

## MENTAL STRESS AND EOSINOPHIL COUNT

By

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*(Received May 1, 57).*

A wide variety of conditions like acute infections, immersion in cold water, surgical and electrical shock, injections of sympathomimetic drugs, of insulin and many poisons have been observed to cause a decrease in the number of circulating eosinophils in animals and human beings. Dalton and Selye (1939), Rud (1947), Laragh and Almy (1949), Gabilove (1950), Recant et al (1950), Abelson and Moyes (1950), Kuhl and Ralli (1951), and Best and Samter (1951) stated that probably this fall is brought about through the agency of adrenocortical hormones.

Short term and diurnal fluctuations in eosinophil counts have been reported in human beings by Rud (1947), Fisher and Fisher (1951) and Donato and Strumia (1950).

Humphreys and Raab (1950) have similarly reported an eosinopenic response to stress of a written examination. Kerr (1956) has studied the effect of mental stress on eosinophil count in dental students and reported that such stress conditions could cause a considerable fall in the eosinophils in subjects who were "obviously anxious". These workers did not use any indices to denote the degree of anxiety.

The present investigation was undertaken to study the effects of mental stress of a viva voce examination on the eosinophil count in human subjects.

To assess the degree of state of anxiety, recording of the pulse rate, blood pressure, and blood sugar were undertaken, and an attempt has been made to correlate these factors with the degree of the eosinopenic response.

### MATERIALS AND METHODS

Investigations were undertaken in 123 normal healthy medical students, 82 males and 41 females, between the ages of 17 to 24 years. Subjects were examined clinically and those exhibiting any sign of disease were not included in the series.

Eosinophil count was undertaken by utilising the method as outlined by Manners (1951) and calculations were done by utilising the conversion factors of Best and Samter (1951). Diluting fluid for counting as outlined in the

method by Manner (1951) was used to determine the eosinophil count. A mean of three readings was taken as a representative count for a particular individual, under a particular condition. Eosinophil counts were undertaken in each subject in the afternoon. In 74 cases it was undertaken at the time of the viva voce test and also at the same time of the day, during the routine working days. In all 738 counts were made in these subjects.

Blood sugar by Folin and Wu method and vitamin C estimation by Photometric method of Hochberg Melnick and Oser were made in those subjects where the fall in eosinophils was over 100 percent.

A record of pulse and blood pressure readings of the subjects was made.

#### OBSERVATIONS

Eosinophil count in normal subjects under ordinary conditions is represented in table 1.

Table 1

Average Eosinophil blood count in normal subjects under resting conditions.

Number of cases.	(Eosinophil Counts per cu. m. m. of blood)
3.	0-5
0	6-10
5	11-20
11	21-30
10	31-40
10	41-50
30	51-100
33	101-200
13	201-300
3	301-400
1	401-600
4	above 500

Total No. of cases studied 123

On analysis of the results, it would be observed that eosinophil counts ranged from zero to above 500 per cu. m. m. in the series. In majority of the cases, about 51 percent, the count ranged from 50 to 200 per cu. m. m. of blood. In about 33 percent cases in the series the counts were below 50 per cu. m. m. while in about 16 percent it was over 200 per cu. m. m.

Eosinophil counts in the above subjects under the stress of the viva voce examination are represented in table 2.

Table 2.  
Eosinophil Blood Count during Viva Voce Test

Number of cases.		Eosinophil Counts per cu. m. m.
17	..	0 to 5
0	..	6 to 10
11	..	11 to 20
11	..	21 to 30
7	..	31 to 40
7	..	41 to 50
10	..	51 to 100
4	..	101 to 200
4	..	201 to 300
2	..	301 to 400
0	..	401 to 500
1	..	Above 500 (500 to 660)

Total number of cases counted. 74

In about 72 per cent of the cases (53) the eosinophil count was below 50 per cent cu. m. m., as compared to about 18 per cent of the cases (14) where it was between 50 and 200 cu. m. m. It was above 200 cu. m. m. in 9 per cent of the cases counted during viva voce.

On analysis of results it would be observed that the stress of viva voce test induces an eosinopenic response in majority of cases (about 66 per cent), (Table 3), where counts were correlated.

In about 72 per cent of cases, belonging to II year class, examined during viva voce for eosinophil count, the count fell by more than 40 per cent of the count on ordinary days, and out of these in about 18 per cent cases it fell by more than 100 per cent.

On the other hand in about 56 percent cases belonging to I year class, the count fell by more than 40 percent of the count on routine days, and out of these in about 13 per cent cases, it fell by more than 100 percent. (Table 3).

Table 3.  
Number of cases where count fell more than 40 to 100  
percent during viva.

II year	Fall of more than 100 percent 9 cases out of 51 cases.	Fall of more than 40 percent 36 cases out of 51.
I year	7 cases out of 23 cases.	13 cases out of 23.

Results of blood sugar analysis in cases showing eosinopenia during the stress of viva voce test showed that in about 50 percent cases showing 100 percent fall of eosinophil an associated rise of blood sugar beyond 120 mg. percent and in 10 percent of such cases even upto 266 mg per 100 c. c. blood was observed.

Vitamin C estimation in these subjects also gave low values ranging from 0.075 to 0.3 mg percent with an average of 0.15 mg percent.

Table 4.

Correlation of cases showing Eosinopenia\* and Pulse rate after viva.

Rise in Pules rate per minute.	Number of cases showing eosinopenia by more than 40 per cent.
10 to 20	5
21 to 30	3
31 to 40	10
41 to 50	21
51 to 60	4
61 to 70	5
71 onwards.	1

\*Only those subjects showing more than 40 per cent eosinopenia have been taken in this table.

In all the 49 cases showing eosinopenia of more than 40 per cent, rise in pulse rate was noticed. In 8 cases the rise ranged from 10 to 20, while in all the remaining cases it was over 20 beats per minute. In 5 cases it increased by 60 beats and in one case by 70. Rise in pulse rate upto 68 beats per minute was however also observed in 11 percent cases who did not show eosinopenia of more than 40 percent.

Correlation of Eosinopenia and Systolic blood pressure.

Rise in Systolic Blood Pressure in m. m. of Hg.	Number of cases showing Eosinopenia of more than 40 per cent
Nil	2
Upto 10	18
11 to 20	16
21 to 30	8
31 to 40	4
Above 41.	1

Out of 49 cases showing Eosinopenia, a rise in Systolic Blood Pressure ranging from 10 to 40 m.m. was observed, in 47 cases. In the remaining 2 it

practically showed no change. In 18 cases the rise was by only 10 m.m. and in the remaining 29 cases it was up to 20 m.m. Hg.

#### DISCUSSION

Normal eosinophil count has been reported differently by different workers (5 to 887 per cu. m.m. by Fisher (1951) and 50 to 500 by Hills et al (1948) and Thorn et al (1950)).

In the present investigation, although the figures range from zero to 858, in the majority of cases, it was from 50 to 300.

Eosinophils continue to be a subject of much research, specially with regard to their use as an index of adrenal function. Since they have been shown to decrease where no increase in blood steroids were apparent, and no increase in urinary output found, some doubt has been expressed concerning their use as an index of adrenal function. Evidence of unsatisfactory results obtained with the use of eosinophils as an index of adrenal function has been presented recently by Meyer (1953), Wolfsoh (1953) and de Mowbray (1953).

In the present investigation eosinopenia of an appreciable degree was induced in 66 percent of subjects by the stress of a viva voce test. It was more marked in II year students due to appear in the coming university examination and who were thus under a greater stress.

Thorn (1954) has shown that adrenalin produces eosinopenia in adrenalectomised animals, sustained by Cortisone.

In the present investigation in 66 percent of cases where marked eosinopenia was observed there was an appreciable increase in pulse rate and blood pressure in 100 percent cases; therefore the part played by adrenaline in these cases inducing eosinopenic response, cannot be overlooked. Rise in pulse rate and blood pressure was, however, also observed in 11 percent of cases who did not give any eosinopenic response.

Kerr (1956) has reported that well prepared students did not exhibit stress and eosinopenia. This is, however, not applicable in this study as two of the students who were well prepared and scored high marks, gave a marked eosinopenic response, upto 100 per cent. Self-confidence, and personality seem to be the factors which determine the state of stress in the examination and which affect the eosinophil response.

#### SUMMARY

Eosinophil count was undertaken in 123 cases undergoing stress of a viva voce test.

In all, 738 counts were undertaken before and at the time of the viva voce test. Normal values ranged from 5 to 858 per cu. m.m. In majority of

cases however the range was from 50 to 300 per cu. m. m. An appreciable fall in eosinophils was observed in 66 percent of cases exposed to mental stress of viva voce test. An attempt has been made to correlate eosinopenia with rise in pulse rate, blood pressure, blood sugar and vitamin C level in blood. The part played by mental make up and adrenaline in mental stress and the eosinopenic response has been discussed.

## ACKNOWLEDGEMENTS

Our thanks are due to Dr. B. C. Bose, M.D., D.Sc., Principal, M. G. M. Medical College, Indore, for his continued interest and help for stimulating research work from the department.

## REFERENCES

1. Abelson, D. and Moyes. (1950): *Lancet*, **2**, 50.
  2. Best, W. R. and Samter, M. (1951): *Blood*, **6**, 61.
  3. Dalton, A. J. and Selye, H. (1939): *Folia Haemat.* **62**, 397.
  4. De Mowbray (1953): *British Med. Jour.* **1**, 17.
  5. Donato, R. A. and Strumia, M. M. (1950): *Blood*, **5**, 1020.
  6. Fisher, B. and Fisher, E. R. (1951): *Amer. Jour. Med. Sc.*, **221**, 121.
  7. Gabrilose, J. L. (1950): *Jour. Clin. Endocrinol.* **10**, 637.
  8. Hills G. et al (1945): *Blood*, **3**, 755.
  9. Hinkle L. and Stewart, W. (1952): *Diabetes*, **1**:383.
  10. Humphreys, R. J. and Roab, W. (1950): *Proc. Soc. Exp. Biol. & Med.*, **74**, 302.
  11. Kerr, A.D. (1956): *Quarterly Jour. Exp. Physiol.*, **41**, 18.
  12. Kuhl, W. J. and Ralli Elaine, P. (1951): *Jour. Clinical. Endocrinol.* **11**, 776.
  13. Laragh, J. H. and Almy, R. P. (1948): *Proc. Soc. Exp. Biol. & Med.* **69**, 499.
  14. Manners, T. (1951): *British Med. Jour.*, 1429.
  15. Meyer, R. J. (1953): *Jour. Clin. Endocrinol. & Metabolism*, **13**, 123.
  16. Recant, L., Hume, D. M., Forsham, P. H. and Thorn, J. W. (1950): *Jour. Clin. Endocrinol.*, **101**, 187.
  17. Rud, F. (1947): *Acta Psychiat et Neurol., Suppl.* **40**, I.
  18. Thorn, G. W. et al (1950): *Jour. Clin. Endocrinol.* **10**, 187.
  19. Thorn, G. W. Laidlaw (1954): *Trans. Amer. Clinical Ass.*, **65**, 179.
  20. Wolfson, W. G. (1953): *Jour. Clin. Endocrinol and Metabolism*, **13**, 123.
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