

## **Research Article**

### **Determination of Stress among Women by Discriminant Function Analysis in Sub-Urban area of South Chennai, India**

**P. J. Parameaswari<sup>1\*</sup>, R. Ravanan<sup>2</sup>, P.M. Udayshankar<sup>3</sup>, B. Kamini<sup>4</sup>**

<sup>1</sup>Asst.Professor Biostatistics, Sree Balaji Medical College & Hospital, Bharath University, Chennai, India

<sup>2</sup>Professor & Head, Department of Statistics, Presidency College, Chennai, India

<sup>3</sup>Professor & Head, Department of Community Medicine, Sree Balaji Medical College & Hospital, Bharath University, Chennai, India

<sup>4</sup>Asst. Professor, Department of Community Medicine, Sri Muthukumaran Medical College Hospital & Research institute, Chennai, India.

#### **\*Corresponding author**

Dr.P.J.Parameaswari,

**Email:** [dr.parameaswari@rocketmail.com](mailto:dr.parameaswari@rocketmail.com)

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**Abstract:** Stress is one of the prime factor for most of the illness in human's life. The aim of this study was to construct Discriminant Function with its Score from STRESS levels measured on 200 women of reproductive age group. A Cross-Sectional, Sample Household Survey was conducted in Sub-Urban Chennai over a period of 6 months. The data was collected on first hand by Personal Interview method in presence of the Community Physician and Psychiatrist. Statistically we observed a Prevalence of 69.5% women with Stress and was significantly high among the Age <30 years & those with BMI<25 and majority of the participants were housewife. Discriminant Function Score of 0.41 with a Canonical Correlation = 0.78; Wilk's Lambda = 0.392 &  $\chi^2 = 167.91$  (P=0.000) by 'Enter method' and DF Score of 0.35 with a Canonical Correlation = 0.73; Wilk's Lambda = 0.465 &  $\chi^2 = 145.07$  (P=0.000) by 'Step wise method' indicates that the two discriminant functions does better than chance at separating women 'with' and 'without' Stress. More than 93.0 percent of Original group cases were correctly Classified in both methods. Hence 17 Life Changing Events responsible for STRESS from this study constructed a Discriminant Function Model. Further research was continued with a larger population.

**Keywords:** Discriminant Function Analysis, Sample Survey, Holmes & Rahe Stress Scale, Random Sampling, Wilk's Lambda, Centroids.

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#### **INTRODUCTION**

Discriminant Analysis [1] builds a predictive model of group membership based on observed characteristics of each case. The procedure generates a discriminant function on linear combinations of the predictor variables that provide the best differentiation between the groups.

Assumptions of this model:[2]

1. There is not much correlation between predictors
2. There is no correlation between mean and variance of a predictor
3. There is a constant correlation between 2 predictors across groups
4. Values of each predictor have a Normal distribution

In this study we wished to build a "Algorithmic Model for Stress" [3] of how we can best predict to which group a 'Woman' belongs. The biggest Stress was felt among women of 25-55 years of age,

typically married where expectations from women have risen and where conflicts between what all women must do too has surged [4]. The working and non-working women on prenatal diagnostic procedures experienced similar psychological distress in Allison et al study [5]. But their stress & anxiety correlated highly with health scores of working women. The prevalence of Post-Traumatic Stress Disorder after childbirth in Nigerian women was slightly higher than those found in western culture and the need for an effective model was highlighted in Adewuya AO, et al findings [6].

#### **Rationale:**

We observed a Prevalence of STRESS as 69.5% [7] and Women with younger Age < 30 years and BMI < 25 were more Stressed leading to a major risk of developing illness with statistical significance.

#### **Objectives**

1. To derive Discriminant Function with its Scores and Classify Women according to

STRESS by Enter method [8] and test for its Statistical Significance.

2. To construct Discriminant Function with its Scores and Classify Women according to STRESS by Stepwise method [9] and test for its Statistical Significance.

This study was sanctioned by the Institutional Research and Ethical Committee Board, Chennai.

**MATERIALS & METHODOLOGY:**

Design: Cross –Sectional Study: Sample Household Survey [10]

Place: Sripuram, the field practice area of the institution from South Chennai, India.

Period: July 2012 to Jan 2013.

Participants: Women of reproductive age group (18-45) years

Sample Size: The minimum required sample size [11] was estimated to be 69 women with Proportion of 87.0 on STRESS from Nielsen’s Survey [12] ,  $\alpha = 0.05$ , limit of accuracy 10% and an attrition of 20% using the formula,  $N = [Z\alpha^2P(1-P)] / [L\%(P)]^2$

**METHODOLOGY**

**Stage 1:** Therefore, 300 out of 3238 households from Sripuram area of South Chennai was randomly selected by Systematic Random Sampling method [13], i.e. every 11<sup>th</sup> household.

**Stage 2:** One women of the age group (18-45) years were recruited by Simple Random .Sampling method after obtaining the written informed consent.

The data about Socio-Economic and Holme-Rahe Stress scale was collected on first hand by the Principal Investigator by Interview method in presence of the Community Physician and Psychiatrist in a Pre-Structured Closed end type Questionnaire in the Vernacular language. The Holmes and Rahe Stress Scale for Adults [14] is a well-known tool for

measuring the amount of Stress a person has experienced within the past one year and helps to find if she is at risk of illness due to Stress. Each event, called a Life Change Unit (LCU), had a different "weight" for stress. The more events the patient added up, the higher the score. The higher the score, and the larger the weight of each event, the more likely the patient was to become ill.

**Statistical Analysis:**

The response to the Holme-Rahe Stress scale (Yes or No) were scored based on the weights provided for each of the ‘Life Change Units’. If the Score < 150 woman had ‘NO STRESS’ coded as ‘0’ and a value  $\geq 150$ , Woman was ‘WITH STRESS’ coded as ‘1’. SPSS 15.0 was used for data analysis [15]. The results are presented as Descriptive statistics - frequency, percentage, range, mean, standard error, Centroids and the Inferential statistics - Chi Square test , Box-M test, Canonical Correlation, Wilk’s Lambda were used to test for the statistical significance at 5% type I error and 10% of type II error[16]. The values within parentheses represents percentages.

**RESULTS**

Thirty Three (16.5) participants of our study had accepted that they were stressed and 167(83.5) without stress. Seventy eight (39.0) were above 30 years with majority 162(81.0) were married, 159 (79.5) house wife and seventy two percent had education lesser than or equal to Higher Secondary level. The participants had and ‘Abdominal Obesity’ ranging between 0.80 to 0.99, where 176(88.0) belonged to medium Standard of Living. Fig 1 shows, 118 (59.0) were unaware of experiencing Stress and their Descriptive Stress score measures on 41 life changing events from Holmes Rahe Stress Scale is highlighted in Fig 2. Further we observed, 3.0 percent had Stress Score >300 (HIGH risk for illness), 58.5 percent with Score between 151 and 299 (MODERATE risk for illness), 1.0 percent with Score equal to 150 (MILD risk for illness) and 30.5percent with Score <150 (NO risk).

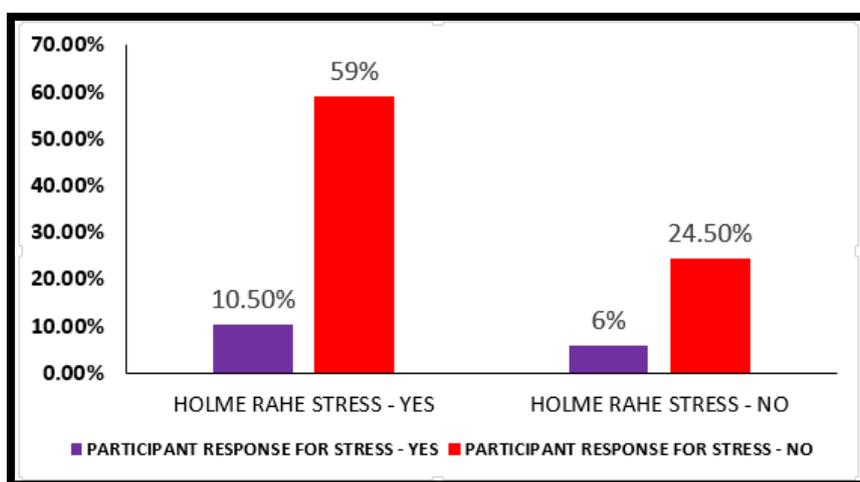


Fig 1. Bar Diagram for Participants Response and Holme Rahe Stress Scale

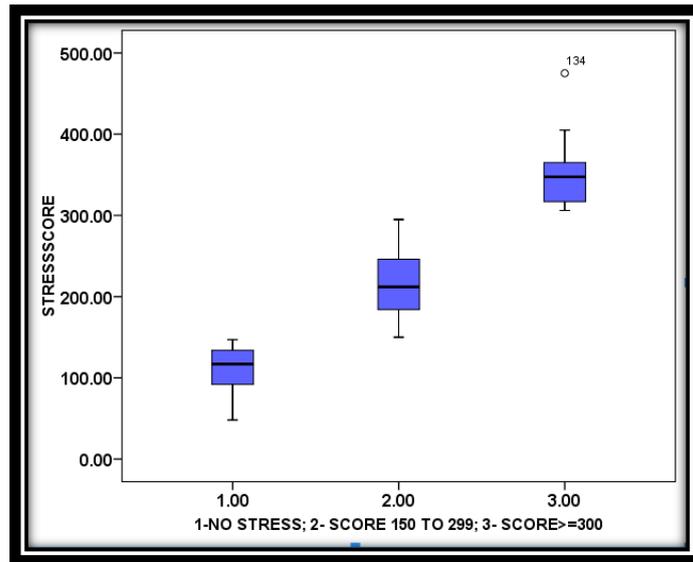


Fig 2. Box Plot for Holme Rahe Stress Score

**Discriminant Function Analysis by Enter Method:**

Stress = Present / Absent was the Criterion (dependent) variable of this study and 41 life changing events from Holme – Rahe Scale were the Predictors (independent variable). The equality of two group means and a square of Canonical Correlation of +0.78 contributing to the variance explained in the Criterion variable with a statistically significant multivariate -

Wilk’s Lambda = 0.392 [ $\chi^2=167.91$  (P=0.000)] were observed. The Discriminant Function was constructed with the unstandardized Canonical Discriminant Function Coefficients. Since the group size of women ‘with’ and ‘no’ stress were unequal, the Optimal cutting point was the weighted average of the two group Centroids.

$$\text{Discriminant Function Cut Score} = \frac{(-1.871) + (0.821)}{2} = (-1.05)$$

Therefore if a woman’s DF Score is less than -1.05, then there was probably “Absence” of STRESS and if it is greater than -1.05, then there was probably “Presence” of STRESS. Further Classification Table showed 93.5% of the cases were correctly classified with a Sensitivity of 92.1% and a Specificity 96.7%.

**Discriminant Function Analysis by Stepwise Method:**

Within-group correlation matrix and the homogeneity of CoVariance matrices were of insignificant differences by Box’s test. We observed ‘Marital Separation’ as the single best predictor, ‘Major mortgage’ as next-best one, ‘Marriage’ is the third best one, ‘Personal Injury or Illness’ was the fourth best one,...totally 17 events was included in a model to get the best possible prediction.

The Wilk’s lambda [1] in Table 1 for each step shows a model with a good fit for the data with just one predictor (Marital separation) or with two predictors (Marital Separation & Major Mortgage) or (1 & 2 & 3) or (1 & 2 & 3 & 4) or and so on till (1 & 2 & .....&16 &17) . i.e. P=0.000 for all Lambdas. The Canonical Discriminant Function yielded an Eigen value [17] of 1.15 and a Canonical Correlation of = +0.731 suggests that the model explains 53.5% of the variation in the Criterion variable with the Wilk’s Lambda = 0.465 ,  $\chi^2 =145.07$  (P=0.000) indicates that the ‘discriminant function’ does better than chance at separating the groups. From the Unstandardized Canonical Discriminant Function Coefficients, we constructed a predictive equation using the 17 best predictors as mentioned in equation 1.

$$DF = (-3.428) + (0.020)*\text{Marital Separation} + (0.019)*\text{Major Mortgage} + (0.018)*\text{Marriage} + (0.026)*\text{Personal Injury or Illness} + (0.020)*\text{Trouble with in-laws} + (0.025)*\text{Change in living Conditions} + (0.022)*\text{Sexual Difficulties} + (0.012)*\text{Death of a close family member} + (0.039)*\text{Change in responsibilities at work} + (0.027)*\text{Change in financial state} + (0.19)*\text{Dismissal from work} + (0.34)*\text{Change in health of family Member} + (0.016)*\text{Spouse starts or stops work} + (0.028)*\text{Gain a new family member} + (0.037)*\text{Foreclosure of mortgage or loan} + (0.045)*\text{Retirement} + (0.031)*\text{Marital Reconciliation} \dots \dots \dots 1$$

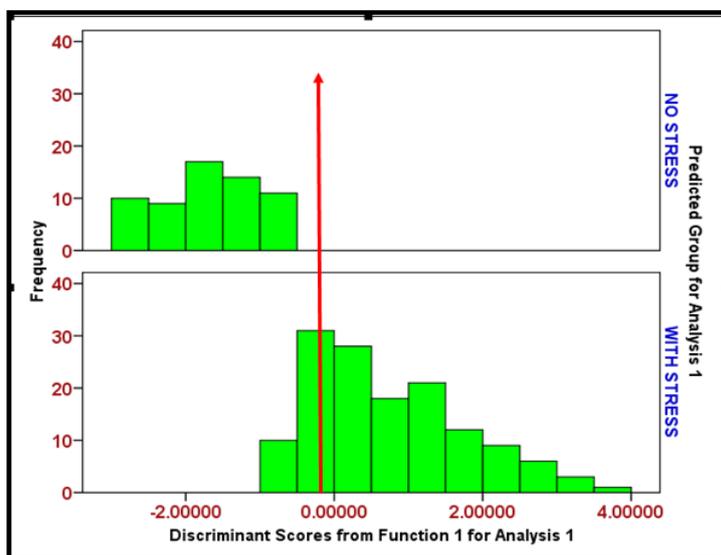
From the Functions at Group Centroids (-1.0611 & 0.707) of STRESS, if the DF Score was lesser to weighted average (-0.3541), there was “NO STRESS” for that woman and if the DF Score was greater than -0.3541), the woman was “WITH STRESS”. Further results highlighted that 89.0% of Cross-Validated grouped cases were correctly classified

with Sensitivity= 97.1%, Specificity=91.8%, PPV=88.5% and NPV= 94.9%. Fig 3 shows the histogram [18] of “Discriminant Scores for the Predicted Groups ( NO STRESS , WITH STRESS )” indicating that the two distributions does not overlap too much as highlighted by red vertical line. So it is a Good discriminant function.

**Table 1. Inferential Statistics on Best Predictors**

Step-Variable	Wilk’s Lambda	F-value (P-value)*
1. Marital Separation	0.902	21.47 (0.000)
2. Major Mortgage	0.846	17.88 (0.000)
3. Marriage	0.791	17.30 (0.000)
4. Personal Injury or Illness	0.739	17.18 (0.000)
5. Trouble with in-laws	0.693	17.16 (0.000)
6. Change in living conditions	0.666	16.15 (0.000)
7. Sexual Difficulties	0.636	15.72 (0.000)
8. Death of a close family member	0.605	15.58 (0.000)
9. Change in responsibilities at work	0.588	14.81 (0.000)
10. Change in financial state	0.566	14.48 (0.000)
11. Dismissal from work	0.546	14.20 (0.000)
12. Change in health of family member	0.527	14.00 (0.000)
13. Spouse starts or stops work	0.513	13.60 (0.000)
14. Gain a new family member	0.499	13.25 (0.000)
15. Foreclosure of mortgage or loan	0.487	12.90 (0.000)
16. Retirement	0.476	12.58 (0.000)
17. Marital Reconciliation	0.465	12.31 (0.000)

\*Statistically Significant



**Fig 3. By Stepwise method**

**DISCUSSION**

The main findings of this study are

1. Discriminant Function Score of -1.05 with a Canonical Correlation = 0.78; Wilk’s Lambda = 0.392 &  $\chi^2 = 167.91(P=0.000)$  by ‘Enter method’ was statistically significant.
2. Discriminant Function Score of -0.35 with a Canonical Correlation = 0.73; Wilk’s Lambda = 0.465 &  $\chi^2 = 145.07 (P=0.000)$  by ‘Step wise method’ was statistically significant.

3. The Discriminant Function in Equation 1 with 17 Life Changing Events does better than chance in separating Women ‘WITH’ and ‘NO’ Stress, and can be used for predicting unknown cases.

Among the 139 women with stress, 88(63.3) from the nuclear family and there was significantly high score among the women with age less than 30 years & BMI ≤ 25 [7] suggested the need for intervention. As most of our demographic variables did not show much significant association with presence of stress other than

the above two parameters. The 'Hit Rate' [3] observed in our study was 97.1% and 91.8% by Stepwise method. Emilia and Noor Hassim's Cross-sectional study on work-related stressors among nurses in a public teaching hospital had also attempted to explore functions of coping strategies in determining stress [19] but in our sample we had only 36(18.0) were working women who had moderate stress score. The prevalence of PTSD after childbirth in Nigerian women is slightly higher than those found in western culture [5] was also one of the reason for targeting the women of the reproductive age in our study.

The main application of discriminant analysis was to assess severity of Stress of all women. All women at risk of developing illness i.e. with stress, were referred to tertiary care hospital for further psychiatric assistance. In this retrospective analysis, women were divided as mild, moderate and severe based on variables which are statistically significant led us to construct Fisher's Linear discriminant functions in order to classify stress level for a future patient. Probably the most common application of discriminant function analysis is to include many measures in the study, in order to determine the ones that discriminate between groups.

The within-group correlation matrix showed correlation between predictors and the assumption of homogeneity of covariance matrix was tested by Box's M. 'Change in health of family member' had a large absolute value corresponding to the greater discriminating ability and Marital separation as the single best predictor followed by Marital separation with Major Mortgage as the next best predictors in our study. The Stepwise method yielded us the best discriminant function model with 17 important variables.

## CONCLUSION

The Holme's & Rahe Stress scale with 41 pertinent life changing events used for measuring the Stress level in the clinics were applied at the community level and hence could be used as a screening tool along with DF scores in classifying the unknown women with and without Stress in a better than chance. Further, an effective model for prediction of Stress level is constructed with a larger sample size, and preventive measures were taken to reduce the incidence of Stress.

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