



Mini Review

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A Note on the Application of Analysis of Variance in Medical Research

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Abstract

In medical and in any field of bioscience the social characteristics vary with respect to any of the health hazards of the investigating units. Some of the variations may be significant or insignificant. The significance of the variation is studied by observing the association of any of the health hazards with any or all of the socioeconomic variables. Significant association indicates that health hazard depends on the social character (s). Same study can be made by the application of analysis of variance if the dependent variable is quantitative. In this paper the application of analysis of variance was presented for the analysis of real data.

Introduction

Some of the data related to bioscience are socioeconomic characteristics which are associated with different types of communicable or non-communicable diseases. For example, age, height, weight, gender, marital status, religion, education, occupation, income, food habit, working conditions, smoking habit, and utilization of time are associated with many non-communicable diseases. This phenomenon was observed in many studies, home and abroad [1-20], especially these characteristics were found associated with level of obesity, prevalence of diabetes and prevalence of other non-communicable diseases. The level of obesity is measured by the ratio of body weight (in kg) to square of height (in m²). This measurement is known as body mass index (BMI) and it is a quantitative measurement. The study of association of this variable with any of the social characteristics is not possible if the variables are not classified into groups. For example, level of income and level of obesity are significantly associated [21]. Here level of obesity depends on level of income and this dependency can be studied if the values of both the variables are measured by numerical figures. In this type of analysis, the main objective is to verify whether the values of BMI vary with the variation of income and for which level(s) of income the BMI is significantly different. This type of information is not available from the study of association. This is possible if analysis of variance, one-way or multi-way, is applied. The analysis of variance helps to distinguish

between the average values of BMI for any two or more levels of income. In this note one-way analysis of variance was presented to distinguish the level of BMI of children and adults of Bangladesh with respect to some social characters.

The model for this analysis is

$$y_{ij} = M + a_i + e_{ij}, i = 1, 2, \dots, K; j = 1, 2, \dots, n_i, \text{ where}$$

M = Grand mean of the study variable,

a_i = Effect of i -th level of any characteristic on which study variable depends,

e_{ij} = Random component. It is assumed that this random component follows normal distribution with mean zero and common variance.

Further assumption is that a_i is not random variable.

Under the assumption mentioned above the usual analysis of variance technique can be applied. It gives

Sum of squares of study variable,

$$S = S.S(y) = \sum \sum y_{ij}^2 - C.T, S_1 = S.S(Characteristic) = \sum \frac{C_i^2}{n_i} - C.T$$

Here $C.T = \frac{G^2}{N}$, G = Grand total of study variable, N = total number of observations = $\sum a_i$.

C_i = total of study variable for i-th characteristic.

Now $S_2 = S.S.(Error) = (S - S_1)$. The results can be presented in the following analysis of variance (Table 1,2 & 3).

Table 1: Anova.

Sources of Variation	d.f	Sum of Squares S_1	$M.S S_i = \frac{S_i}{d.f}$	F	p-value
Characteristic	k - 1	S_1	s_1		
Error	N- k	S_2	s_2		
Total	N - 1				

Some Results of Analysis of Variance

In an investigation [16,20] using data of 662 children and adolescents of affluent families of Bangladesh it was observed that level of obesity measured by BMI was significantly associated with some of the socioeconomic characteristics of the children and their parents. The association indicated that level of BMI was significantly different for different levels of social characteristic. This differential behavior of level of obesity was studied here using the data of BMI instead of level of obesity. The analytical results were shown below. The analysis showed that due to the change in the levels of ages of children and adolescents the levels of BMI were significantly changed. The levels of BMI were also significantly different for those children and adolescents who had parents with different levels of education. Due to the change in the levels of family income there was significant difference in the level of BMI of the children. This analysis was almost similar as it was observed in other studies [16,20].

As another example the analytical results obtained from the data collected from 900 adults of Bangladesh [18,19] were presented here. This analysis indicated that the levels of BMI of the adults were significantly different according to the differences in the levels of residence, gender, age, education, occupation, income, smoking habit, marital status and prevalence of non-communicable diseases. This finding was also similar to those were observed earlier [18,19,22-25].

Table 2: Analysis of variance of BMI according to different social factors of Children and adolescents.

Sources of Variation	d.f	Calculated F	p-value
Residence	2	2.804	0.061
Gender	1	0.115	0.735
Age	2	6.357	0.002
Food habit	2	1.719	0.18
Utilization of time	3	2.578	0.053
Taking nutritious food	1	1.459	0.228
Non-communicable diseases	3	2.166	0.091
Father's education	3	2.65	0.048
Mother's education	3	5.115	0.002
Father's occupation	3	2.166	0.091
Mother's occupation	2	2.691	0.069
Family income	3	4.112	0.007

Table 3: Analysis of variance of BMI according to different social factors of adults.

Sources of Variation	d.f	Calculated F	p-value
Residence	1	5.002	0.026
Religion	1	0.002	0.961
Gender	1	22.218	0
Age	3	3.503	0.015
Education	4	2.715	0.029
Occupation	4	6.126	0
Income	4	5.656	0
Type of work	4	1.089	0.361
Marital status	1	4.318	0.038
Smoking habit	1	5.305	0.021
Prevalence of diabetes	1	1.402	0.237
Prevalence other diseases	4	2.645	0.032

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Conflicts of Interest

No conflicts of interest.

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