Use and Interpretation of Statistical Tests

To the Editor — A recently published article by Razali and Yusoff[1] illustrates some of the challenges of using statistical tests and interpretation of regression analysis.

There are a couple of problems with the choice of statistical test. In Table 1 of the article,[1] the expected value in the cells of "Primary" under "Education level" and "Both" under "Type of antipsychotics" must be < 5. As a result, more than 20% of cells in the contingency table have an expected value of < 5. This contradicts the assumption of using the Chi-square test. The appropriate choice of statistical test would be Fisher's exact test,[2] which is not commonly used before computer era because the calculation procedure is tedious and complicated.[3]

In Table 2 of the article,[1] the mean Insight and Treatment Attitude Questionnaire (ITAQ) score for relapse cases was 7.6 and the standard deviation (SD) was 6. For outpatients, the mean ITAQ score was 9.3 and the SD was 5.1. If the sample score is normally distributed, the 95% of the ITAQ score for relapse cases should be between -4.16 and 19.36 (i.e. mean ± 1.96 SD), and that of outpatients should be between -0.696 and 19.296. The ITAQ score must be positive and range from 0 to 22, which is not the case if we assume the sample score is normally distributed (as shown above). As a result, the sample score distribution must not be normal, as it contradicts the assumption of application of the independent *t* test.[2] In this case, Mann-Whitney *U* test should have been used, or data transformation would have been appropriate.[2]

There are other problems in the interpretation of regression analysis. Under the heading 'Relationship with Medication Adherence' in the Results section,[1] the authors state "After controlling for insight [ITAQ], the MLR [multiple linear regression] analysis showed a significant negative linear relationship between psychopathology [Brief Psychiatric Rating Scale (BPRS)] and total MARS [Medication Adherence Rating Scale] score." Referring to Table 4,[1] the Multidimensional Scale of Perceived Social Support was not included in the MLR model because it did not meet the initial screening criteria ($p < 0.25$). Then, BPRS and ITAQ were entered in the MLR model as predictors and the outcome was MARS. It is stated in Table 4 that "Forward, backward and stepwise multiple linear regression methods were applied." The aim of the stepwise regression method is to select a model with the minimal number of predictors that can well represent the outcome.[2] As a result, different regression models will be developed at each step. There is no 'memory' between the models. The factors can only be controlled if the controlling factors are also presented in the model. If the authors state that insight (ITAQ) is controlled, ITAQ must be presented in the final model, but this is not the case in this article. ITAQ was excluded 'automatically' from the final model in the procedure for the stepwise regression method, and 'insight' was not controlled in the final model. This illustrates a problem of using the stepwise regression method, in that some of the controlling factors we want to keep in the final model may be excluded automatically by the stepwise regression method.

Lastly, relating to the conclusion drawn from the regression analysis, the authors conclude that "…if adherence could be addressed appropriately, the number of admissions and severity of psychopathology could be improved…". This conclusion should come from the result of MLR, which is summarised in Tables 3 and 4.[1] Regression analysis can only establish the association between the predictors and the outcome; causal relationship cannot be confirmed by regression analysis. If it is not a causal relationship, change in predictor will not cause the change in outcome. As a result, the conclusion drawn by the authors may not be true. Lastly, in regression analysis, we use the predictors (explanatory factors) to predict outcome. The reverse is not true. In Tables 3 and 4, it is clear that frequency of admission and BPRS (psychopathology) are predictors and adherence is an outcome. However, in the conclusion, the authors use the outcome (adherence) to predict the predictor (frequency of admission and BPRS), which is logically invalid. Therefore, the conclusion is not valid.

Dr Kai-Choi Wong, FHKAM (Psychiatry), GradStat
Email: kc@drkcwong.com
Specialist in Psychiatry
Graduate Statistician (The Royal Statistical Society)
Hong Kong

References

1. Razali SM, Yusoff MZ. Medication adherence in schizophrenia: a comparison between outpatients and relapse cases. East Asian Arch Psychiatry 2014;24:68-74.
2. Peacock JL, Peacock PJ. Oxford handbook of medical statistics. Oxford: Oxford University Press; 2011: 256, 262-7, 303-7, 406-11.
3. Armitage P, Berry G, Matthews JN. Statistical methods in medical research. 4th ed. Massachusetts: Blackwell Publishing; 2002: 134-7.

