

Conventional Approach of Combining P-Values Using Chi-Square Test: An Essence of Meta Analysis

G Singh

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Abstract

Meta analysis refers to the analysis of analyses. It is the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings.¹ Researches in biosocial sciences like anthropology, human anatomy, anthropometry etc which undertake a lot of measurements offer a good scope for biostatisticians to conventionally carry out preferably multivariate statistical analysis of data. Meta analytic approach of research synthesis is now becoming popular and enjoying wider acceptability in medicine and biosocial sciences. Unlike traditional methods, meta-analysis uses the summary statistics from individual studies as the data points. For example, if study X reported a mean decrease in systolic blood pressure of 5 mmHg in 50 subjects and study Y reported a mean decrease of 2 mmHg in 65 subjects, total n for analysis would be 115 subjects. Meta analysis provides a strong alternative to the more traditional review methods, and allow for quantitative conclusions to be reached. There are a variety of different procedures for conducting a Meta analysis.

Though, it is relatively a newer approach, apart from facing some resistance of competing conventional methodologies, it has emerged as an acceptable technique, which may be evident from its substantial share in the recent leading publications in various disciplines.

It may be argued that the current practice of Meta analysis is not an exclusive approach of combining end results of

independent studies. Accumulating results in some form or other has always been seen in traditional methods also.

Traditional chi-square test offers such an opportunity. A set of p-values obtained from independent studies testing the same null hypothesis may be combined to overall test the null hypothesis. If there are 'k' independent measurements, the resulting p-values will be independent and then the sum of k such p-values as $(-2\log p_1) + (-2\log p_2) + \dots + (-2\log p_k)$ will follow chi-square distribution with 2k degree of freedom. For example, (say) three different studies testing the same null hypothesis resulted in the p-values as $p=0.07$, $p=0.22$ and $p=0.09$ all showing not statistically significant. Now pooling p-values in the above way gives chi-square = 13.17. As the significant value of chi-square at 5% l.s. and 6 d.f. is 12.59 so, the result of pooled studies is statistically significant ($p<0.05$).

This approach of combining p-values and using traditional chi-square test though may not be labeled as Meta analysis but contains the spirit of Meta analysis approach. Therefore meta-statisticians and conventional-statisticians may not be viewed as mutually exclusive.

CORRESPONDENCE TO

6, Ganga Bagh Colony, Lanka Varanasi – 221005 India
Phone: 91-542-2367304 e-mail: drgirishsingh@yahoo.com

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Author Information

Girish Singh

Biostatistics Unit , Department of Basic Principles, Institute of Medical Sciences, Banaras Hindu University