Letter to the Editor

Dear Editor,

In this letter, I would like to express my views on certain statistical tools that were used to analyse the quantitative data obtained from the toxicity studies stated in various articles published in JTS. Attempts also have been made in this letter to suggest few appropriate statistical tools for analysing such data.

Statistical significance level at 5%

The five percent significant level which implies 1 mistake in 20 observations (1/20) is normally unavoidable in biological experiments and has been used for more than half a century in bioassays including toxicity tests (Dunnett, 1955; Kornegay et al., 1961). Hence, I am of the opinion that the five percent significant level can be generally used in toxicity studies for flagging a significant difference.

Bartlett's homogeneity test

According to Finney (1995) Bartlett’s homogeneity test is not necessarily required before ANOVA. The reason for this is that the power of the Bartlett’s homogeneity test is too strong for examining homogeneity of the data obtained from toxicity studies. Therefore, he recommended subjecting the data directly to ANOVA and/or Dunnett multiple comparison tests.

Toxicity studies using Bartlett’s test for testing homogeneity at 1% level, which is not conventional, have been published in this journal (Hayashi et al., 1999; Katsutani et al., 1999; Kudo et al., 2000; Mochizuki et al., 2008, 2009a and 2009b; Shirai et al., 2009; Tsubota et al., 2009; Shibayama et al., 2009; Ishii et al., 2009). The reason for setting a 1% level for detecting a significant difference probably could be: If a significant difference is detected by Bartlett’s test, then the data should be analysed using the non-parametric Dunnett type rank sum test (joint type) (Yamazaki et al., 1981) and/or Dunn test (Hollander and Wolfe, 1973), which have low detection power. Therefore, if a 1% level is set, it is unlikely that the data show a significant difference by Bartlett’s test for testing homogeneity.

For testing homogeneity of variance test (P = 5%), I suggest Levene’s (Levene, 1960; Nichols, 1994) (deviating from mean) or Brown-Forsythe’s (deviating from median) tests (SAS, 1996), which have low power of detection.

ANOVA and F-test

There are studies that had set the significance level of ANOVA at 10% (Obara et al., 1999; Fujii et al., 2005, Kimura et al., 2007) and even at 20% levels (Matsumoto et al., 1999). If the significance level of ANOVA is set at 5% level, it is likely that a significant difference might not be detected and consequently no further statistical analysis is carried out. If the data are directly analysed using Dunnett test, bypassing ANOVA, a significant difference might be detected.

Kobayashi (2000) and Sakaki et al. (2000) suggested using the Dunnett test directly avoiding a priori ANOVA. It may be noted that Dunnett (1964) did not recommend ANOVA. Ohbayashi et al. (2007) did not analyse the data using ANOVA. Miida et al. (2008) set the significance level of F-test at 25% before analyzing the data by Student’s t test.

t-test and other

Significance level of Student’s t-test (Ambali et al., 2007; Kim et al., 2010) and Scheffé test (Hashida et al., 2011) was set at 1% significant level in few studies. I suggest a 5% significant level from the historical viewpoint.

My examination on reports available in public domain of 158 numbers of 28-day repeated dose toxicity studies, 60 short term toxicity studies and 121 numbers of long term toxicity studies revealed that all these studies had set the significant difference level at 5%.

Conclusion

I recommend a 5% significant difference level for flagging statistical significance of data obtained from toxicity studies. If power of the test affects biological relevance to the data, other statistical tools may be selected, but still maintaining 5% significance level. However, selection of the statistical tool should be appropriate.

REFERENCES


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