

The Varying Influences of Perceived Stress and Depression among Selected College Students

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Abstract: Depression has been associated with altered perceived stress level, emotional expression, and immunological response. Prior researches have investigated and found that test tube white blood cells of animals are associated with stress and depression. However, there were lacking evidences on the association of depression of white blood cells, perceived stress, and emotional expression on human samples. This study has investigated the link among these variables and applying a causal modeling technique in establishing an indirect causal relationship among variables. From the result, 32 assessed depressed college students in Quezon City completed measures of depression, perceived stress, and emotional expression, while Monocyte count was consecutively extracted from the assessed depressed patients. The study yielded an interesting result explaining that depression can be predicted by stress, while monocyte counts can be altered by stress but not specifically by depression. Emotional expression, however, is not found to be related to depression, stress, or monocyte counts. It is also proven that stress indirectly aggravate depression level. An exciting result has also been obtained from the study wherein human monocyte samples from depressed patients are directly related and are indirectly increased by their perception of stress. Both partial correlation and path analysis suggest that stress plays an important role in the influence of depression to the monocyte proliferation. The result is also suggesting further research in terms of the time of the onset of depression-whether longer exposure to depression will alter the depression level of an affected suffer. Nevertheless, the results support a biopsychosocial approach in the treatment of depression and add to the existing knowledge that mere perception of stress aggravates levels of depression and would later have a negative effect to one's immunity.

Keywords: (ABS) College Graduates, Perceived stress, Depression, Monocyte count, Emotional Expression.

1. INTRODUCTION

Statistics on depression has been active in stating that increase in cases of depression is becoming rampant. World Health Organization has predicted that in the year 2020, depression would be the 2nd leading cause of disability (Murray, 1996). Contradictory to what the research has found out, recent research has suggested that in the year 2013, depression has become the 2nd leading cause of disability following major heart attacks (Ferrari et al., 2013). Another WHO research that would be very alarming would be that of 2006, suggesting that in the year 2030, depression would be the first and major cause of disability worldwide (Mathers & Loncar, 2006) It appears that the projection of cases of depression is rapidly increasing.

In addition, suicide, a diagnosing element of depression, has been reported to have a rapid increase of rate in the Philippines as stated in a comprehensive study of suicide in the country (Redaniel, Lebanan-Dalida, & Gunnell, 2011); while unemployment, a factor highly associated to suicide (Lin, 2006), in the country is still in an undesirable number of 2.8 million, which is seven percent of the population. Excluding the fact that there are unreported suicide cases which may be due to the religious inhibition (Redaniel, Lebanan-Dalida, & Gunnell, 2011), or unidentified reasons of deaths, the reported suicide rate might have been higher. A relatively high rate of suicide has been reported among adolescents and young adults. Thus, mental health workers and family members of suspected patients should pay attention to the depression level and what determines it besides emotional disclosure.

With the hazards that have been discussed, the current research has investigated other factors that could determine depression other than what have been stated in the diagnostic criteria. Moreover, it is also essential to investigate the relationships of different factors that could have mediated or have caused depression and emotional expression. As a result, this research has investigated the psychological, which is perceived stress, and immunological alterations, which is monocyte counts, among college students.

Another view that can be of a focus is the immunological perspective of depression. Past researches suggest that there is a cytokine imbalance in depression (Blume, Douglas, & Evans, 2010). Cytokine, proteins released by white blood cells, is responsible for sickness behavior, such as high temperature, in human beings. Since there is imbalance in cytokine in depression, it is implied that depression is a sickness behavior. On one hand, cytokine is released by specific white blood cells, which is macrophage or monocyte. The research has investigated the source of cytokines for further investigation of what have been discussed in previous researches.

Psychoneuroimmunology is the study of immune system in relation to psychological and behavioral changes. It has been published in biological psychology textbooks that the immune system is affected by the psychological changes there is among individuals who are seen to be stressed. This branch of psychology discussed the importance of the primary and secondary line of defense of the body. The white blood cells, such as the leukocytes and monocytes, are seen to have been affected by the concentration of cortisol, a stress hormone. Leukocytes, such as natural cytotoxic killers have already been found out to be depleted by the concentration of the said stress hormone. On the other hand, monocytes' protein communicators, which are called cytokines, are found to have increased in number when confronted with stress. Nonetheless, researchers should be cautious in suggesting that if cytokines increases, its source, monocytes, also increases when confronted with stress. Moreover, stress should specifically be distinguished with depression. Stress is almost a natural event in the body. However, depression is a clinical diagnosis characterized by sadness and loss of interest accompanied by 5 more symptoms, which is suffered by patients for duration of two weeks.

The research has utilized a path analysis method for the reason that it can explain the origin of a construct to a targeted construct. It is predictive statistics that could find out the determinant of a variable. As a result, it creates an indirect causal relationship among variables (Myers & Hansen, 2012). Another reason for using the predictive method is the incapability of other methods and statistics to establish causal relationship of a risk variable such as depression.

The study aimed to investigate the link between perceived stress, monocyte count, and depression among college students. A model has been tested after the correlation has been established. In addition, the following secondary questions have been answered in the course of the study: What are the depression, perceived stress, and monocytes mean and standard deviation values of the samples? Is there a significant relationship between the following pairs of variables depression and perceived stress; depression and monocytes; and perceived stress and monocytes? Is perceived stress a significant predictor of depression; and monocyte counts? Are perceived stress and depression significant predictors of monocyte counts?

2. METHODOLOGY

Design

The researched study has employed Correlational Research Design, specifically path analysis (Myers & Hansen, 2012). Path analysis is a research design, as well as a statistical method, that makes use of correlational data in creating an indirect causal relationship through multiple regression. It can also suggest the predictor variables from the predicted variables of the study. The magnitude and direction of constructs' relationship have been tested in the proposed research using the beta weights.

The model proposed by the researcher also suggests that those whose stress positively affects their depression level may have an affected monocyte counts. In the same way, Nevertheless, other variables outside the study have been considered that may play a role the relationships therein among the variables observed.

Participants

The 32 subjects of the study are students enrolled in any course offered by Colleges located around Quezon city. The subjects have met the following criteria before joining the study: High in Depression scale as measured by Depression, Anxiety, and Stress Scale, Low in both purpose and search factors present in Meaning in Life Questionnaire, Self-reported to have suffered at least 5 out of 9 symptoms of depression enumerated in DSM 5 for two weeks, Signed the

informed consent in the presence of another witness and the researcher, Belong to the age group 18 – 24, Filipino citizen, and does not take any psychopharmacological treatment

Research Instrument

The research study has employed four paper and pen instruments, three of which are obtained from previous researches, which have undergone standardization procedures and have established validity and reliability. A diagnostic instrument/machine has been used in the study. It has been used to quantify the monocyte count in the extracted blood of samples. The instruments have been described in details in the subsequent pages.

Depression, Anxiety, and Stress Scale (DASS) 21

The test was formulated by Dr. Peter Lovibond. The 21 item English version of the test has been used to in the study. In published researches, DASS depression scale has been found to be correlated with BDI as high as .75 and correlated to depressed samples reaching a coefficient of .94. The reliability of the test is also as high as Cronbach alpha coefficient .96 (Brown, 1997). This suggests that the test is a good measure of depression.

Perceived Stress Scale (PSS)

Perceived Stress Scale (PSS) is a test for the subjective perception and evaluation of stress (Cohen and Williamson, 1988). It has been translated in many languages including in Filipino. It is a 14 item test answerable by a 5 point Likert scale (1 – Never, 2 – Almost Never, 3 – Sometimes, 4 – Fairly Often, 5 – Very Often). The internal consistency obtained was .84, which indicates its reliability. The validity was established using convergent validity and obtained a score of .76 correlation with other scales for depression. PSS, thus, is a good tool for obtaining the value for the Perceived Stress construct.

XN1000i and XE2100

Monocyte count has been measured by XN1000i and XE2100, a machine created by SYSMEX to count for blood cells from blood samples. The machine has been operated and run by Hi Precision Diagnostics.

Procedures

Ethical considerations have been met before the actual data gathering procedures. Ethical review board has been obtained from Armed Forces of the Philippines Medical Center. Approval to conduct the study of the president of the college has been obtained.

Phase 1: Administration of DASS 21 and MLQ to students. Samples who have obtained with a minimum of moderate depression as measured by DASS 21 and low in purpose and search for meaning as measured by MLQ have been considered as for the second phase.

Phase 2: Students who had been considered in phase 1 has been interviewed depending on the day they were available. The objective of the interview is to assess whether they manifest at least 5 symptoms of depression for two weeks.

Phase 3: Samples who has been considered in phase 2 are invited to participate in the study. Informed consent has been solicited from the samples, has been asked to sign the informed consent in the presence of a witness and the researcher.

Phase 4: Samples considered have been asked to complete the PDS, DASS-21, PSS, and EES. Upon accomplishment of the paper and pen materials, they have been invited to Hi-Precision Diagnostics located at Baranggay Del Monte, Quezon City branch for blood extraction.

Phase 5: The samples have been debriefed with the nature and purpose of the study.

Ethical Considerations

The following protocols were executed to ensure ethical considerations in the study: (1) Permission to use the following instruments has been solicited from the authors. An email requesting for official permission has been solicited upon approval of the research. (2) Permits to conduct a study in the schools have been obtained from the school administrations. Schedules of data gathering have been informed to the faculty members that would be affected during research gathering. (3) Informed consents for each sample were solicited from the respondent/s before they engage in the study. (4) The study underwent ethical review board. The study was reviewed by Armed Forces of the Philippines Medical Center.

3. RESULTS

Rumination theory and Beck's cognitive triad are also be found to be supportive to this finding-suggesting that the more a person mentally chews stress, the more that he develops symptoms of depression. In the same way, the more a person entertains negative ideas about the self, environment, and future, the more that he experiences symptoms of depression.

Table 1. Bivariate Correlation of depression, perceived stress, expressivity, and monocyte counts

Variable Pairs	r	p-value
Perceived Stress and Depression	.368*	.038
Perceived Stress and Expressivity	-.091	.621
Perceived Stress and Monocyte Count	.566**	.001
Depression and Monocyte	-.124	.498

**Correlation significant at 0.01 alpha level (2-tailed)
*Correlation significant at 0.05 alpha level (2-tailed)

It is illustrated that perception of stress is positively related to monocyte counts. There is a significant relationship between perceived stress and monocyte counts. It is presented with a positive correlation coefficient of .566 ($p=0.001$). This suggests that perception of stress alone, without the direct measure of physiological stress as manifested by cortisol levels, is associated with increased monocyte counts. . As stress increases, the tendency for monocytes to proliferate is also high. Stressed samples are also found to be immunologically active.

Pagdet and Glaser (2003) indirectly supports this finding by suggesting that corticosteroid hormones proliferates monocytes. It should be noted that corticosteroids or cortisol are released by the adrenal gland upon the activation of the Hypothalamopituitary (HPA) axis. HPA axis is basically triggered by the activation of the amygdala which tells the whole cortex that the stimulus is emotionally toned; in other words, the stimulus is perceived as stressful. The connection of perception of stress and monocyte counts can be explained through the mind body connection among the brain structures and the observed effect of the stress hormone in the body. It is suggested that the human body automatically prepares itself to combat infection even in the perception of stress.

Enduring stress may have a different result to the immune system. Experimental studies suggest weaker immune when reviewing for the medical board exam, which is considered to be a source of chronic stress (Jabaaaj, 1996; and Glaser, 1992). Medical students in the study are found to have weaker response to vaccines indicating a weaker immune system.

It has been suggested that the study failed to reject the null hypothesis suggesting that there is no significant relationship between depression and immune system. A correlation coefficient of -0.124 ($p=0.498$) suggests that it is not proven that there is no association between the monocytes and depression. Dispersion of the samples may have influenced the association of monocyte and depression. It may be pointed out that the levels of depression as well as the length of time patients' have been suffering depression may have influenced their link to monocyte counts. It can be noted that these levels are not observed in the present study.

Discrepancy between Smith(1991)'s theory of depression and the gathered data should be taken into cautious conclusion. The correlational data gives researchers a space to consider uncontrolled variables outside the study that might have influenced the relationship of the two variables. A variable, perhaps, might have affected the relationship of the depression and monocyte counts. Another factor to consider about the discrepancy between the theory and observed data is the number of pro-inflammatory cytokines, which is expected to be high but have not been measured in the study. There might be alterations in the level of cytokines that have not been observed in the study. The level of depression of the patients should also be considered a factor to consider. The mean score depression level of the samples falls under moderate level. The severity of depression might also influence the relationship between depression and immune system.

Failure to reject the correlational null hypothesis is also seen between expressivity and depression. This is contradicted by the study of Kahn and Cantwell (2012), suggesting that there is a significant relationship between depression and emotional expression. The result, however, is supported by a study by Lue, Wu, and Yen (2009). The cultural differences might explain the differences in the results.

It is showed that as opposed to the correlation of depression and monocyte, these two variables are correlated ($r = -0.435$, $p = 0.015$) when stress is held constant. In other words, depression and monocytes may not have a relationship because of the fluctuating effect of stress to monocyte count. This suggests that there may be different levels of perception of stress within the group that make depression and monocyte unrelated based on simple correlation. High level of perception of stress associated with proliferated monocytes is observed with people who are moderately depressed. While it may be noticeable among the samples that severely depressed samples have increased stress but low monocyte counts. It further proves that there is something within the perception of stress that influences that relationship of depression level and monocyte counts.

Table 2. Partial Correlation of depression, monocyte, expressivity, and monocyte counts

Controlling for	Variable Pair	r	p-value
Perceived Stress	Depression and Monocyte	-.435	.015
	Depression and Expressivity	.029	.876
	Monocyte and Expressivity	.018	.922
	Monocyte and Perceived Stress	.664	.000
Depression	Monocyte and Expressivity	-.037	.841
	Perceived Stress and Expressivity	-.095	.611
	Perceived Stress and Depression	.537	.002
Monocyte	Perceived Stress and Expressivity	-.085	.649
	Depression and Expressivity	-.011	.953

Note: Significant results are in boldface; Int=Interpretation; Sig=Significant

The nearest explanation, though it was not observed in the study, is the influence of the cortisol, the major stress hormone, to the relationship of depression and monocyte counts. Cortisol has been found to play a role in the activation of HPA axis. It may activate the immune response of the body, however; as Wiedenmayer and his colleagues (2006) suggests, it may damage brain regions, specifically the hypothalamus, if there is concentration of it in the blood stream.

The previous table adds that monocytes and stress are strongly related even when other variables such as depression ($r = 0.664$, $p = 0.000$) and expressivity ($r = 0.566$, $p = 0.001$) are controlled using partial correlation. This suggests the highly reliable strength of relationship between perception of stress and monocytes.

Depression level and perception of stress are also related to each other even though variables monocyte and expressivity are controlled. This suggests that the relationship of depression and perception of stress is strong enough and not dependent on the influence of other factors.

Expressivity, on the other hand, is consistently found to be unrelated to depression, stress, and monocyte counts, which is supported in researches of Lue, Wu, and Yen(2009) and Kahn and Garriso (2009). The reason why the variable is found to be unrelated is, perhaps, the nature of the construct. Expressivity is a trait while stress and depression are both disturbances. Whether a person is expressive or not, the individual may still suffer depression as well as severe stress.

Table 3. Predictors of Monocyte, Expressivity, and Perceived Stress

Predicted	Predictor	R	R ²	F
Monocyte	Depression	.670	.449	11.820
	Perceived Stress			
Depression	Perceived Stress	.368	.136	4.712

The table above suggests that depression and perceived stress are significant predictors of monocyte ($F=11.820, P=0.000$). It suggests that from the values of depression and perception of stress, the level of monocyte can be determined. It can also be emphasized that correlational computations have already suggested that monocyte is related to perceived stress. It is also cited that depression is related to monocyte count. Nonetheless, the two variables are seen to be a significant predictor of monocyte.

A certain level of perceived stress can be used to predict depression level. It is also consistent that depression and stress are related to each other both in bivariate correlation and partial correlation.

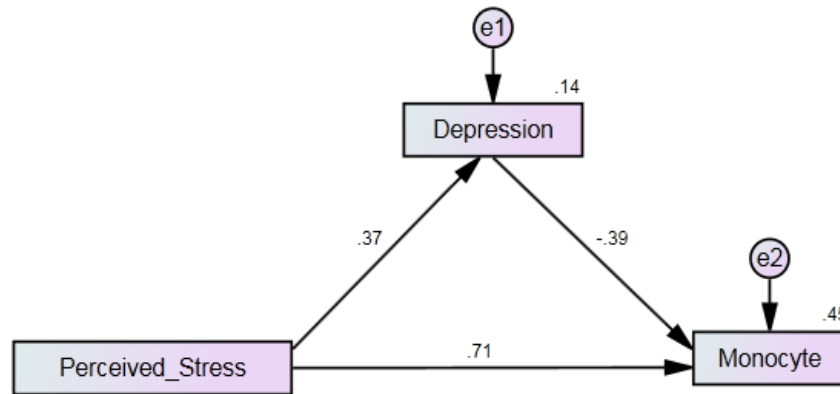


Figure 1. Adjusted Model Perceived Stress, Depression, and Monocyte Counts.

The figure above shows the SPSS AMOS version 21 output. It shows that stress, in the model, is believed to be the main source of depression. Perceived stress has a beta weight of .37 to depression, and .71 to monocyte counts. Depression also has projections to monocyte counts with beta weight of -.39. Variables depression and monocyte counts have ‘e’ variables representing unobserved variables in the study.

Table 4. Beta weights from regression independent variable to dependent variables, p-value, and interpretation

Regression	β weight	p-value
Depression \leftarrow Perceived Stress	.368	.027
Monocyte \leftarrow Perceived Stress	.708	.000
Monocyte \leftarrow Depression	-.385	.007

Note: Significant results are in boldface

4. DISCUSSION

Path from perception of stress to depression

Perception of stress aggravates depression level. As depressed samples perceive stress, the more likely that their depression is aggravated. Multiple number of researches are in agreement with this result (Yang, et al, 2008; Harkness, et al., 2000; de Rooij, et al., Abolghasemi and Varaniyab (2010). Rumination theory and the cognitive triads are both supportive of the results of the study suggesting that depressed patients’ cognition, such as perception of stress can make the individual feel melancholic, less interested to pleasurable activities, fatigued, less concentrated, consume more or consume less, and other symptoms of depression.

Path from perceived stress to monocyte counts

Perception of stress may also indirectly increase the monocyte count. It means that perception of stress makes the immune system active. This is also highly supported by prior researches as indicated in studies conducted by Padgett and Glaser (2003), Jabaaij (1996), Glaser (1992), and Koh and his colleagues (2008). The main mediator of the relationship between stress and the immune system is the cortisol level, which is consistently mentioned among researches.

Path from depression to monocyte counts

There is a significant beta weight of -0.385 ($p=0.007$) from depression to monocyte counts. This exposes the view that increase in depression level might suggest a decrease in the monocyte counts, as manifested by the significant negative

beta. It implies that increased level of depression can cause immunosuppression among samples. This finding indirectly contradicts the macrophage theory of depression by Smith (1991). The theory basically proposed that there is immune activation as manifested by the increased number of pro-inflammatory cytokines and decreased number of anti-inflammatory cytokines released by the macrophages, mature monocytes that are associated with the presence of depressive symptoms. The study, nevertheless, did not observe the number of cytokines that would suggest immune activation. It has only suggested that there is decrease in number of monocytes, the major source of both pro-inflammatory and anti-inflammatory cytokines, among samples with high depression level, aggravated by their perception of stress. However, with reference to the actual data, it is noticeable that samples whose depression level is interpreted as severe have low level of monocyte count.

It may be noticeable that the correlation table exposes a non significant relationship between depression and monocytes ($r=-0.124$, $p=0.489$) while the regression table shows a negative significant predictability from depression to monocyte ($\beta=-0.385$, $p=0.007$). In mere bivariate correlation, without the control of other variables present, depression and monocytes are not found to be related to each other. It should be noted that the path where depression comes from is from perceived stress. The positive beta from perceived stress to depression implies that increased depression and those who have increased depression may lead to having decreased monocyte counts. This pattern can be clearly seen from the individual results of the samples. Severely depressed patients have low level of monocyte counts but have been observed to have increased perceived stress; while those patients who have moderate level of depression have higher levels of monocytes as well as increased perceived stress.

Observation of immunosuppression in depressed samples is not new. It is pointed out by past researches (Blume, Douglas, and Evans, 2011, & Witek-Janusek, Gabram, & Mathews, 2006) that immune suppression has been present among patients of depression. Nevertheless, it should be taken into consideration by researchers to clearly distinguish the effect of depression on the cellular defenses, such as monocytes and the well researched leukocyte, to proteins, such as the pro-inflammatory cytokines, that also play a role in the immune system.

Clearly, not all stressed are severely depressed. Those who are observed to be moderately depressed but highly stressed are seen to have proliferated monocyte counts. Nevertheless, the study has pointed out that those who are highly stressed and severely depressed have decreased monocytes. Depression may not be expressed outward; rather, an inward expression through the monocyte counts.

5. CONCLUSION

The stress level of individuals is different among the year levels. Activities of fourth year college students are more stressful than that of the third year students. As a result, because of the high correlation between stress and monocytes, their monocyte counts are also affected. High stress levels would increase the level of monocyte counts. Depression and stress are two distinct disturbances as expressed by the monocyte counts. Stress proliferates monocytes, while depression suppresses monocytes. The association of depression to monocyte count is not evident because of the stronger association that stress has with the monocyte counts. The severity of depression would have a different effect to the immune system. People with heightened depression will have a lower immune system but those who are moderately depressed will not have an immune defense lower than that of those who are depressed. There is immunosuppression among people with severe depression. The strength of the immune system of an individual may be downgraded because of depression.

6. RECOMMENDATION

In light of the research findings and conclusion, the researcher would like to recommend the following to the readers who find the results of the study useful in their undertaking and to future researchers who wanted to pursue the same research area:

1. Depressed patients should be taken care of not only psychologically but physically as well. The results suggest that depression suppresses immune system; thus, people who are depressed are susceptible to infections and diseases. There are various methods to increase one's immune system. They can be advised of proper diet, exercise, and adequate intake

of vitamins to enhance their immune system. It is also advised that people who suffer from depression should be isolated from people with highly infectious disease.

2. Future researchers should also include and investigate on the pro-inflammatory and anti-inflammatory cytokine levels, which were proposed by the macrophage theory of depression, of the depressed patients in order to have a clearer picture of the immune system of the depressed patients.

3. Future researchers should also have a higher number of samples to avoid the type 1 error. To increase the number of sample, future researchers could incorporate the study in the pre-admission procedures in an institution.

4. Future researchers should also investigate the same constructs among people in the higher age group. This is to confirm whether the same results will be obtained among elders who have the natural decline of immune system.

5. It is also advised to that future researchers apply a cross-lagged panel design in the same number of samples to better interpret the effect of the depression to one's immune system. A year of developing of a depression may have different results to the monocyte counts of an individual.

6. Cortisol levels should also be studied as part of future models. It is advised since cortisol level is found to be related to stress. Thus, inclusion of cortisol level would determine its influence to depression.

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