_duration_rash <- matrix(c(4757-136, 136, 580-30, 30, 112-11, 11, 16-0, 0),
                                       nrow=4, ncol=2, byrow=TRUE)
dimnames(data_admission_duration_rash) <- list('Duration between rash onset and admission'=onset_admissi

#view matrix
data_admission_duration_rash
```

```
##                                         Outcome
## Duration between rash onset and admission Alive Dead
##                                      0-3d   4621  136
##                                      4-6d    550   30
##                                      7-14d   101   11
##                                      >14d     16    0
```

```
# calculate odds ratio for this data
oddsratio(data_admission_duration_rash, method="wald")
```

```
## Warning in chisq.test(xx, correct = correction): Chi-squared approximation may
## be incorrect

## Warning in chisq.test(xx, correct = correction): Chi-squared approximation may
## be incorrect
```

```
## $data
##                                         Outcome
## Duration between rash onset and admission Alive Dead Total
##                                      0-3d   4621  136  4757
##                                      4-6d    550   30   580
##                                      7-14d   101   11   112
##                                      >14d     16    0    16
##                                      Total  5288  177  5465
##
```

```
## $measure
##                                         odds ratio with 95% C.I.
## Duration between rash onset and admission estimate    lower    upper
##                                   0-3d  1.000000       NA       NA
##                                   4-6d  1.853342 1.236006 2.779014
##                                   7-14d 3.700568 1.941083 7.054930
##                                   >14d  0.000000 0.000000      NaN
##
## $p.value
##                                         two-sided
## Duration between rash onset and admission   midp.exact fisher.exact
##                                   0-3d            NA           NA
##                                   4-6d  0.0048463965 0.0048613802
##                                   7-14d 0.0006190982 0.0004989293
##                                   >14d  0.6292303167 1.0000000000
##                                         two-sided
## Duration between rash onset and admission   chi.square
##                                   0-3d            NA
##                                   4-6d  2.445033e-03
##                                   7-14d 2.077851e-05
##                                   >14d  4.925976e-01
##
## $correction
## [1] FALSE
##
## attr(,"method")
## [1] "Unconditional MLE & normal approximation (Wald) CI"
```

```
# verify percentages of dead children
data_admission_duration_rash[,2] / (data_admission_duration_rash[,1] + data_admission_duration_rash[,2])
```

```
##     0-3d     4-6d    7-14d     >14d
## 2.858945 5.172414 9.821429 0.000000
```