

Modeling correlates of depression among in-school adolescents using multilevel models

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Abstract- Introduction: Depression is a mood disorder that affects people across ages. It is estimated that more than 300million people have depression worldwide and the onset is usually at mid-to-late adolescence. However, local data on depression among in-school adolescents in Nigeria is scanty in the literature. The present study assesses individual and compositional level factors associated with depression in the population.

Method: The study population was in-school adolescents in Ikere-Ekiti, Ekiti state Nigeria. Six schools were purposively selected and 490 consenting students were interviewed with a study instrument consisting of three segments i.e. Demographic section, Rosenberg Self-esteem Scale and CES-DC Scale. Data was analyzed using descriptive statistics, Pearson's moment correlation analysis and Multilevel Linear Regression using MLwiN package at 5% level of significance.

Results: Participants comprised of more females (59.1%) and majorly from monogamous families (77.5%). A prevalence of 25.5% for mild to moderate and 14.9% for severe depression was reported and males scored higher on all the depressive symptoms than the females. Polygamous family background, low self-esteem, single sex only school and private school were shown to be positively related to depression. Interestingly, a unit increase in self-esteem decreases depressive mean score by 0.76unit while between school variations contributed more than 10% of the total variations.

Conclusion: The present study reveals a striking prevalence of depression among the setting which could serve as an indicator to policy makers. Also, it is necessary for mental health issue to be taken seriously among male adolescents just like their female counterparts.

Index Terms- Adolescence, Depression, Multilevel Modeling, Prevalence, Self-esteem

I. INTRODUCTION

Depression is a psychosocial illness in which the sufferer has feelings of sadness, instability, loneliness, hopelessness, worthlessness, and guilt (Ahangar et al, 2012). Its symptoms are commonly grouped into four categories: somatic and retarded activity, depressive affect, interpersonal problem and positive affect (Bettge et al, 2008). Recent findings show that depression is a leading cause of disability worldwide and more than 300million people are reported to be living with the disease (WHO, 2017). Moreover, higher proportion of these sufferers

lives in developing countries and sub-Saharan countries where the Global Burden of the Disease is very high (21.4%) (Suliman et al, 2010). Unfortunately, It has also been predicted that the burden from depression alone is likely to increase to a single biggest burden of all health conditions by 2030 (WHO, 2004).

Although prevalence of depression has been reported to vary across the globe (WHO, 2017), the situation was reported to be higher in America than some African countries, particularly Nigeria (Tomlinson et al, 2009). A prevalence of about 25% for mild to moderate depression and below 10% for definite depression have been reported somewhere in Nigeria (Adeniyi et al, 2011; Pengpid et al, 2013). Despite that the rate seems to be higher among adults, the onset of depression is typically around mid-to-late adolescence (Serani, 2016). Though an average of mid-twenties (26years) has been reported elsewhere (Zisook et al, 2007). Older children and adolescents with depression may be silent, sad, refuse to participate in family and social activities, get into trouble at school, use alcohol or other drugs, or stop paying attention in class and even to their appearances (Zisook et al, 2007; Smith et al, 2018). They may also become negative, restless, grouchy, aggressive, or feel that no one understands them (Healy, 2013; Hurley, 2018).

Depression in adolescents has been associated with a number of factors such as poverty, unemployment, distressing life events (such as death of parents, broken home, chronic or life threatening diseases etc), behavioral problems as well as certain environmental issues (Patel, 2003). Individual characteristics that are frequently mentioned as risk factors for depression are female gender (Adewuya et al, 2006; Khasakhala,2012) and lower socio-economic status as reported in a study among U.K undergraduate students (Ibrahim el al, 2013). Perception of under-protective parents has also been mentioned (Khasakhala, 2012). In Africa, parents are traditionally seen as authority in the family setting. Father is expected to be a sign of protection to the family while mother is more of interactive influence especially to female adolescents. However, in any home where there is deprivation in this attributes either as a result of domestic crises or separation etc., children may develop emotional problem, hence depression. Therefore children from polygamous families are more likely to suffer from psychological disorders compared with those from non- polygamy families (Al-Krenawi & Slonim-Nevo, 2008).

On the other hand, self-esteem has been identified as a protective factor for depression especially among adolescents (Bettge et al, 2008; Colman et al, 2009; Yaacob et al, 2009). For instance Feelings of worthlessness (characteristics of low self-esteem) is one of the symptoms of depression. However, there is an intrinsic

complexity in the relationship between self-esteem and depression as high self-esteem correlated with low depressive disorder and vice versa. (Manna et al, 2016)

Therefore, examining the predictors and the prevalence of depression among adolescents in Ikere LGA could serve as a pointer and provide aids for easy counseling, prevention and rehabilitation policies both locally and in the state at large. The aim of this study is to examine predictors of depression among in-school adolescents and also to evaluate the prevalence and to investigate interrelationship between depressive symptoms and self-esteem among the participants.

II. METHODS

Study design

This study was a cross-sectional research on Nigerian in-school adolescents within Ikere Local Government Area of Ekiti State, South-west Nigeria.

Participants

The sample comprised 490 secondary school adolescents between age 11 and 19 randomly drawn from 6 secondary schools within 11 political wards in Ikere-Ekiti. Two of the schools are boys only and girls only schools and there were 5 public and 1 private.

Data collection and procedures

A sample size of 486 was estimated with a precision of 0.05 at 95% significance level and power component (1-β) of 80% with a prevalence of 18% (Cortina et al, 2012). Attrition rate of 10% was considered. Six schools (both private and public) were purposively selected and the questionnaires were administered to those who consented to the privy of the research after illustration had been given on the nitty-gritty of the study. It was as well emphasized that participation was voluntary and participants were at liberty to withdraw if they so wish. However, approval was sought from the Ethic Committee, Ekiti State Teaching Hospital as well as the principals in the selected schools.

Assessment of Depression and self-esteem

The instrument comprises of two scales: The Center for Epidemiological Studies Depression Scale for Children (CES-DC), a 20-item self-report depression inventory with possible scores ranging from 0 to 60 in 4 sub-scales namely; somatic symptoms and retarded activity, depressed affect, positive affect and interpersonal problems. Each response to an item was scored as follows: 0 = "Not At All"; 1 = "A Little"; 2 = "Some"; 3 = "A Lot" except where reversal is inevitable according to the user's recommendation. Higher CES-DC score indicates high risk level of depression (Weissman et al, 1980). In this study, the scores were categorized into two groups: depressed and non-depressed, based on a cut off of 22 as used in a similar study (Trangkasombat and Rujiradarporn, 2012).

Also, the Rosenberg self-esteem scale was scored, analyzed and computed as the total scores for the 10 items. To buffer the effect of nonresponse, average values were used in the analysis. Meanwhile, the higher the score value, the better the self-esteem while the possible values range from 0 to 30.

Model specification

Multilevel linear regression model

In this study we adopted multilevel modeling considering the advantage of hierarchical structure of the sample (i.e. students were nested within classes and classes nested within schools), a multilevel level regression was considered suitable for our modelling. Of course, the choice of linear multilevel was conceived in order to avoid loss of information that could be incurred from categorization of the depression score which was measured on an interval scale.

Model stages

Model1 is an empty model i.e. it contains no explanatory variable with class as the subject while model 2 contains all the individual level predictors i.e. Self-esteem, Age, Sex, Family type, location, Being disappointed by friend of opposite sex (BDFOS). Moreover, the full model (Model 3) contains school level variables [i.e. School type(private or public) and school category(single only school or mixed)] in addition to model 2.

Mathematically, we have: Multilevel model has both fixed and random components. Random effects are useful for modeling intra cluster correlation i.e. degree of similarity between observations in the same cluster when they are perceived to share the same cluster-level characteristics. Therefore, a three-level random intercept characteristic was initiated thus:

$$y_{ijk} = \beta_0 + \beta_i \sum_{i=1}^n x_{ijk} + \beta_j \sum_{j=1}^j x_{jk} + \beta_k \sum_{k=1}^k x_k + u_{jk} + v_k + \varepsilon_{ijk} \quad (1)$$

Where y_{ijk} is the response for student i in class j nested within school k while β_i , β_j , & β_k are the fixed effect parameters associated with individuals, class & school level respectively.

The random variables are assumed to be independent of one another and normally distributed with zero mean and constant variances which can be derived as follow:

$$\text{Var}(y_{ijk}) = \text{Var}(u_{jk} + v_k + \varepsilon_{ijk}) \quad (2)$$

$$= \text{Var}(u_{jk}) + \text{var}(v_k) + \text{var}(\varepsilon_{ijk}) \quad (3)$$

$$= \sigma_u^2 + \sigma_v^2 + \sigma_\varepsilon^2 \quad (4)$$

However, no variable was considered at class level and from our preliminary analysis, between class variations was redundant and its inclusion became needless and non-informative. Consequently, a 2-level model was set up.

MI: Unconditional model

$$y_{ik} = \beta_{0ik} + e_{0ik} \quad (5)$$

$$= \beta_0 + u_{0k} + e_{0ik} \quad (6)$$

$$u_{0k} \sim N(0, \sigma_{u0}^2) \quad (7)$$

$$e_{0ik} \sim N(0, \sigma_{e0}^2) \quad (8)$$

MII: MI + Individual level variables

$$\text{Depression Score}_{ik} = \beta_0 \text{Cons} + \beta_1 \text{Male}_{ik} + \beta_2 \text{Monogamy}_{ik} + \beta_3 \text{BDFOS:Yes}_{ik} + \beta_4 \text{Age}_{ik} + \beta_5 \text{Selfesteem}_{ik} + \beta_6 \text{Urban}_{ij} + u_k + e_{ik} \quad (9)$$

Where $\beta_0, \beta_1, \dots, \beta_6$ are fixed effects

$$u_{0k} \sim N(0, \sigma_{u0}^2)$$

$$e_{0ik} \sim N(0, \sigma_{e0}^2)$$

MIII: MII+ School Level variables

$$\begin{aligned} \text{Depression Score}_{ik} = & \beta_0 \text{Cons} + \beta_1 \text{Male}_{ik} + \\ & \beta_2 \text{Monogamy}_{ik} + \beta_3 \text{BDFOS:Yes}_{ik} + \beta_4 \text{Age}_{ik} + \\ & \beta_5 \text{Selfesteem}_{ik} + \beta_6 \text{Urban}_{ik} + \\ & \beta_7 \text{Private_school}_{ik} + \beta_8 \text{Mixed_School}_{ik} + u_k + \\ & e_{ik} \end{aligned} \quad (10)$$

MIII could also be expressed with matrix notation

$$Y = X\beta + Z\mu + \epsilon \quad (11)$$

Where Z is an nxq matrix of random effect regressor. Here, Y is an nx1 vector of responses. X is n x p matrix containing the effect regressors. Beta (β) is a px1 vector of fixed effect parameters and μ is a qx1 vector of random effects and ϵ is an nx1 vector of errors or residuals.

Parameters estimation: We have only six schools, reweighted iterative generalized least square (RIGLS) estimation method which provides less biased estimates of the variance than IGLS when the number of higher-level units is small was used.

Intra-class correlation coefficient (ICC)

The ICC describes the level of dependency in the data i.e. it measures the extent to which individuals within the same group are more similar or correlated to one another other than they are

to individuals in different groups. Thus,
$$\rho = \frac{\sigma_e^2}{\sigma_e^2 + \sigma_u^2}$$
 (12)

Where σ_e^2 represents the individual level variance and σ_u^2 represents between school variance. Also, ICC is the proportion of between group variance to the total variance.

Data Management and Statistical Analysis

Data were extracted and entered into IBM SPSS version 20. It (data) was explored for easy detection of outliers while cases where important variable was missing were deleted. However, 490 out 500 cases scaled to the final analysis. Normality of the depression mean scores was tested with P-Plot and it conformed to normal distribution. Also, Cronbach alpha value (0.79) for the CES-DC scale indicates a high reliability of the scale. Multilevel analyses were carried out using MLwiN trial version 2.36 (University of Bristol, Bristol, UK). However, Multilevel Linear Regression (MLR) was deliberately conceived due to the within-school clustered nature of the data in our study. The area level variables were school category and the school type: These were dichotomized as single only school or mixed school and private or public respectively. Meanwhile, Chi-Square Statistic was used to test the association between the potential categorical predictors and the response variable (depressed or non-depressed group). Consequently, those that show significance at 90% confidence level were recruited into the multilevel regression analysis.

III. RESULT

Demographic data of the respondents are presented in terms of frequency and percentage. Out of 520 students approached for the study, a total of 490 adolescents aged 11 to 19 years (mean age = 15.22±1.35 years) from six secondary schools consented and participated in the study among which were more females (59.1%) than males. More than two-third of the participants were from monogamous families (77.5%) with majority (83.8%) having parents living together. See Table 1 for the details.

Variables	Frequency	percentage
Sex		
<i>Male</i>	201	40.9
<i>Female</i>	289	59.1
Religion		
<i>Christianity</i>	461	96.2
<i>Islam</i>	18	3.8
Area of residence		
<i>Rural</i>	179	42.1
<i>Urban</i>	246	57.9
Ethnicity		
<i>Yoruba</i>	447	93.3
<i>Others</i>	30	6.7
Family type		
<i>Monogamy</i>	354	77.5
<i>Polygamy</i>	103	22.5
Family status		
<i>Parents are living together</i>	402	84.5
<i>Parents are divorced</i>	10	2.1
<i>Parents are separated</i>	32	6.7
<i>Single mother</i>	32	6.7
Father's education		
<i>No formal education</i>	111	25
<i>Pry/sec education</i>	120	27
<i>Tertiary education</i>	213	48
Father's occupation		
<i>Farming/trading</i>	127	30.8
<i>Civil servant</i>	184	44.6
<i>Employee of private org.</i>	102	24.7
Mother's highest education		
<i>No formal education</i>	104	23.1
<i>Pry/sec education</i>	131	29.1
<i>Tertiary education</i>	215	47.8
Mother's occupation		
<i>Farming/trading</i>	224	51.1
<i>Civil servant</i>	173	39.5
<i>Employee of private org.</i>	41	9.4
Have you been disappointed within the last few days?		
<i>Yes</i>	122	27.1
<i>No</i>	328	72.9
School category		
<i>Single only school</i>	58	12.1
<i>Mixed school</i>	422	87.9

Table 1: Demographic Variables

Table2 shows that higher means scores on somatic and retarded activities, interpersonal problem, and depressive symptoms strongly correlated with higher mean scores on depression scale whereas higher score on positive affect only correlated with lower score on depression. Age has no substantial relationship with depression sub-scales except with the positive affect which decreases ($r = -0.117, p < 0.05$) as age increases. However, higher scores on Somatic symptoms, Depressive Affect, and Interpersonal Problem significantly correlated ($r = -0.808, r = -0.867, r = -0.670$ respectively) with lower scores on self-esteem while positive affect was in contrast ($r = 0.163, p < 0.001$).

Table 2: Interrelationship between age, self-esteem, and depression symptoms

Variables	1	2	3	4	5	6	7
1. Age	1						
2. Self-esteem	0.048	1					
3. Depression score	0.032	-0.278***	1				
4. Somatic problem	-0.034	-0.170***	0.808***	1			
5. Depressive affect	0.049	-0.250***	0.867***	0.617***	1		
6. Interpersonal problem	-0.055	-0.174***	0.670***	0.490***	0.525***	1	
7. Positive affect	-0.117*	0.163**	-0.225***	0.163**	-0.051	0.034	1

*P<0.05, **P<0.01, ***P<0.001

Prevalence of depression

Among overall participants, prevalence of mild to moderate depression was 25.5% and severe depression was 14.9%. Higher proportion (29.2%) of depressive symptoms was observed among boys than girls (23.8%). Similarly, students from polygamous families and participants that ticked yes to being disappointed by friends of opposite sex within the last six

days prior the study show higher prevalence of depression. Moreover, rural dwellers also displayed a greater (20.3%) risk compared to (11.6%) their colleagues residing within the urban areas. Surprisingly, Figure1 shows that male participants scored higher on total depression mean scores and other depressive symptoms except Positive Affect scale as rated by CES-DC.

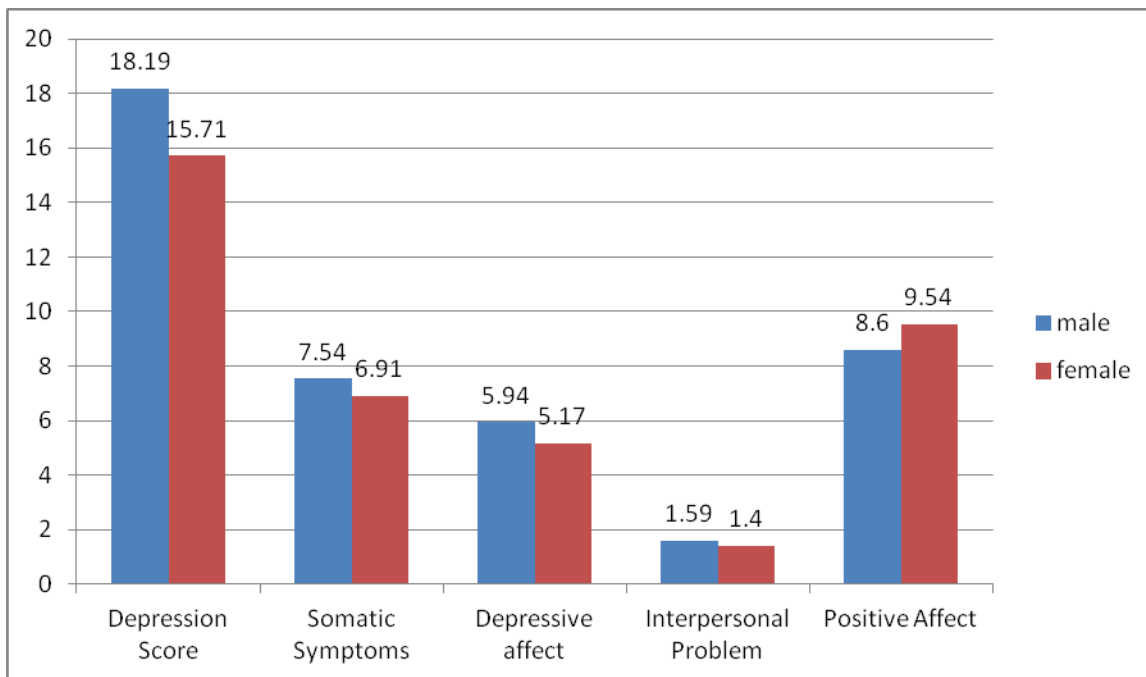


Figure1. Depressive symptoms mean scores by genders

Mixed Model Result

Displayed in Table 3 is the result of the mixed models where the intercept of the unconditional model (Model 1) is 16.58 (p<0.001). This conveys the grand mean of the depression score without the effect of any explanatory variable. That is, the depression score for a female adolescent, from polygamous family, with cordial relationship with friends, living in an urban location with average age and self-esteem score. Also the residual was almost 8times the variation in intercept. That is, the main variation was due to individual differences rather than between-school difference. Intra-class correlation is 11.5 (considering equation 12). Meaning 11.5% of the total variation could be attributed to between school variations. The difference

between the RIGLS values in Model II and Model III is 153.21which was assumed to follow a Chi-square distribution and it is significant (P<.01). Therefore, model III fitted better than Model 2 with only individual level explanatory variables.

There was a marginal change in the significance of gender & BDFOS influence on depression mean score as the addition of school level variables rendered effects insignificant. Perhaps, the initial gap might be due to the disparity in contextual school level differences between factors. All being equal, a student from a monogamous family is expected to score 0.86(P<.05) lower on the depression mean score than his/her colleague from polygamous family. As shown on Table3 below, a unit rise in self-esteem reduces depression mean score by 0.65(0.135). This

is evident that self-esteem is protective against depression and its symptoms. However, those in private schools are expected to have 2.45(1.056) more depression mean score than their counterparts in public school. It can be deduced from the table that the differences observed among those that ticked ‘Yes’ against ‘No’ to ever being disappointed by friend(s) within the

previous few days and that of respondents place of residence might have resulted by chance. Those attending boys or girls’ only schools may be more vulnerable as shown in Table 3. Also, age difference cannot significantly predict/explain depression mean score.

Table 3: Multilevel Models of Depression Score and its Explanatory Variables

Explanatory variable	Empty model	Model with individual level variables	Model with individual & school level variables
	Model 1	Model 2	Model 3
	Estimate(SE)	Estimate(SE)	Estimate(SE)
Sex			
Male		1.65(0.917)*	1.35(1.027)
Female		Ref	ref
Family type			
Monogamy		-0.93(0.641)	-0.86(0.511)*
Polygamy		Ref	ref
BDFOS			
Yes		2.03(0.997)*	1.210(1.086)
No		Ref	
Fathers education			
No formal edu		0.93(1.649)	0.71(1.739)
Educated		Ref	
Mothers education			
No formal edu		-1.13(1.670)	-1.07(1.740)
Educated		Ref	
Age		0.03(.318)	0.08(0.35)
Self-esteem		-0.69(0.130)***	-0.65(0.135)***
Location			
Urban		-0.89(0.966)	-0.94(0.933)
Rural		Ref	Ref
School type			
Private			2.45(1.056)*
Public			Ref
School Category			
Mixed School			-3.45(1.97)*
			Ref
Intercept	16.58(0.552)***	18.60(1.313)***	22.99(2.375)***
Model fit statistics			
RIGLS	3592.52	2599.07	2445.760
	68.95(4.833)***	62.54(5.095)***	66.14(5.324)***
	9.03(3.626)	10.25(4.18)	11.21(3.628)
	11.5	14.1	14.4

BDFOS: Being Disappointed by Friends of Opposite Sex, *p<0.05, **p<0.01, ***p<0.001

IV. DISCUSSION

The main focus of this study was to examine the prevalence and the predictors of depression among the study population. However, more than fourteen percent of the participants scored above cut-off on the depression scale (CES-DC). Actually, this finding is very high compared to what was found in some previous studies (Adeniyi et al, 2011; Ahangar et

al, 2012; Raven-Sieberer et al, 2009). Although, our report cannot be taken as a clinical diagnosis for the presence of the dysfunction but it can serve as a suggestive value. It was found that depression was shown to be more prevalent among boys than girls. This result is similar to what was reported for Thai adolescents in a research conducted in Thailand where boys had 19% and girls had 17% (Naushad et al, 2015; Verma et al, 2014; Trangkasombat and Rujiradarporn, 2012) in deviance to the

common reports that girls are prone to emotional and depressive symptoms (Ahangar et al, 2012; Chinawa et al, 2015; Massip et al, 2010; Bettge et al, 2008; Keller, 2010). Reasons for this disparity might not be far from the socio-cultural differences as expectations are known to be too high for boys than girls in most Nigerian communities, particularly within Yoruba settings. Most parents believed that boys are more important and they are expected to perform better in all, even academically. Failure to meet up with this demand might consequently result in fear and hence, depression.

Also, boys scored higher in all the depressive symptoms sub-scales except positive affect sub-scale. Similarly, our result was in concordance to what was found in a study among in-school adolescents in the south-eastern part of Nigeria where depression was more prevalent among adolescents from families whose parents are separated but least among those whose parents are together (Chinawa et al, 2015). It could be suggested that parental care has a role to play in preventing depression because the burden due to parental separation could clamp down on children hence leading to psychological trauma.

Positive affect and self-esteem consistently played a protective role against psychosocial internalizing symptoms, just like other previous studies position that an increase in self-esteem equally increases one's happiness perhaps, reduces depression (Ahangar et al, 2012; Barnow et al, 2005; Bettge et al, 2008; Manning, 2007; Yaacob et al, 2009). Therefore, emphasis should be laid on how these attributes could be enhanced in order to minimize depression among adolescents.

As shown in Table 3, family type, school type, school category and self-esteem are significantly associated with depression among adolescents.

Moreover, the statistical method adopted in this research work was judiciously used and very appropriate since the effect of clusters uniqueness in the regression analysis was observed and ICC is greater than 0.1. Also, multilevel regression has been identified to be more conservative and efficient than the classical regression (Yusuf et al, 2011). Nevertheless, using multilevel regression analysis in this study would definitely present a more accurate and conservative result considering the nature of the study where there are nested group structures due to within school connectedness and collegiate activities that could influence students' psychological well-being as a result of their day-to-day interactions.

In conclusion, the present study identified family type and self-esteem at individual level and school type and school category at area level as determinants of depression. Gender and age couldn't significantly predict depression.

V. RECOMMENDATION

Striking prevalence of this menace is a wakeup call for policy makers to encourage and establish school-based mental health programs in Ekiti and Nigerian schools at large. Effort should be made to improve students' wellbeing by enhancing protective factors like self-esteem. Nigeria regular and special educational institutions for children and adolescents lack school-based mental health programs. Programs that can boost self-esteem and positive affection among adolescents should be encouraged for its protective effect on depression. More comprehensive research into the risk factors of psychosocial

disorders as depression among adolescents in Ekiti state and Nigeria at large should be intensified by mental health researchers. Also, application of multilevel regression analyses in public health research should be encouraged where suitable.

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