

APPLICATION OF STRUCTURAL EQUATION MODELS TO ESTIMATE ONE PERSONALITY TRAIT FROM OTHERS WITH PARENTAL MENTAL HEALTH AS A LATENT VARIABLE

Mathematics

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ABSTRACT

Introduction: Adolescence is a transformational but vulnerable age. Personality starts taking shape at this age and the traits developed during this phase are likely to remain with a person for the whole life. A favourable atmosphere at home and surroundings play a pivotal role in development in different dimensions of personality. Lack of a support system may result in some psychiatric disorders among adolescents which might needs to be addressed. Eysenck personality questionnaire is a psychiatric tool to assess various dimensions of personality. **Methods:** Structural equation models with two and three layers were applied to estimate personality traits as identified by Eysenck personality questionnaire on two groups of adolescents: (i) The 'Control' group whose parents were not reported any psychiatric disorder; and (ii) the 'Case' group whose parent(s) were suffering from some psychiatric disorder as diagnosed by DSM-IV. **Results:** The conventional three-layer model for 'Control' group estimated 'Psychoticism' directly by 'Lie-scale' and indirectly by 'Extraversion' with p -values < 0.05 . The two-layered model yielded no significant difference between the base and the proposed model for 'Control' and 'Case' group as p -values were more than 0.05. The variability of Neuroticism was estimated up to 63.6% by a linear combination of Psychoticism, Lie-scale and Gender in Layer 1 of the model for the 'Control' group. **Conclusion:** In this study either through the conventional three-layer model or the proposed two-layer models, we concluded that some information about one dimension can be extracted from the other dimension with EPQ even if the correlation is not significant. Also, the proposed two-layer model established the effect of gender at 10% level of significance in case of 'Control' group. Psychoticism and Neuroticism mean scores were higher for the 'Case' groups than those for the 'Control' group thus establishing the effect of parental mental health on adolescents' personality.

KEYWORDS

Comparative Fit Index, Eysenck Personality Questionnaire, Parental mental health, Root Mean Square Error, Structural Equation Models.

1. INTRODUCTION

Adolescence is a transitional phase between childhood and adulthood and is the beginning of the biological, social, and psychological maturity. Tremendous changes, physical, psychological, and behavioral, are observed during this phase. Personality starts taking shape at this age and the personality traits developed during this phase are likely to remain with a person for the whole life. Since personality traits are inseparably related to the social environment around us, so a healthy atmosphere at home, school and society at large play a pivotal role in shaping personality of an individual. However, adolescence is a vulnerable age and absence of any component of the support system needed for a healthy growth of a person may lead to development of personality disorders (PDs) (Kasen et al, 1999; Adshead et al, 2012; Larrivee, 2013). Also, sometimes it is difficult to distinguish a personality disorder from the typical adolescents' personality traits which may aggravate the problem due to delay in identification of the same. Nonetheless treatment of these disorders at this budding stage is crucial as untreated disorders often lead to social isolation, drug abuse, suicides, and other anti-social activities (Adshead et al., 2012; Larrivee, 2013; McGorry, 2013).

The study of adolescent personality has been an area of immense interest and extensive research is done by psychiatrists and psychologists. A number of tests and tools have been developed to examine various personality traits and causes of any deviations of these traits from the set standards i.e., emergence of personality disorders. **Millon Adolescent Personality Inventory** is a 150-items personality inventory for adolescents between the age of 13 and 18 years, which correlates personality styles based on Millon's theory of personality types with DSM-III-R diagnostic criteria (Gurley, 2011). The **16 PF** questionnaire, initially developed by Raymond B. Cattell in 1950 and later modified several times, is a 185-items questionnaire which summarizes personality into 16 factors and uses factor analysis to determine the inter-dependency of the traits (Cattell, 1988). **Eysenck Personality Questionnaire** (EPQ) is another personality assessment questionnaire which identifies four personality traits viz. Psychoticism (P), Extraversion (E), Neuroticism (N) and Lie-scale (L). H. J. Eysenck and Sybil B. G. Eysenck developed a 40-items questionnaire named Maudsley Medical Questionnaire, which was subsequently followed by a 48-items Maudsley Personality Inventory and 57-items Eysenck Personality Inventory (EPI) (Eysenck, 1952; Eysenck, 1959; Eysenck, 1964). These questionnaires were used to assess two personality traits namely, Extraversion and Neuroticism. Introduction of a third personality trait Psychoticism and later the fourth trait Lie-scale lead to

development of 90-items Eysenck Personality Questionnaire (EPQ) and 100-items Revised Eysenck Personality Questionnaire (EPQR) (Eysenck, 1975. Eysenck, 1985; Tiwari et al, 2009).

The wide acceptance of EPQ is due to its availability across the globe and translation into regional/local languages. The four dimensions of personality are a culmination of various factors and are somewhat independent (Eysenck & Eysenck, 1991). Extraversion is a trait of high energy, talkativeness, and outgoingness; Neuroticism is associated with anxiety and depression levels, Lie/Sociability trait arises from the generic behaviour; and tough mindedness, hostility, recklessness are basic features of Psychoticism. One of the determinants of the four dimensions of the personality is the cultural environment, so EPQ has been used to study the effect of cultural differences on personality. In a similar comparative study of personality between the adults and children of Hong Kong and Britain, it was found that the scores of Hong Kong adults were higher in Psychoticism and Social Desirability and lower in Extraversion than the British adults wherein children from Hong Kong have lower score in Extraversion and Neuroticism but higher in Social Desirability than the British Children. The primary reason for these variations is found to be the cultural differences between the countries and somewhat the translation also changes the purpose of the question (Eysenck, 1982). Damodaran et al. (2015) studied the six subscales of personality: anxiety, depression, loss of behavioural /emotional control, general positive effect, emotional ties, and life satisfaction, among the youth of Kerala. Using EPQ they established the relation of Neuroticism with anxiety, depression, and loss of behavioural and emotional control among the youth of Kerala, India.

Structural Equation Models (*SEM*) are useful in case of non-experimental data and are well accepted in the field of psychology, economics, business, and other social sciences applications. *SEM* is a set of multivariate statistical techniques of identifying, estimating and validating the hypothesized relationships (linear or non-linear) between a set of variables and specifying measurement errors in the data when the cause and response variables are not clearly distinguishable and also to assess the effects of unobservable 'latent' variables and constructs. The most common models in *SEM* analyses are MANOVA, Path analysis, Confirmatory factor analysis and Latent Growth Curve Models (Kline, 1998). Cunningham et al. (2008) conducted a survey among Canadian youth to examine the relationship between a latent variable (demoralization) and measured variables (anxiety, depression, and hopelessness) through *SEM* and concluded

that there is a close relationship between latent variable and measured variables [18]. Cherewick et al. (2016) applied *SEM* (i) to explore the effects of trauma exposure and coping strategies on the psychology and well-being of youth; and (ii) to find the role of peer relationships, family, and caretakers in the stress management. Theerthaana and Sheik (2019) used *SEM* to determine the direct factors and moderators namely neuroticism, conscientiousness, extraversion, and intellect on gender disappointment. Their study concluded that societal pressure, cultural factors, economic expectancy, and safety expectancy significantly explain the gender disappointment with girl child.

In this study we wish to examine the role of parents' mental health which affects home environment, on adolescent personality. For this objective, data was collected on two groups of adolescents using 90-item EPQ: The 'Control' group consisted of class XI students of a New Delhi based school, whose parents were not reported any psychiatric disorder; and the 'Case' group consisted of students whose parent(s) were suffering from some psychiatric disorder. The data on the two groups was analyzed using a three layered Conventional Structural Equation Model, based on the hierarchy of personality traits identified during the development of EPQ (*CSEM*) and a two layered Proposed Structural Equation Model (*PSEM*) postulating a personality trait as a linear combination of other traits. Through these two models, we wish to extract information about one or more personality dimension(s) from the other(s) with parental mental health being a latent variable. Besides introduction this paper includes three more sections. In section 2 material and methods are discussed. Section 3 applies the models to both the data sets and some concluding remarks are made under discussion in section 4.

2. MATERIALS AND METHODS

2.1 Material

Data was collected using 90-item EPQ questionnaire (having 24 Psychoticism (*P*) items, 21 Extraversion (*E*) items, 24 Neuroticism (*N*) items and 21 Lie-scale (*L*) items) on two groups of adolescents (age group 15-18 years): the first group ('Control' group) consisted of 84 willing and eligible students of class XI from Kerala Education Society senior secondary School, New Delhi. The parents of these students were not reported any psychiatric disorder. Responses were collected from this group in a single visit, in the presence of a child psychiatrist and school authorities. The second group ('Case' group) consisted of 58 students whose parent(s) were suffering from some psychiatric disorder as identified by DSM IV and were utilizing the services of the Department of Psychiatry and Drug De-addiction Center, Lady Hardinge Medical College, New Delhi. The method of sampling for this group was purposive as the data was collected only from those adolescents who accompanied their ill parents in the hospital during the period of data collection. The adolescents from both the groups were matched on the basis of socio-economic status, age, gender and educational level. Adolescents suffering from head injury with neuro-organic consequences and/or any chronic (non-psychiatric) disease were excluded from the study.

2.2 METHODS

Simultaneous Equations Models (*SEM*) is an extension of multiple regression analysis. It is a multivariate technique specifying simultaneous relationships between observed (measured) and/or latent (unobserved) variables which can be exogenous or endogenous. The relationships can be direct, indirect, multiple or reversed and there can be several layers of relationships. A three-layer *SEM* model specifying relationships between *P*, *E*, *N*, and *L* traits of personality (as deduced from EPQ) is given by:

Layer 1: $N = \alpha E + \epsilon$

Layer 2: $E = \beta P + \upsilon$

Layer 3: $P = \gamma L + \delta$

α , β , and γ are layer wise regression coefficients; ϵ , υ and δ are the noise terms.

Figure 1 is the pictorial representation of the model (*CSEM*).

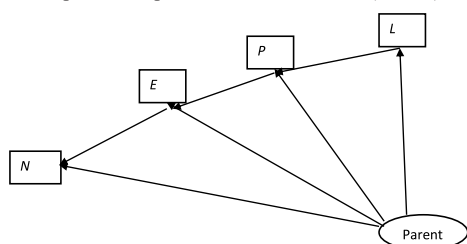


Figure 1: The Conventional Simultaneous Equation Model (*CSEM*) specifying the three-layered relation between Neuroticism (*N*), Extraversion (*E*), Psychoticism (*P*) and Lie-scale (*L*).

'Parent' is a latent variable presenting parental mental health.

A two-layer *SEM* with a number of predictor variables (*PSEM*) has been proposed; *G* denotes the 'Gender' of the participant. The structural form of the model is:

$$N = \alpha_1 P + \beta_1 L + \gamma_1 G + \epsilon_1$$

$$P = \alpha_2 E + \beta_2 L + \gamma_2 G + \epsilon_2$$

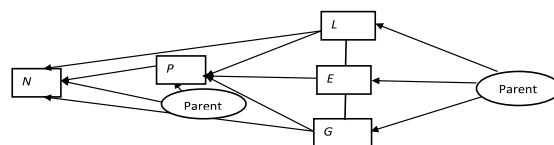


Figure 2: The Proposed Simultaneous Equation Model (*PSEM*) specifying a two layered relation between Neuroticism (*N*), Extraversion (*E*), Psychoticism (*P*), Lie-scale (*L*) and Gender (*G*).

Figure 2 is the graphical representation of *PSEM*.

2.2.1 Indices for comparing baseline and alternative models

The Comparative Fit Index (*CFI*), Tucker-Lewis Index (*TLI*) and Root Mean Square Error (*RMSEA*) are the indices which are used to compare the performance of alternative model with the baseline model.

The *CFI* is based on non-centrality measure and is given by

$$CFI = \frac{(\chi^2 - df)_{\text{Baseline model}} - (\chi^2 - df)_{\text{Alternative model}}}{(\chi^2 - df)_{\text{Baseline model}}}$$

where χ^2 is computed for the proposed model for *df* degrees of freedom.

The *TLI* is non-normed fit index and is defined as

$$TLI = \frac{\left(\frac{\chi^2}{df}\right)_{\text{Baseline model}} - \left(\frac{\chi^2}{df}\right)_{\text{Alternative model}}}{\left(\frac{\chi^2}{df}\right)_{\text{Baseline model}} - 1}$$

Both the indices have values between 0 and 1 (values less than zero are set at 0 and values greater than 1 are set at 1). The larger the values, better is the alternative fit (Hu & Bentler, 1999).

The *RMSEA* is an absolute measure of fit given by

$$RMSEA = \frac{\sqrt{\chi^2 - df}}{\sqrt{df(N-1)}}$$

N is the sample size. A smaller *RMSEA* corresponds to a good fit.

3. RESULTS

In the 'Control' group, out of 85 students, 42 (49.4%) were girls and 43 (50.6%) boys. However, in the 'Case' group of 58 adolescents, the number of girls was 12 (21%) and the number of boys was 46 (79%).

3.1 Data Description

For 85 adolescents of the 'Control' group and 58 of the 'Case' group, descriptive statistics were computed and compared. The results are presented in the Table 1.

Table 1: Descriptive of the data (Case-control table)

Statistics	Group	Personality scale			
		<i>E</i>	<i>P</i>	<i>N</i>	<i>L</i>
Mean	Control	14.90	6.00	9.85	9.45
	Case	13.95	6.34	13.62	10.78
Median	Control	15.00	6.00	14.00	9.55
	Case	15.00	6.00	9.00	11.00
SD	Control	3.38	3.02	4.00	1.67
	Case	3.04	2.89	4.12	4.42
95%CI	Control	(14.24, 15.56)	(5.69, 6.99)	(8.75, 10.94)	(9.09, 9.81)
	Case	(13.18 14.72)	(5.15 7.31)	(12.76, 14.49)	(9.60, 11.99)

-Neuroticism, -Extraversion, -Psychoticism, -Lie-scale

For all the four dimensions, the data is slightly positively skewed. Although the mean values were higher than the point norms but were in the 95% confidence intervals for all the four dimensions and hence were statistically equal to norms. In fact, the confidence intervals for this data were much compact than the norm intervals. We then computed the bivariate correlations among the dimensions of EPQ for both the groups and observed that dimensions are not correlated in both the groups. The results are shown in Table 2.

Table 2: Bivariate correlations among the personality traits for both the groups

Group	Control				Case			
Personality traits	<i>P</i>	<i>E</i>	<i>N</i>	<i>L</i>	<i>P</i>	<i>E</i>	<i>N</i>	<i>L</i>
<i>P</i> [*]	1				1			
<i>E</i> [*]	0.272 (<0.011)	1			-0.151 (>0.05)	1		
<i>N</i>	0.144 (0.189)	-0.077 (0.4796)	1		0.245 (0.056)	0.119	1	
<i>L</i> [*]	0.376 (<0.001)	-0.031 (0.761)	0.745 (<0.001)	1	-0.266 (0.041)	0.114	-0.295 (0.011)	1

*-Neuroticism, ^-Extraversion, ^-Psychoticism, ^-Lie-scale.
In brackets, *p*-values are there.

3.2.1 Conventional structural equation model to find the relationship between four dimensions of personality for both groups.

SEM is applied after testing for the basic assumptions about the sample size, normality, independence, outliers and collinearity. Conventional approach is to analyze personality traits by finding relationship between 'Neuroticism' and 'Extraversion'; followed by inclusion of 'Psychoticism' and finally that of 'Lie scale'. In SEM framework, 'Extraversion' and 'Neuroticism' are the direct variables (DVs) and 'Psychoticism' and 'Lie scale' are indirect variables (IVs) to estimate 'Neuroticism'. The Conventional structural equation model (CSEM) is given by:

Layer 1: $N \sim E$
Layer 2: $E \sim P$
Layer 3: $P \sim L$

Parental mental health is the latent variable. Layer 1 is the outermost layer and layer 3 is the innermost layer. Comparison of the results under CSEM with base model are given below in Table 3. Under both the groups CSEM deviates and is a weaker model than the base model as suggested by different measurement indices. Based on individual contribution of variables we found from CSEM for control group that Lie-scale is significantly explaining *P* (Layer3), which in turn is significantly explaining *E* (Layer 2) with *p*-value less than 0.05 in both the layers. But *E* is not explaining *N* significantly (Layer 1). Under 'Case' group CSEM is not explaining effect of one variable (direct or indirect) over other personality traits as *p*-value is greater than 0.05. The detailed results are given in Tables 3 & 4.

Table 3: Comparison of Conventional Structural Equation Model with base model (LAVAAN) for both the groups

Test statistics	SEM- 3-layer Model	
	Control Group	Case Group
Estimator	ML	ML
Optimization method	NLMINB	NLMINB
Number of free parameters	6	6
Number of observations	85	58
Number of iterations	19	19
Model Test User Model:		
Test statistic	74.761	8.113
Degrees of freedom	3	3
<i>p</i> -value (Chi-square)	<0.000	0.044
Model Test Baseline Model:		
Test statistic	94.794	10.930
Degrees of freedom	6	6
<i>p</i> -value	0.000	0.091

User Model versus Baseline Model:		
Comparative Fit Index (<i>CFI</i>)	0.192	0.000
Tucker-Lewis Index (<i>TLI</i>)	-0.616	-1.074
Loglikelihood and Information Criteria:		
Loglikelihood user model (<i>H₀</i>)	-658.116	-459.829
Loglikelihood unrestricted model (<i>H₁</i>)	-620.735	-455.773
Akaike (<i>AIC</i>)	1328.232	931.659
Bayesian (<i>BIC</i>)	1342.887	944.021
Sample-size adjusted Bayesian (<i>BIC</i>)	1323.9591	925.157
Root Mean Square Error of Approximation:		
<i>RMSEA</i>	0.530	0.171
90 Percent confidence interval	(0.430, 0.638)	(0.026, 0.319)
<i>p</i> -value <i>RMSEA</i> $\leq$ 0.05	0.000	0.068
Standardized Root Mean Square Residual (<i>SRMR</i>)	0.248	0.114

*-Neuroticism, ^-Extraversion, ^-Psychoticism

Table 4: Regression Coefficients of Conventional Structural Equation Model for 'Control' and 'Case' group

Model equations	Group	Estimated model parameter	Estimate	Std. Err	<i>z</i> -value	<i>P</i> ($> z $)	<i>R</i> ²
$N \sim E$ $E \sim P$ $P \sim L$	Control	<i>E</i>	-0.102	0.142	-0.719	0.472	0.006
		<i>P</i>	0.274	0.105	2.607	0.009	0.074
		<i>L</i>	0.680	0.182	3.744	<0.001	0.142
	Case	<i>E</i>	0.224	0.185	1.211	0.226	0.025
		<i>P</i>	0.038	0.112	0.340	0.734	0.002
		<i>L</i>	-0.112	0.099	0.260	-0.112	0.021
Fitted Model	Control	Layer 1 - $N = -0.102 E$; Layer 2 - $E = 0.274 P$; Layer 3 - $P = 0.680 L$					
	Case	Layer 1 - $N = 0.224 E$; Layer 2 - $E = 0.038 P$; Layer 3 - $P = -0.112 L$					

*-Neuroticism, ^-Extraversion, ^-Psychoticism

3.2.2 Proposed structural equation model to find the relationship between four dimensions of personality for both groups.

A two-layer structural equation model is proposed (*PSEM1*) and applied to analyze personality traits by finding relationship between 'Neuroticism'; and 'Extraversion'; 'Psychoticism' and 'Lie scale' for both the groups. The *PSEM1* is given by:

Layer 1: $N \sim L + P + G$
Layer 2: $P \sim L + E + G$

Under both the groups *PSEM1* is not significantly different from base model as suggested by different measurement indices namely, Chi-square test value, *CFI* and *RMSEA* as given below in Table 5. Also, similar results are observed with base model when effect of gender is removed under second proposed model (*PSEM2*) on 'Case' group as there are only 21% girls in this group. Based on individual contribution of variable layer wise we found our *PSEM1* for 'Control' group is leading to significant effect of Lie-scale and Gender on Neuroticism (Layer1) and that Lie scale and Extraversion are significant contributors in estimating Psychoticism (Layer 2) as *p*-value is less than 0.05. Also, 63% variability in Neuroticism can be explained through contributors of layer 1 for *PSEM1*. But *PSEM1* / *PSEM2* are not explaining effect of one variable (direct or indirect) over other personality traits under 'Case' group as *p*-value is greater than 0.05 except for Psychoticism which is a significant contributor for estimating Neuroticism in layer 1. Detailed results are depicted in Tables 5 & 6.

Table 5: Comparison of Proposed Structural Equation Model (s)with base model (LAVAN) for both the groups

Test statistics	Base Vs PSEM1		Base Vs PSEM2
	Layer 1: $N \sim L + P + G$ Layer 2: $P \sim L + E + G$		Layer 1: $N \sim L + P$ Layer 2: $P \sim L + E$
	Control	Case	Case
Estimator	ML	ML	ML
Optimization method	NLMINB	NLMINB	NLMINB
Number of free parameters	8	8	6
Number of observations	85	58	58
Number of iterations	27	28	15
Model Test User Model:			
Test statistic	0.097	1.677	1.930
Degrees of freedom	1	1	1
p-value (Chi-square)	0.755	0.195	0.165
Model Test Baseline Model:			
Test statistic	110.287	11.039	8.113
Degrees of freedom	7	7	5
p-value (Chi-square)	0.000	0.137	0.150
User Model versus Baseline Model:			
Comparative Fit Index (CFI)	1.000	0.832	0.701
Tucker-Lewis Index (TLI)	1.061	-0.173	-0.494
Loglikelihood and Information Criteria:			
Loglikelihood user model (H_0)	-397.797	-312.680	-314.270
Loglikelihood unrestricted model (H_1)	-397.749	-311.842	-313.305
Akaike (AIC)	811.594	641.360	640.540
Bayesian (BIC)	831.135	657.844	652.903
Sample-size adjusted Bayesian (BIC)	805.897	632.691	634.038
Root Mean Square Error of Approximation:			
RMSEA	0.000	0.108	0.127
90 Percent confidence interval	(0.000, 0.196)	(0.000, 0.386)	(0.000, 0.398)
p-value RMSEA ≤ 0.05	0.779	0.227	0.195
Standardized Root Mean Square Residual (SRMR)	0.005	0.040	0.054

Table 6: Regression Coefficients of Proposed Structural Equation model(s) for 'Control' and 'Case' group

Model equations	Group	Estimated model parameter	Estimate	Std. Err	z-value	P(> z)	R ²
<i>PSEM1</i>							
Layer 1: $N^* \sim L^* + P + G^*$	Control	L	1.758	0.175	10.028	<0.001	0.636
		P	-0.147	0.095	-1.550	0.121	
		G	-1.998	0.545	-3.668	<0.001	
Layer 2: $P^s \sim L + E^* + G$		L	0.760	0.174	4.372	< 0.001	0.249
		E	0.279	0.093	2.993	0.003	
		G	1.016	0.581	1.750	0.080	
Layer 1: $N \sim L + P + G$	Case	L	-0.134	0.118	-1.129	0.259	0.117
		P	0.314	0.153	2.057	0.040	
		G	-2.058	1.249	-1.648	0.099	
Layer 2: $P \sim L + E + G$		L	-0.112	0.103	-1.091	0.275	0.036
		E	0.102	0.155	0.657	0.511	
		G	0.775	1.068	0.726	0.468	
Fitted Model equation	Control	Layer 1 - $N = 1.758 L - 0.147 P - 1.999 G$; Layer 2 - $P = 0.760 L + 0.279 E + 1.016 G$					
	Case	Layer 1 - $N = -0.134 L + 0.314 P - 2.058 G$; Layer 2 - $P = -0.112 L + 0.102 E + 0.775 G$					
<i>PSEM2</i>							
Layer 1: $N \sim L + P$	Case	L	-0.098	0.119	-0.824	-0.098	0.276
		P	0.292	0.136	2.147	0.292	
Layer 2: $P \sim L + E$			L	-0.125	0.101	-1.234	-0.125
		E	0.094	0.155	0.605	0.094	
Fitted Model equation	Case	Layer 1 - $N = -0.098 L + 0.292 P$; Layer 2 - $P = -0.125 L + 0.094 E + 0.775 G$					

*-Neuroticism, ^- Extraversion, \$-Psychoticism, #-Lie-scale, !=Gender

4. DISCUSSION

Research has established that patients with personality disorders (PDs) tend to experience serious impairment and distress which may lead to long term negative effects. Although PDs are common in general population, but only a few community-based studies have investigated their adverse effects (Johnson et al., (1999). Parent personality and parenting behaviour play a significant role

in the development of adolescent personality traits. Children's socio emotional and behavioural problems can be influenced by parental mental health especially if mother's mental health is afflicted. In this study we have found out the effect of parents' psychiatric disorder on the personality of their adolescent offspring through Eysenck Personality Questionnaire (EPQ) (Kvalevaaget al., (2013).

EPQ consisting of 'Extraversion', 'Neuroticism', 'Psychoticism', and 'Lie scale' is widely used and reliable tool under cross-cultural studies. EPQ is a self-report measure of personality with dichotomized responses (yes or no). Adolescence is an age marked by significant biological and psychosocial changes necessary for the transition of a person from childhood into adulthood and is accompanied by its own set of problems which may get aggravated by presence of some external influence (Petersen et al., 1988). EPQ profiles of adolescents with parent(s) mental disorder exhibit lower mean value of 'Extraversion' (13.95 vs. 14.90) and a higher mean of 'Psychoticism' (6.34 vs. 6.00) when compared with controls (Table 1). The observation are similar with previous studies which indicated 'Control' group subjects scored higher in 'Extraversion' (characterized by energetic engagement, enhanced sociality, activity and positive emotionality) but lower in 'Psychoticism', 'Neuroticism' and 'Lie scale' as compared to 'Case' group subjects (Clark et al., 1994; John et al., 2008). The correlation between 'Extraversion' and 'Neuroticism' is found to be negative in 'Control' group which is consistent with the previous studies and observed as low positive in case of 'Case' group (Ivkovic et al., 2007).

We have applied SEM with three layers and two layers where 'Extraversion' and 'Neuroticism' are the measured direct variables (DVs) and 'Psychoticism' and 'Lie scale' are indirect variables (IVs) for measuring 'Neuroticism'. Parents' mental health is latent variable. SEM is a general technique widely used in behavioural science and provides a convenient framework that includes several multivariate procedures. In CSEM, for 'Control' group, 'Lie-scale' is explaining 'Psychoticism' (Layer 3) which in turn explaining 'Extraversion' (Layer 2) with p -value < 0.05, but R^2 for all the three runs is abysmally low. The CSEM (three-layer) obtained the Chi-square values of 74.761 and 8.113 respectively, for 3 degrees of freedom for 'Control' and 'Case' groups with p -values less than 0.05 and the model is rejected for both the groups. The PSEM 1 (two-layer) yielded the Chi-square values of 0.097 and 1.677 for 3 degrees of freedom for 'Control' and 'Case' group with p -values more than 0.05 and thus we failed to reject the model for both the groups as the SEM is based on a comparison between the covariance structure of a hypothesized model and the covariance matrix of the observed variables. If there is no significant difference, then the hypothesized model is accepted.

In this study either through CSEM or PSEM1/PSEM2 we have found that some information about one dimension can be extracted from the other dimension with EPQ even if the correlation is not significant. Also, we found with PSEM1 that gender is a significant factor at 10% level of significance in case of 'Control' group (with 42 (49.4%) girls and 43 (50.6%) boys). In this study, we have found from two-layer SEM that for control group 'Lie-Scale' is significant dimension for 'Neuroticism' and 'Psychoticism' whereas 'Extraversion' is significant for 'Psychoticism' only. In case group, 'Psychoticism' is significant for 'Neuroticism'. Similar findings are observed through the correlation values. These results are consistent with the previous studies (Stewart et al., 2005; Al-Turkait & Ohaeri, 2016; Kawamoto et al, 2020; Jackson & Francis, 1998).

Though the sample size for this study is small, the results are consistent with the previous studies. The effect of gender could not be extracted due to less number of girls' participants in the 'Case' group, which can be considered as a limitation of this study.

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